EFFECTS OF COMBINED McKENZIE TECHNIQUE AND LUMBAR STABILISATION EXERCISE ON SELECTED PSYCHOSOCIAL AND CLINICAL VARIABLES OF INDIVIDUALS WITH CHRONIC MECHANICAL LOW BACK PAIN

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DEDICATION

Unto you the most high God who made this dream and gargantuan pursuit a reality do I dedicate it. Also to my lovely wife, Adejoju Oyinlola Nudamajo, and our wonderful children, Ebunoluwa Sesi and Ibukun Anjolaoluwa, for their immense support, sacrifice, tolerance, prayers, and unflinching support till the completion of this great vision. On a final note, it is dedicated to the overwhelming individuals experiencing the discomfort of excruciating spinal pain.

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ABSTRACT

Chronic Mechanical Low Back Pain (CMLBP) is a major health condition whose management poses a challenge to clinicians. Literature suggests specific therapeutic exercise types to achieve effective management, although the best type of exercise remains controversial. McKenzie Exercise (ME) and Lumbar Stabilisation Exercise (LSE) have been reported to be effective in the management of CMLBP. There is paucity of information on the effectiveness of combined ME and LSE in CMLBP. Given that majority of individuals with CMLBP have recurrent pain resulting in fear-avoidance, investigating the effect of Combined McKenzie and Lumbar Stabilisation Exercises (CMLSE) on fear avoidance beliefs is pivotal. The effects of eight-week CMLSE, ME, and LSE on selected psychosocial and clinical variables of individuals experiencing CMLBP were investigated.

Participants in the single-blind 8-week randomised controlled trial were 142 consecutively sampled individuals with CMLBP recruited from LAUTECH Teaching Hospital Ogbomoso, UniOsun Teaching Hospital, and State Specialist Hospital, Osogbo. Participants were randomly assigned to ME Group (MEG), LSE Group (LSEG), and CMLSE Group (CMLSEG). The MEG (n=47) received ME for posterior derangement, LSEG (n=47) received LSE, while CMLSEG (n=48) received CMLSE. Age was recorded, weight and height were measured using standard procedures, and BMI was calculated. Pain intensity, functional disability, and fear avoidance beliefs to physical activity and work were assessed using the Quadruple Visual Analogue Scale, Oswestry Low Back Pain Disability Questionnaire, and Fear Avoidance Belief Questionnaire, respectively. Participants were treated twice weekly, assessed at baseline, and at end of fourth and eighth weeks of study. Data were summarised with descriptive statistics, and analysed using ANOVA, and repeated measures ANOVA, with Bonferroni post-hoc test at $\alpha = _{0.05}$

Participants' age was 53.00±12.00years. Age, weight, height, and BMI of participant's in the three groups were comparable. At the end of week four, MEG and LSEG compared to CMLSEG had significantly lower pain scores (28.87±13.73, 26.01±14.79, 37.64±14.58), functional disability scores (14.47±10.62, 15.54±12.36, 22.94±11.76), fear avoidance beliefs to physical activity (10.85±2.08, 11.32±3.79, 13.46±3.16), and work scores (8.02±6.03, 8.98±9.13, 15.02±11.08). At the end of eight week eight, MEG had significantly lower functional disability score (3.04±4.07) than LSEG (6.36±8.40) and CMLSEG (7.57±6.74), and fear avoidance beliefs to work score (0.45±1.02) than LSEG (2.80±6.85), and CMLSEG (3.98±4.39), respectively. At the end of week eight, groups were not significantly different in pain scores (8.80±7.11, 14.13±14.68, 13.19±8.58), and fear avoidance beliefs to physical activity scores (6.70±1.77, 8.53±4.23, 8.67±5.74) for MEG, LSEG, and CMLSEG, respectively.

Combined McKenzie and lumbar stabilisation exercises is not effective in producing better treatment outcomes for functional disability and fear avoidance beliefs to work in the management of chronic mechanical low back pain. McKenzie exercise is recommended for effective management of functional disability and fear avoidance beliefs to work in individuals with chronic mechanical low back pain.

Keywords: Functional disability, Pain intensity, Fear avoidance beliefs, Exercise therapy.

Word count: 483

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LIST OF ABBREVIATIONS

AANS- America Association of Neurological Surgeon

ANCOVA- Analysis of Co-variance

ANOVA- Analysis of variance

ANSPM- Altered Nervous System Processing Model

APTA- American Physical Therapy Association

BMI- Body Mass Index

CBT- Cognitive Behavioural Therapy

CPR- Clinical Prediction Rule

CSE- Core Stabilisation Exercise

CMLBP- Chronic Mechanical Low Back Pain

CMLSE- Combined McKenzie and Lumbar Stabilisation Exercises

CMLSEG- Combined McKenzie and Lumbar Stabilisation Exercises Group

EODM- End-Organ Dysfunction Model

FD-Functional Disability

FAB- Fear Avoidance Beliefs

FABQ- Fear Avoidance Beliefs Questionnaire

IVD- Inter-Vertebral Disc

IASP- International Association for the Study of Pain

IHE- Institute of Health Economics

LBP- Low Back Pain

LSEG- Lumbar Stabilisation Exercise Group

LSE- Lumbar Stabilisation Exercise

ME- McKenzie Exercise

MEG- McKenzie Exercise Group

MSIS- Movement System Impaired Syndrome

MCE- Motor Control Exercise

MILSAF- McKenzie Institute Lumbar Spine Assessment Format

MF- Multifidus muscle

NSAID- Non-Steroidal Anti-Inflammatory Drug

OCS- O’Sullivan Classification

ODQ- Oswestry Disability Questionnaire

PI- Pain Intensity

PPC- Pain pattern classification

PSE- Pain Self Efficacy

PSB- Postural Structural Biomechanical model

PAM- Process Approach Model

PBC- Patho-anatomic Based Classification

QTFC- Quebec Task Force Classifcation

QVAS- Quadruple Visual Analogue Scale

QOL- Quality of Life

SE- Self Efficacy

TBC- Treatment Based Classification

TA- Transversus Abdominis muscle

WHO- World Health Organization

Z-Joint- Zygapophyseal Joint

LIST OF FORMULA

CHAPTER ONE

INTRODUCTION

1.1 Background to the study

Low Back Pain (LBP) could be defined as excruciating discomfort commonly situated in the back region spanning the twelfth rib and the lower gluteal fold (Kamper et al., 2015), which can be classified based on duration into acute pain of below six weeks, sub-acute pain of between six to twelve weeks, or chronic pain of more than twelve weeks (Hoy et al., 2014; Hasaneen et al., 2018). It may occasionally radiate to the lower limb(s). Low back pain of varying intensity (increase or reduce) during physical activities, change in postures, or movements is termed mechanical LBP (Kumar, 2011). Chronic Mechanical Low Back Pain (CMLBP) is a globally recognized excruciatingly painful medical condition common to humans (Kamper et al., 2015). It is often dscribed as persistent/intermittent discomfort that has lasted more than three months (hasaneen et al., 2018), a major non-communicable medical problem warranting hospital visits (Hoy et al., 2014), and notably the highest ranking musculoskeletal conditions for physiotherapy referrals (Ayanniyi et al., 2016; Hasaneen et al., 2018). Chronic mechanical low back pain is musculo-skeletal pain in which there is no agreement on the causes. Spinal joints, discs and connective tissues are among structures in the back suspected to contribute to the symptoms of CMLBP (Stankovic et al., 2008). This health menace is highly prevalent and renowned for causing greater disability than any other known health condition in any given population (Balague et al., 2011; Hoy et al., 2014).

The findings from methodical evaluation (Lemeunier et al., 2012) of studies on natural/ inherent history of LBP corroborated earlier reported fluctuating episodes of LBP in which majority of individuals with acute episode experience improvement without been treated, a sizeable portion experience repeated episodes or recurrences following initial recovery, while some live with continuous symptoms for years to come (Dunn and Croft, 2004; Smith et al., 2014). The failure of duration-based symptoms classification to capture emotional and social impacts of CMLBP on affected individuals led to the idea of recognizing CMLBP as a disease condition instead of mere painful symptoms (Ehrlich, 2003). Affected individual's worry about the recurrent painful symptoms despite having recovered from previous episode, making them ask series of question if possibly an undiagnosed systemic disease is the cause of the recurrence, or if it could be sign of terminal illness. The experience of recurrent symptoms in individuals with CMLBP provokes development of fear avoidance beliefs when affected individuals assume that moving around and carrying out activities will worsen their pain, and it leads to developing fear avoidance behaviours with the hope that such activity/ movement restrictions will prevent aggravated symptoms (Burton et al., 1996; Dunn and Croft, 2004). In addition to fear avoidance, other emotional disorders that could follow the episode of recurrent symptoms includes anxiety, depression, withdrawal from social, recreational, and work life in order to prevent aggravated symptoms and impaired function (Kamper et al, 2015).

Chronic mechanical low back pain is a globally recognized disabling condition that require huge finances to manage, aside its associated socio-economic problem (Stankovic et al., 2008), with resultant prolong period of sickness, difficulty/ inability in carrying out activities related to daily means of living (Ladeira, 2011; Hoy et al., 2014; Smith et al., 2014), and eventual increase in risk of developing new/ unwarranted medical conditions (Krismer and van Tulder, 2006; Wang et al., 2012). Different types of intervention available for the management of CMLBP comprise conservative approach, non-conservative approach (surgical), or combination of both approaches (van Middelkoop et al., 2010) depending on symptoms severity, and individual's response to treatment. Conservative (non- invasive) management commonly utilised in practise includes drug therapy, physiotherapy, back school/ patient education, and cognitive-behavioural intervention (Airaksinen et al., 2006; Spoto, 2012). Although physiotherapy modalities are often used in CMLBP management, these modalities are not just expensive, they increase treatment cost substantially, while treatment guidelines reported limited effects of these modalities in

CMLBP (Airaksinen et al., 2006; Chiodo et al., 2010). Methodical evaluation of various physiotherapy approaches in the treatment of CMLBP identified exercise therapy as more beneficial than other forms of intervention, and at lower cost (Searle et al., 2015).

Therapeutic exercise is a widely used non-invasive, conservative modality that could be defined as a set of movements specifically tailored towards promoting the physical health of concerned individual (Abenhaim et al., 2000; van Middelkoop et al., 2010). Exercise therapy prescription ranked top on the list of evidence-based management of CMLBP in recent practise guidelines (Martins et al., 2018; Oliveira et al., 2018), although no specific type of exercise is recommended. Systematic review of clinical trials of different types of exercise identified involvement of heterogeneous samples of individuals with LBP as reason for limited successes (van Middelkoop et al., 2010; Smith et al., 2014), but to improve on clinical decision and achieve better treatment outcome, therapeutic exercise intervention classification based on cluster of signs and symptoms was suggested (Fritz et al., 2007). Classification-based treatment approach is defined as classification of individuals with similar clinical characteristics (such as age, symptoms duration, or pain distribution) into clinically relevant subgroups, and matching them with targeted/ specific exercise therapy (Hicks et al., 2005; Fritz et al., 2007; Hebert et al., 2011).

Systematic review of different classification-based models (Karayannis et al., 2012) reported Mechanical Diagnosis and Treatment (MDT) and Treatment-Based Classification (TBC) approach as two most reliable classification-based models that could promote a more effective treatment outcome. The MDT (otherwise known as McKenzie exercise- ME) is a clinical approach which uses the directional preference (extension and flexion) exercise in the assessment and treatment of LBP by keeping focus on symptoms centralisation (Dunsford et al., 2011; Abdelaziz et al., 2019). Mechanical Diagnosis and Therapy is a valid classification system with reported high inter-rater reliability, and better treatment outlook whose main objective is to abolish painful symptoms through the application of repeated lumbar spine movements in a specific direction (Long et al., 2011; Peterson et al., 2012; Lam et al., 2018), or assumption of proper postures by personalising individual’s exercise strategies for symptoms relief (Machado et al., 2010; Karayannis et al., 2012). The TBC scheme on the other hand has two exercises that centralises symptoms (similar to the ME): Specific Direction Exercise and Lumbar Stabilisation Exercise (LSE). While specific direction exercise is similar to ME that uses direction-specific exercise for treatment, LSE is a therapeutic exercise that improves the co-contraction pattern of deep spinal muscles, as well as the functioning of spinal and trunk stabilising muscles during activities (Fritz et al., 2007a; Moon et al., 2013). Literature evidence revealed that pain related decrease in the bulk of stabilising muscles within twenty-four hours of acute LBP is not automatically reversed after the initial symptoms has subsided, except it is consciously re-activated (Hides et al., 1996; Hodges et al., 2019).

Literature is replete with documented evidence of ME and LSE in minimizing the two prominent symptoms of pain and functional disability in CMLBP. However, most research studies on exercise (ME and LSE inclusive) failed to capture the outcome/ result of exercises on Fear Avoidance Beliefs (FAB), a psychological factor that promotes avoidance of movements that are believed could further aggravate CMLBP symptoms, thus fuelling reduced joint motion, increased disability and pain that promote a continuous cycle of avoidance of movement, joint stiffness, increase functional disability and pain (Verbunt et al., 2003; Menezes-Costa et al., 2011). Although FAB is a psychological/ emotional factor that significantly predisposes to the development and perpetuation of painful and disabling symptoms associated with CMLBP, there is limited reportage on the influence of therapeutic exercise on psychological factors (Grotle et al., 2006; Wertli et al., 2014; Alhakami et al., 2019).

The effects of ME and LSE on FAB in CMLBP is sparsely documented in literature; even though the presence of high FAB, and the adopted avoidance behaviours are predictive of increased Pain Intensity (PI) and pain-related Functional Disability (FD) in CMLBP (Pinto et al., 2022). The identified gap of ME of not strengthening weak back muscles (stabilisers inclusive) while achieving rapid symptoms relief, and the failure of LSE in addressing primary cause of the LBP during reactivation/ strengthening of weak stabilisers could be adduced as reasons for recurrent symptoms of CMLBP (Hosseinifar et al., 2013; Bid et al, 2018). Furthermore, systematic review (Airaksinen et al., 2006) recommended more research efforts on specific exercises commonly used in physiotherapy, as well as their combined use, on fear avoidance beliefs in CMLBP. The dearth of literature on the effects of ME and LSE on FAB, and paucity of researches on their combined use in CMLBP, especially in the African region, necessitated investigating the influence of Combined ME and LSE (CMLSE) on FAB, PI, and FD in CMLBP, and to compare it with effects of ME and LSE on aforementioned selected treatment outcomes in individuals with CMLBP in line with the bio-psychosocial model which accounts for the interactions between clinical and psychosocial factors in CMLBP (WHO-ICF, 2001; Jacobs, 2003).

1.2 Statement of the Problem

Chronic mechanical low back pain is a frequently cited reason for hospital patronage that constitutes a high percentage of physiotherapy referrals and workload (Ayanniyi et al., 2016). Practise guidelines advocated usage of therapeutic exercises in CMLBP, but were not specific on the type of exercise. Evidence from systematic review and meta-analysis showed that exercise therapy is highly influential in the reduction of PI and FD, as well as enhancing/ enabling physical activities and work-related functions in individuals with CMLBP (Hayden et al., 2005; Ferreira et al., 2010; Lizier et al., 2012; Searle et al., 2015). McKenzie exercise and LSE were suggested as the best forms of exercises that could effectively address the challenges of recurrent and other related symptoms peculiar to CMLBP, especially FAB that could provoke increased PI and pain-related FD in CMLBP (Karayannis et al., 2012; Pinto et al., 2022).

Researches on ME and LSE revealed that both are effective in CMLBP management (Vikranth et al, 2015; Bello, 2x016; Ali et al, 2017; Akhtar et al., 2017; Aderibigbe, 2017; Bid et al., 2018; Lam et al., 2018; Abdelaziz et al., 2019). However, there is limited evidence proving that ME addresses the accompanying spinal muscles' inhibition in such individuals (Hosseinifar et al., 2013), or that LSE resolves the disc-related cause of back pain (Russo et al., 2018), both of which could be precursors of recurrent symptoms of CMLBP and the associated avoidance behaviours in affected individuals. While some studies recorded differences in the comparative effectiveness of the two exercises on PI and FD (Hosseinifar et al., 2013; Moon et al., 2013; Mohan et al., 2015), other researchers recorded no differences in effect (Hosseinifar et al., 2009; Smith et al., 2014; Halliday et al., 2016). However, a systematic review on comparative effects of ME and LSE on CMLBP was inconclusive due to paucity of literature (Alkahami et al., 2019). In addition, there is paucity of literature on effects of the two modes of exercise on FAB. In view of the above mentioned identified deficits and attending psychosocial disorders common with CMLBP, the effects of CMLSE in the management of CMLBP needed investigation. These motivated investigating the effects of 8-week CMLSE on FAB, PI, and FD, in comparison with 8-week ME, and LSE on FAB, PI, and FD in individuals with CMLBP. The following inquiries were explored in the study:

1: What would be the effects of 8-week CMLSE on FAB, PI and FD of individuals with CMLBP?
2: What would be the effects of 8-week ME on FAB, PI and FD of individuals with CMLBP?
3: What would be the effects of 8-week LSE on FAB, PI and FD of individuals with CMLBP?
4: Would the treatment outcomes of 8-week CMLSE of individuals with CMLBP be comparable with ME, and LSE in terms of FAB, PI and FD?

1.3 Aims of the Study

The study's main objective was to investigate the effects of 8-week CMLSE on FAB, PI and FD of individuals with CMLBP, and compare them with the effects of 8-week ME and LSE on the selected variables in individuals with CMLBP.

1.4 Hypotheses

1.4.1 Major Hypotheses

1: There would be no significant difference in the effects 8-week CMLSE on FAB, PI and FD of individuals with CMLBP.
2: There would be no significant difference in the effects of 8-week CMLSE, ME, and LSE on FAB, PI and FD of individuals with CMLBP.

1.4.2 Sub-Hypotheses

The underlisted sub-hypotheses were tested:
1: There would be no significant difference in the FAB of individuals with CMLBP in the CMLSE Group (CMLSEG), ME Group (MEG), and LSE Group (LSEG) at baseline, weeks 4 and 8 of the study.
2: There would be no significant difference in the PI of individuals with CMLBP in the CMLSEG, MEG, and LSEG at baseline, weeks 4 and 8 of the study.

3: There would be no significant difference in the FD of individuals with CMLBP in the CMLSEG, MEG and LSEG at baseline, weeks 4 and 8 of the study.

4: There would be no significant difference FAB of individuals with CMLBP in CMLSEG at baseline, weeks 4 and 8 of the study.

5: There would be no significant difference in the PI of individuals with CMLBP in CMLSEG across the three time frames of baseline, weeks 4 and 8 of the study.

6: There would be no significant difference in the FD of participants with CMLBP in CMLSEG across the three time frames of baseline, weeks 4 and 8 of the study.

7: There would be no significant difference in the FAB of individuals with CMLBP in MEG across the three time frames of baseline, weeks 4 and 8 of the study.

8: There would be no significant difference in the PI of individuals with CMLBP in MEG across the three time frames of baseline, weeks 4 and 8 of the study.

9: There would be no significant difference in the FD of individuals with CMLBP in MEG across the three time frames of baseline, weeks 4 and 8 of the study.

10: There would be no significant difference in the FAB of individuals with CMLBP in LSEG across the three time frames of baseline, weeks 4 and 8 of the study.

11: There would be no significant difference in the PI of individuals with CMLBP in LSEG across the three time frames of baseline, weeks 4 and 8 of the study.

12: There would be no significant difference in the FD of individuals with CMLBP in LSEG across the three time frames of baseline, weeks 4 and 8 of the study.

13: There would be no significant difference in the mean changes in FAB of individuals with CMLBP in CMLSEG, MEG, and LSEG at baseline –week 8 of the study.

14: There would be no significant difference in the mean changes in PI of individuals with CMLBP in CMLSEG, MEG, and LSEG at baseline –week 8 of the study.

15: There would be no significant difference in the mean changes in FD of individuals with CMLBP in CMLSEG, MEG, and LSEG at baseline –week 8 of the study.

1.5 Delimitation of the Study

This study was delimited to the following:

1- Participants:

a) Persons referred for physiotherapy with diagnosis of CMLBP.

b) First contact individuals with history of CMLBP.

c) Individuals whose treatment response demonstrates preference for extension exercise according to McKenzie Institute Lumbar Spine Assessment Format (MILSAF).

2- Venue: Out-patient Physiotherapy departments of:

a) LAUTECH Teaching Hospital, Ogbomoso.

b) Uniosun Teaching Hospital (former LAUTECH Teaching Hospital), Osogbo.

c) State Specialist Hospital, Osogbo.

3- Instruments:

a) Quadruple Visual Analogue Scale (QVAS) (Von Korff et al., 1993) for assessment of participants' perceived PI score before and during the study.

b) Oswestry Low Back Pain Disability Questionnaire (Fairbank and Pysent, 2000) was used to assess participants' FD.

c) Fear Avoidance Belief Questionnaire (FABQ) (Waddell et al., 1993) for assessment of pain related fear of activities that prediposes to avoidance of activity and increase disability.

d) McKenzie assessment form for the lumbar spine was used to assess for Derangement category of low back pain (McKenzie Institute, 2005).

e) Weighing scale with combined Height meter (Lemfield Medical, England) was used to assess the weight and height of participants.

f) Digital Stopwatch DM51 (Seiko Instruments Incorporated, China), was used for timing exercise duration in the study.

1.6 Limitation of the study

The underlisted were the observed limitations:

1: adherence to home exercise could not be ascertained/ recorded except by asking, and hence assumed.

2: observance of back care instructions/ education on pamphlets handed out could not be ascertained, but assumed.

3: the two exercises (ME and LSE) were not carried out/ commenced simultaneously in the combined exercise group.

1.7 Significance of the study

The obtained results have:

1. Supported/ contributed to previous evidence that Combined McKenzie exercise and Lumbar stabilisation exercise (CMLSE) is not effective in improving FAB, PI and FD of individuals with CMLBP.

2. Provided evidence for physiotherapists in prescribing ME as a more effective treatment for FD and FABW in individuals with CMLBP.

3. Provided clinical evidence for individuals with CMLBP to benefit from the effectiveness of ME in the management of FABW and FD in CMLBP.

4. Provided clinical evidence for health institutions and the larger society to shorten period of dysfunction associated with CMLBP by improving psychosocial and clinical symptoms, in line with some aspects of the millennium goals.

5. Provided clinical evidence on the effectiveness of each the exercises in improving the psychosocial and clinical symptoms of individuals with CMLBP.

6. Added to the body of knowledge on success of therapeutic exercises in the treatment of individuals with CMLBP.

1.8 Definition of terms

1) **McKenzie exercise** is a systematically designed assessment tool to obtain responses to spinal/ mechanical forces in determining / informing individual's management (Clare et al, 2004a)
2) **Lumbar Stabilisation exercise** is an exercise programme fashioned to maintain muscular control of the lumbo-sacral column in order to prevent abnormal motion in the region (Marshall et al, 1999).
3) **Chronic mechanical low back pain** is persistent spinal pain of at least twelve weeks of varying/ fluctuating severity during activity, postural change and movement (Maughan and Lewis, 2010; Kumar, 2011).
4) **Activity** is what individual do for leisure or habitually (ICF, 2001).
5) **Fear avoidance belief** describes a behavioural pattern where leisure and/ or vocation are avoided consequent of fearing recurrent symptoms or exacerbations of existing symptoms (Rainville, et al., 2011).

CHAPTER TWO

REVIEW OF LITERATURE

2.1 Low Back Pain

2.1.1 Definition

Low back pain (LBP) is painful disturbance spanning the posterior lower border of the ribcage and above the thigh that could also radiate to the lower extremity (Chiodo et al., 2010). It is not a regular diagnostic disease, but an irritatingly painful condition that has endlessly afflicted humans for ages (Erhlich, 2003; Hepple and Robertson, 2006). LBP includes back pain that is not disease or trauma related (e.g., cancer or motor vehicle accident), but regarded as a consequence of structural impairments in the lumbo-sacral region, e.g., inter-vertebral disc displacement/ rupture, injury to the sciatic nerve, muscle tension, or spinal stiffness (Chou, 2011). LBP is a multifaceted disorder incorporating painful, physically exhausting, physiological, emotional, and relational components of life in an affected individual, and is globally reckoned as a major reason for medical consultation due to functional disability (FD) / inability to work, and consequent interference with quality of life in affected individuals (Ehrlich, 2003).

2.1.2 Aetiology

The real cause of LBP is difficult to pin-point in many individuals having the first experience of back pain (Ehrlich, 2003; Stankovic et al., 2008). Manek and MacGregor (2005) submitted that despite tremendous investigative efforts at finding out different causes of back pain, only those presentations directly linked/ connected with neurological origin (e.g., cauda equina lesion, sciatica, or spinal stenosis) have distinct clinical presentations, thus LBP is commonly classified as Specific/ Secondary LBP caused by a known pathology/ disease, and Non-specific/ Mechanical LBP of unknown cause. Mechanical LBP has no serious underlying pathology, while Specific or Secondary LBP which occurs in about 10% of cases is traceable to known/ specific pathologies (Last and Hulbert, 2009) such as organic diseases (e.g. systemic referred pain), psychogenic pain, malignant tumour, vertebral infection, congenital disease, osteoporotic fracture, musculoskeletal conditions (e.g. degenerative discs disease, facet joints arthrosis, prolapsed intervertebral discs, radicular pain, spondylolisthesis, sacroiliac joint dysfunction, spinal stenosis, traumatic fracture from road traffic accidents, fall / landing on the buttocks), and prolonged corticosteroid use in the elderly (Koes et al., 2006; Stankovic et al., 2008). LBP is termed mechanical when activities, change of postures, or movements influence musculoskeletal pain of varying intensity (Vikranth et al., 2015), or as a result of damage or injury to the spinal disc, or zygaphopheseal joints (Z- joint) that significantly distort ligaments/ muscles of the lumbo-sacral region (McKenzie and May, 2003; Stankovic et al., 2008; Savigny et al., 2009; Karayannis et al., 2012).

Low back pain is also classified based on the duration of symptoms into three categories: Acute LBP commonly defined as pain of not more than 6 weeks, Sub-acute LBP of less than 12-week duration, and chronic LBP (CLBP) of not below 12 weeks duration (Chiodo et al., 2010). When the nature/presentation of CLBP is of mechanical origin, it is labelled Chronic Mechanical Low Back Pain (CMLBP). CMLBP is not a diagnosis, but describe the expression of symptom in individuals at different stages of impairment, FD, and persistence (Airaksinen et al, 2006) which could affect more than 50% in a given population (Stankovic et al, 2008; Edomwonyi and Ogbue, 2017). The outcome of studies on natural history of LBP reported fluctuating episodes where majority of people who experienced first episode of pain improved over time, a sizeable proportion experience repeated bouts/ recurrence, and some reported unremitting symptoms for many years (Dunn and Croft, 2004; Lemeunier et al., 2012). CMLBP is a disabling condition due to the physical activitiy limitations on affected individuals, as well as the consequent emotional distress (Ehrlich, 2003) such as reduced quality of life, unstable emotions, low self-confidence, apprehension, psychiatric disorders, and exaggerated symptoms that makes them respond poorly to regular forms of treatments. Though CMLBP management has remained notoriously difficult with no single panacea emerging (Ehrlich, 2003), the proposed incorporation of the bio-psychological model into spinal musculoskeletal pain management yielded early symptoms resolution and minimal analgesic usage (IASP, 2010). This corroborates the reported widespread acceptance of the recommended application of bio-psychosocial model that considers emotional, social, and physical domains in the assessment and treatment of individuals with CMLBP syndromes by the World Health Organization (Werneke et al, 2009).

2.1.3 Epidemiology

It is a well-documented medical challenge of global proportion that predisposes to restrictions in daily vocational acts and reduced/ loss of income with resultant enormous economic burden on affected individuals, relations, society, employer, and overall governments (Hoy et al., 2014). It is a worldwide phenomenon that could predictably affect up to 85% of any given population, mostly prevalent in females and the active/ productive age group (Hoy et al., 2012). It is a global phenomenon with substantial direct financial costs and reduced quality of life, which has disabled/ prevented increasing number of people from working in comparison with other known group of diseases (Katz, 2006; Odole et al., 2011; Vos et al., 2012). Reports on prevalence of LBP in different regions of the world are available, but the systematic review of prevalence studies reported 31% general prevalence, 18% point prevalence, 30% one month prevalence, 38% annual prevalence, and approximately 38% lifetime prevalence (Hoy et al., 2012). The report differs from some studies reports, e.g. one year prevalence of more than 50% reported by Nascimento and Costa, (2015), whereas CMLBP affected between 4-14% of the population studied.

The reported high prevalence of LBP related disability on the African continent (Louw et al., 2007) is corroborated by the submission about alarming increase rate of prevalence on the continent (Vos et al., 2012). The said report observed a lifetime, annual, and point prevalence rates of 28% - 74%, 14% - 72%, and 10% - 59%, respectively. Other reported lifetime prevalence and point prevalence rates of 58% - 59% and 14.7% -17% among African adolescents (Ayanniyi et al., 2011; Adegoke et al., 2015). Some recorded LBP prevalence rates due to occupational stress are as follow: Computer users 74% (Adedoyin et al., 2005), industrial workers 59.7% (Sanya and Ogwumike, 2005), Nurses 44.1% to 78% to (Fabunmi et al., 2008; Sikiru and Shmaila, 2009; Tinubu et al., 2010), Physiotherapists 69.8% (Adegoke et al., 2008), fishermen 68.23% (Dienye et al., 2015), and bankers 63% (de Wet, 2003).

2.1.4 Risk factors

The factors that predisposes to LBP are multidimensional (Rubin, 2007); physique, financial status, medical status, psychosocial and climatic factors. Delitto et al. (2012) categorised the factors into two - individual and activity-related factors. The individual's factors commonly seen as predisposing to LBP include anthropometric, weak trunk muscles, and smoking. Others are sedentary lifestyle, overweight, obesity, prolonged sitting, and genetics (Koes et al., 2006; Dunn and Croft, 2010; Chou, 2011; Eyichukwu and Ogugua, 2012, Edomwonyi and Ogbue, 2017). Nicotine in smoked cigarette alters sensitivity to pain, promotes reduced blood flow to the disc with consequent increase risk of trauma and inflammation that makes the disc susceptible to injury, and the ensuing LBP (Shiri et al., 2010; Green et al., 2016). Work-related risk factors include physically exhaustive work, wrong lifting technique, assumption of postures that are not ergonomically viable, rapid work pace, repetitive motion patterns of bending and lifting, short rest periods, manually lifting heavy objects, forceful manual exertions, operating mechanical pressure concentrators, segmental/ whole body vibration, and low environmental temperature (Punnett et al., 2005; Koes et al., 2006; Hochscholer, 2008; Chou, 2011; Eyichukwu and Ogugua, 2012; Edomwonyi and Ogbue, 2017). Sometimes socio-economic factors like poor educational background, language communication problem/ barrier, low earning power, and an unfavourable family status in the society can engender onset of LBP.

The factors engedering CMLBP are more of psychological and social than physical factors. In addition to physical and vocational factors, psychosocial disorders such as apprehension/ nervousness, fear of pain, depression, negative emotions, negative pain behaviour, stress, and previous episode of LBP also predisposes to recurrent episode and CMLBP (Ehrlich, 2003; Dunn and Croft, 2004; Punnett et al, 2005; Koes et al., 2006; Delitto et al., 2012; Lemeunier et al., 2012).

2.2 Anatomy

The back covers the space from below the cervical region to above the gluteal folds. It is the linkage for the attachment of the upper and lower appendanges. The back is made up of connective tissues, muscles, vertebral column, intervertebral discs, posterior aspect of ribs, spinal cord, meninges, ligaments, spinal nerves, and blood vessels (Moore et al., 2014).

2.2.1 Spinal Column

The Spinal column/ spine is the centre of locomotor apparatus which extends from below the cranium to the tail of the spine, and is central to the trunk posture (Nwuga, 1990). It acts in transmiting weight of the upper trunk, provides stable focal point for attachment of muscles and bones of all limbs, and protective shield for both the spinal cord and emerging nerves. Approximately one quarter of the column in an adult is made up of 72 – 75 cm long Intervertebral discs (IVD) that separates and bind the vertebrae together. The spine is made up of 33 organised vertebrae bones (Figure 2.1) that are labelled according to the five regions of the body where they are found: cervical (7), thoracic (12), lumbar (5), sacral (5), and coccyx (4) (Nwuga 1990; Moore et al., 2014). Spinal cord occupies a foramen (spinal canal) created by the spinal bones/ vertebrae that are large and triangular shaped in both cervical and lumbar regions, but smaller and roundish in the thoracic region. Spinal nerves that convey signals/ messages from and to the spinal cord emerges from the vertebral foramen created between adjacent vertebrae. The cervical and lumbar regions are concave anteriorly when viewed from the side, while thoracic and sacrum regions are convex anteriorly. Greater portion of spinal motion is achieved in the upper 25 vertebrae only, while the 9 inferior vertebral bones lack flexibility. The lumbar curve is more acccentuated in the females, and terminates at at junction of the L5 vertebra and sacrum (lumbosacral angle), followed by the pelvic curve that terminates at the tail end of the coccyx (Nwuga, 1990; Standring, 2008).

A typical vertebra is made up of anteriorly placed body and posterior neural arch which join to make up the walls of the spinal/ vertebral canal (Moore et al., 2014). The arch has two pedicles and two laminae that give rise to seven processes. The two laminae give rise to the projecting spinous process. Vertebrae vary in size and shape depending on the body region and the functions; the lumbar vertebrae that support weight of the trunk are larger than the cervical vertebrae that support the skull. The vertebral column gets bigger towards the sacrum and reduces in size towards the tip of the coccyx in line with its weight bearing fuctions (Nwuga, 1990; Snel, 2006). Starched between the vertebrae is the resilient fibrocarlilaginous pads known as the intervertrbral discs (IVD) that accounts for about a quarter of the length of the spine and permits movement between adjacent vertebrae, while their elastic ability to get

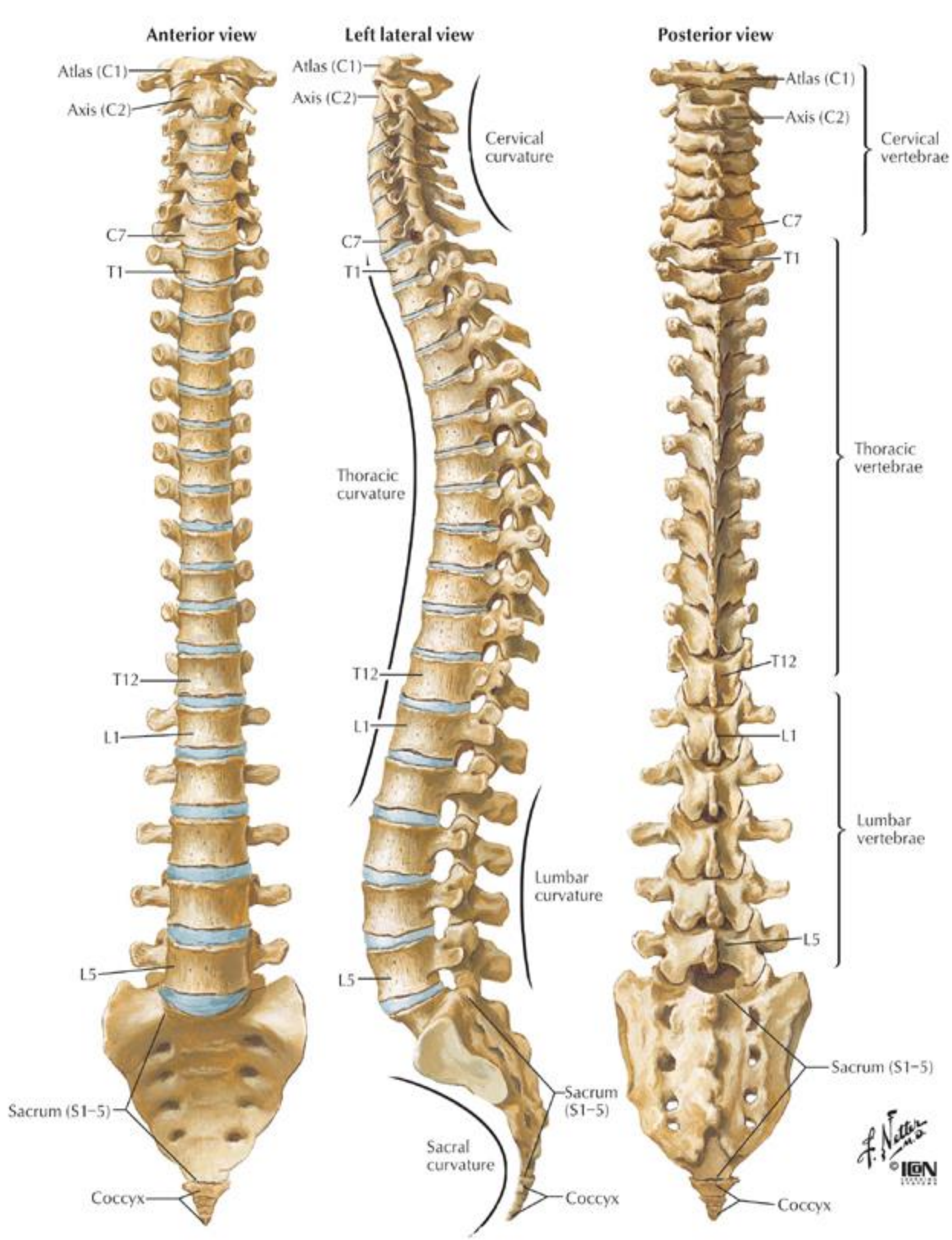


Plate 2.1: The Vertebral Column (Netter, 2014)

recover from distorted/ deformed shape allows them function as shock absorbers. Facet joints (zygapopheseal joints/ Z-joints/ posterior joints/ apophyseal joints) are cartilaginous joints that originate from the neural arches of adjoining vertebrae stabilises the spine by preventing anterior slippage of the vertebrae on each other while permitting gliding movement (Nwuga, 1990; Moore et al., 2014).

2.2.2 Muscles of the Back

There are superficial and intermediate (extrinsic), and deep (intrinsic) muscles; the extrinsic group acts as muscles of the limbs and respiration, while intrinsic group acts on spinal column (Figure 2.2). The intrinsic back muscles cover the pelvis to the base of the skull (Netter, 2014; Moore et al., 2014). The intrinsic back muscles (Figure 2.3) are in three (3) layers- the outermost splenius, the middle erector spinae (illiocostalis, longissimus, and the spinalis) that extends the spine, and the deeper transversospinalis group (semispinalis, multifidus, and rotators) (Netter, 2014; Kenhub, 2020). Anterior and posterior longitudinal ligaments runs the entire length of the spinal column anteriorly and posterirly, respectively. The anterior longitudinal ligament is a wide ligament lining the entire length of the anterolateral sides of the spine that prevents spinal hypenextension, and ensure stability of the Z-jonts. The posterior longitudinal ligament is a narrower, weak ligament covering the posterior side of the spine, it fairly resists hyperflexion of the spine, and IVD rupture. Ligamentous flavum (yellow ligament) that lies between adjacent laminae help return flexed spine into extension due to its elastic nature. The branches of sinu- vertebral nerve and posterior primary ramus that are multisegmental in distribution provide innervations to the spine (Standring, 2008; Moore et al., 2014).

2.3 Low Back Pain Models

Different models have been fashioned out towards understanding LBP and its management. James Cyriax, Mixter and Barr belonged to the school of thought that focussed on the IVD as the major factor in LBP. The concept is premised on disc prolapsed (herniation or protrusion) as being responsible for LBP, and manipulation will reverse the herniation in order to achieve relief. Another school of thought pushed by James Mennell identified the Z- joint, postural strain and capsular adhesion as causatative factors of LBP. This school of thought was further expanded to incorporate loss of joint play motion, joint dysfunction (following trauma or degenerative disc

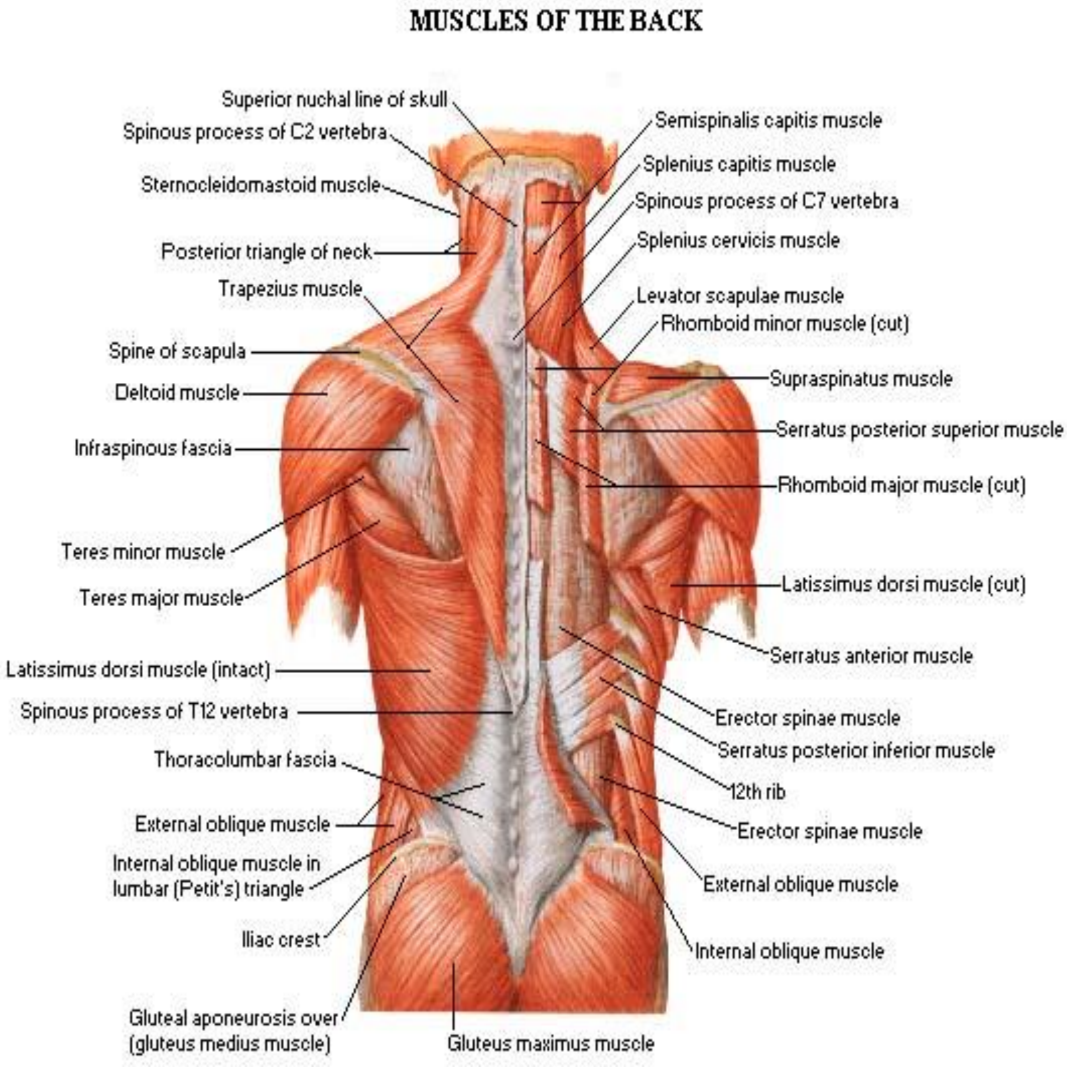


Plate 2.2: The extrinsic muscles of the back (Netter, 2014).

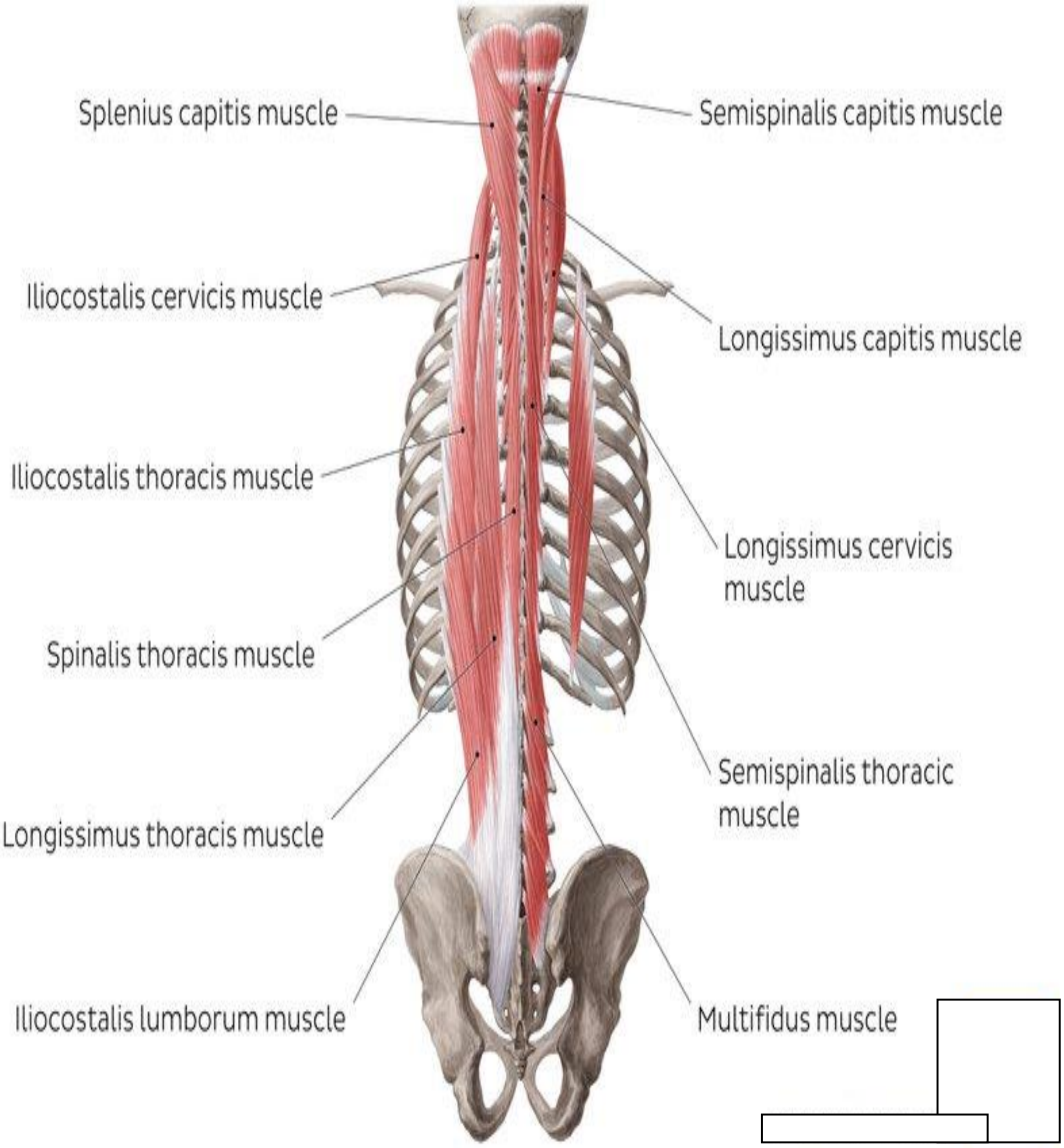


Plate 2.3: The intrinsic muscles of the back (Kenhub, 2020)

disease resulting in reduced discs height and consequent loss of facet joint alignment) as the cause of LBP. Like Cyriax, Mixter and Barr, spine manipulation is employed in treating LBP. The concept of painlessness and opposite motion postulated by Robert Maigne believes in manipulation administered in opposite direction to painful and restrictive movement to achieve pain relief (Nwuga, 1990).

Osteopaths and Chiropractors developed the theory of subluxation interfering with nerve function with resultsant atrophy and malfunction of affected spine as reason for LBP. This school of thought also believe in manipulating the spine to achieve pain relief. Kalternborn is the proponent of the school of thought that combined osteopathic and chiropractic practise with physiotheraphy in managing LBP. This school of thought pointed at joint strain, with the resultant inflammation and oedema that put pressure on spinal nerves, as the cause of pain and spasm which further increase pain by setting up a vicious cycle of pain and spasm. The resultant oedematous thickening precipitate joint restriction and reduced spine mobility that require manipulation to terminate before or after the vicious cycle of pain and altered mobility is established. However, a different school of thought that used mobilisation in pain relief was led by Maitland. He believed mobilisation, rather than manipulation, will achieve better symptom relief by following the concept of painlessness and opposite motion publicised by Maigne. A school of thought developed by Nwuga combined Cyriax, Maitland, Mennell, Maigne and osteopathic theories to his own innovation to develop the Nwugarian technique of managing LBP (Nwuga, 1990).

As knowledge increased, different schools of thought on the likely cause of LBP resulted in formulation of related models. Among these models is the Postural-Structural-Biomechanical (PSB) model which believes that structural imbalance and body asymmetry could result in LBP, recurrent injury and development of CMLBP due to abusive use of the spine (Verbunt et al., 2003; Lederman, 2010). The PSB assessment includes postural examination, spinal observation for deformities/ abnormal curvatures, and limb length discrepancy. However, an internal conflict occurred in the PSB model in that if persistent PSB factors led to injury/ pain, no patient would ever recover from LBP of any duration, and such individuals would deteriorate to the point of disability. Process Approach Model (PAM), an alternative to the PSB model, is aimed at identifying processes underlying individuals back pain as well as provision of needed care that will facilitate recovery (Lederman, 2010).

There is also End-Organ Dysfunction Model (EODM) that is premised on the fact pain experience by an individual is a reflection of spinal abnormalities and combination of assumed spine related injuries and degenerative changes. The model belief pain experience is a reflection of functional nervous system when tissue injury and musculoskeletal dysfunction is put into consideration. Most researches that focus treatment on the IVD, the facet joint or the lumbar spine follow/are tailored after this model. An alternative to EODM is the Altered Nervous System Processing Models (ANSPM) that is premised on the belief that individuals with LBP are suffering from alteration in the analysis of sensory impulses, and not from tissue damage or malfunction in the spine. It could be as a result of abnormal changes in the nervous system (exaggerated noxious stimulus, or heightened susceptibility to pain), and a variety of psychological disorders e.g., depression or anxiety. Researches on central nervous system involvement in LBP supports ANSPM since it belief CMLBP is associated with functional and physiological changes in the system (IASP, 2010).

Notwithstanding the above, in recent times, the three (3) commonly utilised models related to development and sustenance of CMLBP symptoms are:

1: Physical De-conditioning Model which believes that muscle weakness and poor exercise tolerance account for inactivity and consequent FD (Verbunt et al., 2003; Duque et al., 2009). This model is premised on the belief that enhancement of the physical fitness is crucial towards improving functions in individuals with CMLBP. It is assumed that de-conditioning is related to fear avoidance behaviour which precipitates muscle atrophy, reduced strength, and impaired motor function that culminate in functional limitations common with CMLBP.

2: The Cognitive-Behavioural Model is an off-shoot of the Cognitive Behavioural Therapy (CBT) whose focussed approach to the treatment of varying types of emotional, behavioural, and mental health disorders seeks ways to improve individual's state of mind through positively changing the thought pattern and the behaviours negatively feed their thoughts and feelings about their condition, with the ultimate goal of achieving wellness (Blenkiron, 2013; Chen, 2016). Cognitive Behavioural Model postulates that maladaptive beliefs about CMLBP and avoidance behaviours about the condition results in functional limitations associated with CMLBP (Turk and Okifuji, 2002). CBT increase individuals' activity level, modify dysfunctional beliefs by incorporating self-confidence, ergonomic breaks, reversal of disability promoting habits, adoption of behavioural modifications that counters disability, and eventual attainment of therapy goals (Ehrlich, 2003).

3: The Bio-Psychosocial Model is a patient-centred healthcare system that acknowledges that physical, social, psychological, cultural, and environmental factors shape an individual's response to CMLBP (Nielson and Weir, 2001; Sanders et al., 2013). It is the current, acceptable, multidisciplinary rehabilitation programme/ model being propagated by World Health Organization (WHO-ICF, 2001). Although Bio-psychosocial Model addresses both biomechanical and psychosocial aspects of CMLBP, it is opined (Sanders et al., 2013) that this approach is an expensive (cost and resources) and time demanding model to both affected individuals and institutions rendering such a scarce medical servises.

2.4 Chronic Mechanical Low Back Pain and Psychosocial Factors

The bio-psychosocial model in LBP treatment requires the evaluation of biomechanical, psychological, and social variables of individuals with CMLBP. Evidence of psychosocial factors, otherwise known as yellow/ warning flags, are long term risk for pain related disability in CMLBP or indication of poor prognosis for treatment (Last and Hulbert, 2009). Such factors include high fear avoidance, low self-efficacy beliefs, workplace difficulties, and emotional distress that are linked to the onset and persistence of CMLBP (Chou, 2011; Karayannis et al., 2012).

2.4.1 Psychological Distress

Delitto et al. (2012) observed that emotional and social factors are more predisposing to CMLBP than anatomical factors. Numerous medical, physical and surgical therapies can provide temporal relief, but have little overall impact on the recurrence of the symptoms as imaging of the spine often reveals disc and bony abnormalities in adults that are often weakly associated with complaints/ symptoms of CMLBP (Koes et al., 2006; Anderson, 2011). Though most adults will experience disabling LBP once in their life, the specific physical cause cannot be identified in more than 80% of cases (Chou, 2011). The difficulty encountered in pin-pointing the cause or cure of LBP led to identification of a broader model of the problem that incorporates psychological and social influences on pain experiences. The most important psychological disturbances associated with LBP are anxiety, increased bodily awareness/ consciousness, and depressive symptoms clinically known as psychological depression (Dunn and Croft, 2004; Chou, 2011). Psychological distress and anxiety are directly linked/ connected with PI and FD in individuals with CMLBP (Ehrlich, 2003; Dunn and Croft, 2004).

2.4.2 Fear Avoidance Beliefs

Fear-Avoidance Beliefs (FAB) is behavioural pattern of activity avoidance prompted by apprehension on likely recurrent or exacerbated painful symptoms (Rainville et al., 2011). Fear-avoidance behaviour is a well-known component of the bio-psychosocial model of LBP (Parish, 2002) that focuses on individuals' perception of how daily activity and vocation influences symptoms of pain (Chou, 2011). Challenging/ confronting pain and avoiding pain are basically two behavioural responses to pain; avoidance exaggerates pain and promotes disability. Muscle disuse and de-conditioning, FD, and depression are part of the bio-psychosocial challenges associated with FAB in CMLBP (Jacobs, 2003). Some individuals with exacerbated acute LBP progresses to CMLBP because their overly fear of pain kick-start avoidance behaviours premised on the beliefs that avoiding movement and activities that could provoke their painful symptoms will minimize it/ be beneficial, but on the contrary the behaviour further aggravate the symptoms of CMLBP (Lorimer, 2011; Menezes-Costa et al., 2011; Pinto et al., 2022). High FAB is synonymous with increased pain intensity and pain-related disability in CMLBP. The nervousness about pain increase or re-injury often results in ceaseless observance of pain signals with resultant exaggeration of apparently insignificant pain that further stimulate avoidance behaviours of disengagement from meaningful activities, FD, and eventual psychological depression (Lorimer, 2011; Gatchels et al., 2016). Patients' main fears and concerns about LBP are that it may be due to serious disease (pathology) and the likelihood that the pain will persist. Meanwhile confronting pain by remaining active (pain confronters) or avoiding pain by being inactive (pain avoiders) is more of perception/ mindset rather than the degree/ intensity of pain or suspected tissue injury (Jacobs, 2003). Two classes of pain avoidance beliefs that occur in individuals with back pain are FAB to vocation and leisure (Waddel et al., 1993).

2.4.3 Pain Self-efficacy

Self-Efficacy (SE) refers to personal assurance in one's ability to assume the mindset necessary to attain a height and the accomplishement of the set goal (Bandura, 1997). It is an expression of self-trust/ assurance to accomplish a targeted goal, while standing on the principle that a goal is achievable irrespective of presence of pain-related factors once the self-motivation is high, while the reverse is the case when the self-motivation is low (Menezes-Costa et al., 2011). In practice, when self-esteem is boosted, there is more likelihood of reaching a set target irrespective of the initially conceived apprehension on aggravating symptoms of pain (Carey and Forsyth, 2016). This field of health psychology has been applied to various aspects of human behaviours, including pain control.

Pain SE (PSE) refers to self-assurance in the ability to function effectively despite the presence of pain (Nicholas, 2007). High PSE is linked to/with low levels of PI and FD in individuals with CMLBP, while low PSE predisposes to prolonged FD and emotional disorder. This mean high PSE enhances and maintains long-term effect of rehabilitation (Tonkin, 2008; Menezes-Costa et al., 2011). Menezes-Costa et al.'s (2011) study on PSE and FAB to find the connection between PI and FD in CMLBP observed that PSE is superior to FAB. Similarly, Woby et al (2004) study PSE, FAB and PI in individuals with CMLBP and observed that PSE is more influential towards manifesting FD in individuals with CMLBP.

2.5 Treatment of Low Back Pain

Nwuga (1990) opined that LBP is a widespread menace that is defiant of different treatment strategies. The key role of any form of intervention is remission of symptoms and reducing the number of individuals transiting from acute to chronic LBP (Hepple and Robertson, 2006) with its associated disability and job loss, but unfortunately there is limited understanding of the mechanism of LBP, coupled with low evidence of which particular intervention would benefit each concerned individual. PI and FD are the most important/ conspicuous physical symptoms of CMLBP (Koes et al., 2006). Total symptoms relief in CMLBP before returning to full activity may be very difficult to achieve in most cases (Ehrlich, 2003; Last and Hulbert, 2009). Ehrlich (2003) submitted that ability to live/ cope with the painful symptoms or getting on with one's life despite minimal restrictions imposed by the pain is a more realistic goal of treatment. Most individuals with acute LBP require only symptomatic relief of their pain via conservative management coupled with gradual return to normal activities (Bratton, 1999).

Treatment of LBP is broad, but comprises conservative (non-invasive) approach, non-conservative (surgery) approach, or combination of both approaches (van Middelkoop et al., 2010; AANS, 2011). While surgical treatment is primarily focused on specific LBP by altering anatomy of spinal structure(s) perceived to be the source(s) of pain, conservative treatment instead is a non-invasive therapy aimed at improving individuals' ability to function, with or without concurrent improvement in pain, depending on individuals coping ability (Rainville et al., 2009). Current musculoskeletal interventions for low back pain include postural correction, strengthening exercises, stretching exercises, functional training programs, mechanical traction, biofeedback, thermal modalities, muscle stimulation and therapeutic massage (Delitto et al., 2012).

2.5.1 Surgical treatment of Chronic Mechanical Low Back Pain

Surgical treatment often refers to invasive care in CMLBP (Chou, 2011). When CMLBP is unresponsive to conservative management, surgery is usually resorted to as the final option of intervention despite report that most individuals with CMLBP will not benefit from surgery (Last and Hulbert, 2009; AANS, 2011). Surgery is considered in individuals who have experienced significant impairment in carrying out basic daily activities, severe FD and individuals with very severe pain (of over one year) irrespective of non-invasive treatments from different healthcare professionals. Indicators of surgery includes radiating back pain to the lower limb(s) with severe functional impairment, progressive lower limb weakness and/ or numbness, failed response to conservative treatment (Last and Hulbert, 2009; AANS, 2011), presence of red flags such tumor, fracture, and suspected cauda-equina lesions (characterized by saddle anaesthesia, sensori-motor changes in the legs, progressive weakness of the lower limbs, faecal and urinary retention/ loss of normal bowel and bladder functions) noted at the initial evaluation (Patel and Ogle, 2000; AANS, 2011).

Literature evidence support invasive procedures commonly targeted at achieving a firm fusion of two or more adjacent vertebrae in the management of CMLBP - spinal fusion, artificial disc, laminectomy, open- and micro-discetomy (Airaksinen et al., 2006; Koes et al., 2006; Last and Hulbert, 2009; AANS, 2011). Disc arthroplasty/ artificial disc replacement is reported to be effective as lumbar fusion in CMLBP. Despite the intervention, these individuals still require postoperative physiotherapy (Last and Hulbert, 2009; Rainville et al., 2009; AANS, 2011).

2.5.2 Conservative treatment of Chronic Mechanical Low Back Pain

Conservative cares are non-invasive treatment that are given based on clinical evidence and experience of the healthcare practitioner (Spoto, 2012) with the aim of improving on individuals' ability to carry out basic functions with or without simultaneous improvement in pain (Rainville et al., 2009). Physiotherapy is actively involved in the delivery of conservative management of CMLBP in addition to other pharmacological and non-pharmacological treatment like drug therapy, back school, cognitive-behavioural therapy, and patient education (Spoto, 2012). Non-steroidal anti-inflammatory drugs (NSAIDs), pain killers, muscle relaxants, and antidepressants are usually introduced as first line of management, while addictive drugs and other helpful prescriptions that are benefitial to individuals who react to first line prescriptions are introduced for a short period of usage (Last and Hulbert, 2009; Chou, 2011). Topical analgesics can be used alone to treat CMLBP or could be combined with NSAIDs or oral analgesics.

One of the treatment guidelines (Airaksinen et al., 2006) is against the use of all forms of invasive procedures in CMLBP, while a later guideline (Savigny et al., 2009) recommended acupuncture as well as other invasive therapy/ injection of therapeutic substance into the spine as viable treatment for CMLBP. Physiotherapists' use of modalities in the treatment of CMLBP as analgesia, and aiding healing process as response to the presence of re-injury, because most treatment guidelines reported small effect size of individual modalities on CMLBP (Spoto, 2012). Although modalities are used by physiotherapist as adjunct therapy because literature evidence support inclusion of physical agents to active (exercise) therapy approaches as been beneficial at improving treatment outcomes of CMLBP, however, many of these physical modalities (such as ultrasound, diathermy, phonophoresis or iontophoresis, and TENS) do not have long-term effects in CMLBP (Chiodo et al., 2010), while they often cause substantial increase in cost of care (Odole et al., 2011). Bed rest, lumbar corsets, and spinal braces that were routinely prescribed are not necessarily effective in CMLBP; they further weaken back muscles by preventing it from providing the necessary structural support (Koes et al., 2006). Supervised therapeutic exercise, spinal manipulation, cognitive behavioural therapy, back care education, massage, bio-psychosocial treatment are recognized as the mainstay/ basic component of care in CMLBP (Last and Hulbert, 2009; Chou, 2011).

Exercise therapy is the globally recognized and acceptable conservative intervention that promotes significant improvement in PI and FD when compared with other conservative treatments of LBP (Koes et al., 2006; Chou, 2011). Exercise therapy generally improve blood flow to the painful sites and entire body, correct abnormal posture, improve joint motion, minimise pain in the low back as blood wash away nociceptive substances, stabilise hyper-mobile spinal segments, and improve cardio-respiratory fitness of individuals (Hayden et al., 2005). In CMLBP, it helps in eliminating paresis and tightness of spinal muscles, improve execution of functions, reduce PI and FD through confrontation of destructive behavioural actions about recurrent symptoms (Rainville et al., 2004). Meta-regression analysis by Ferreira et al. (2010) concluded that all types of exercise produced significant reductions of PI and FD when compared with minimal or no care at all. However, it remains inconclusive which exercise or protocol of treatment has more beneficial effects (Ranville et al., 2004). Physiotherapists prescribe exercise therapy as a stand-alone modality, combined with other non-invasieve treatment, or as group therapy under the watchful eye of a physiotherapists, conducted with or without use of mechanical devices/ equipment, on land or in water, and usually include home exercise programme (van Middelkoop et al., 2010; Ferreira et al., 2010, Lizier et al, 2012). Exercises prescription follows Frequency, Intensity, Interval, and Type (FIIT) principle for maximum effect (Ferreira et al, 2010; Lizier et al., 2012).

2.5.3 Therapeutic Exercise in Chronic Mechanical Low Back Pain

Therapeutic exercise could be defined as a set of specifically directed movements aimed at building/ strengthening specific muscle and the related joints through adherence to a routine, with the overall goal of enhancing individual’s physical fitness and general health (Abenhaim, 2000). Therapeutic exercises consist of different types of exercises which can be carried out with or without the use of gadgets/machine, as group of patients or as an individual, under the supervision of physiotherapists, or as prescribed home exercise (Lizier, 2012). Research evidence and methodical evaluations on effectiveness of exercise therapy revealed exercise therapy effectively managed CMLBP in term of reduction in PI and FD (May and Donelson, 2008), improvement of long-term functions, improved flexibility and increased muscle strength (Rainville et al., 2004), as well as lessened fearful (fear-avoidance) behaviour, and cognitive - affect aspects common with CMLBP (Rainville et al., 2009; van Middelkoop et al, 2010). Popular types of exercise intervention include fitness and balance training, spinal flexion and extension, pilate/ planking, stretching, stabilisation, balance, weight reduction and strengthening, aimed at pain relief, prevent inactivity related debilitation, improve exercise tolerance, muscle strengthening, increase range of motion, and restoring individuals to highest level of functioning as much as possible (Chou, 2011; Lizier et al., 2012).

Researches on various types of back exercise against placebo treatment (Kankaanpaa et al., 1999; Ferreira et al., 2010; Kumar, 2011; Miyamoto et al., 2013), or other exercise programmes (Critchley et al., 2007; Franca et al., 2010; Hosseinifar et al., 2013; Moon et al., 2013; Abhijit et al, 2015; Ko et al, 2018; Abdelaziz et al., 2019; Suh et al, 2019) produced different results. Notwithstanding, evidence from systematic reviews (van Tulder, 2008; van Middelkoop et al., 2010; Miyamoto et al., 2013: Smith, 2014; Alhakami et al., 2019) revealed this non-invasive procedure effectively reduced PI and FD in CMLBP, although there is dearth of literature evidence that established the superiority of one type of exercise over others. The error in most of the studies was incorporating heterogeneous samples of individuals with LBP as a homogeneous group of condition in line with patho-anatomic approach, whereas the cause of LBP is unknown in more than 80% of the condition (Hebert et al., 2011). The proposed solution was to correlate individuals with similar characteristics and expose them to specific exercise for ease of treatment that would likely promote better treatment outcomes (McKenzie, 1989; Rose, 1989; APTA, 2001), seeing evidence has shown that treatment based on patho-anatomic approach that was the order of the day did not yield desired outcome, but was only applicable to less than 10% of LBP cases.

Several classification models were formulated to categorise individuals with LBP into homogeneous groups that could guide clinical management. Among these are:

a) Quebec Task Force Classification (QTFC) classified individuals with LBP into one of eleven classes according to location of pain, evidence of neurological compromise, findings from imaging examinations, and previous surgery (Spitzer, 1987).
b) Pain Pattern Classification (PPC) system categorises LBP based on reported pain pattern response from repeated movement during initial assessment/ evaluation or after multiple treatment visits (Werneke and Hart, 2003).
c) Treatment-Based Classification (TBC) approach utilise baseline data that predicts improvement when individuals are tretated with mobilisation, LSE, Directional exercise, or Traction (Dellito et al., 1995).
d) Patho-anatomic Based Classification (PBC) connect symptomatic response to provocative tests, assumption of a specific pathology, syndromes defined by symptoms site/ location, as well as result of overloaded spine to direct therapy (Peterson et al., 2003).
e) Mechanical Diagnosis and Treatment (MDT) scheme determines if LBP symptoms can be minimised/ eradicated via any of spinal overloading, movement/ sustained posture that produces centralised symptom (McKenzie, 2009).
f) Movement System Impairment Syndromes (MSIS) main objective is to locate biomechanical dysfunction, abnormal spinal motion or stressor that generate and aggravate LBP symptoms (Sahrmann, 2002).
g) O'Sullivan Classification System (OCS) developed by O'Sullivan (2005) has the objective of identifying spine deformities, and avoidance behaviours provoking LBP that are consequently utilised to direct treatment.

Due to the challenges encountered in CMLBP management, practise guidelines were developed to aid clinical management (Airaksinen et al., 2006; Chou et al., 2007; Krismer and van Tulder, 2007; IHE, 2009; Savigny et al., 2009), but the sparse evidence on effectiveness of the guidelines due to different causes of CMLBP made the implementation looked ineffective as the traditionally based patho-anatomic strategies of sub-grouping LBP failed in establishing relationships between pathology and symptoms, thus resulting in an alternative approach of classification of affected individuals into clinically relevant subgroups for ease of management and better outcome (Hebert et al., 2011; Ladeira, 2011). The recommended minimal level of evidence on effects of classification-based treatment for CMLBP is moderate level

(Maher, 2004; Airaksinen et al., 2006). Systematic review of different models of sub-grouping individuals with LBP identified classification schemes through expert reviews and surveys (such as the PBC, MDT, MSI, TBC, and OCS) before submitting that MDT and TBC classification schemes are the most reliable of the various classification models available considering the fact that both schemes are aimed at eliciting centralisation of symptoms which is a sign of recovery and improvement in LBP (Karayannis et al., 2012). The review also reported moderate evidence of inter-tester reliability of the two exercise protocols. Centralisation occurs when assumption of a specific posture promotes symptoms relocation from the periphery to the spinal column (Aina et al., 2004; Karayannis et al., 2012).

The MDT, otherwise called McKenzie exercise method, is a validated classification scheme with high inter-rater reliability that uses detailed clinical examination of posture, spinal range of motion, and response to vertebral loading to determine appropriate line of LBP management (Machado et al., 2010; Lam et al., 2018). Objectively, MKE determine if the application of spinal movement in a specific direction, repeated lumbar spine movements, or sustained postures can influence/ provoke the abolition, reduction, or centralisation of individual's symptoms. McKenzie scheme classifies LBP into 3 distinct syndromes: the most common Derangement syndrome, the less common Postural syndrome, and Dysfunction syndrome (McKenzie and May, 2003; Ayanniyi et al., 2007). Postural Syndrome is believed to result from prolonged assumption and maintenance of postures (e.g. slouched position) that affect muscles, tendons, or joint surfaces at end range positions; Dysfunction Syndrome implies soft tissue shortening, post-injury scars formation, or adhesion of contractile structures that elicit painful sysmptoms at end-range of movement; Derangement Syndrome is pain of sudden onset during movement which progresses gradually to become disabling (Machado et al., 2010; Karayannis et al., 2012). The symptoms may be felt locally adjacent to the midline of the spinal column, and may also radiate distally in the form of pain, paraesthesia or numbness.

The TBC identifies features that predict responsiveness into four different treatment sub-groups; manipulation, stabilisation, directional exercise and traction subgroups. This approach is a step by step process of clinical decision making where after screening individuals for the evidence/ signs of medical red flags (representing dangerous pathology) and psychosocial yellow flags, the classification system proposed usage of synthesized data from both subjective and objective assessments to allocate each individual to one of the four treatment classification subgroup in TBC in accordance with the Clinical Prediction Rule (CPR) specific to each treatment sub-group (manipulation/ mobilisation, specific directional exercise -flexion, stabilisation, and traction) (Delitto et al., 1995; Fritz et al., 2007b; Hebert et al., 2011). CPR is defined as a critical instrument formulated to help in classifying individuals, and pencilling down better treatment plan through incorporating evidence in the allocation of individuals who will likely benefit from exposure to a specific treatment module. Studies at validating the CPR have been carried out (Flynn et al., 2002; Hicks et al., 2005; Fritz et al., 2007b), and research evidence as well as evidence from clinical practises demonstrated improved effectiveness of care when clinical prediction rules were incorporated into management of LBP (Hebert et al., 2011).

2.5.4 McKenzie exercise in Chronic Mechanical Low Back Pain

The McKenzie exercise (ME) developed by Robin McKenzie is a standardised step by step assessment procedure designed to classify spinal problem for adequate and appropriate intervention (Romano, 2013). The main objective of the ME is determining if spine overloading movement, or static postures can result in abolishment/ reduction of LBP symptoms (McKenzie, and May, 2003; McKenzie, 2009). The assessment is made up of clinical interview, examination of postures, range of movement, and symptomatic response to different loading strategies (specifically directed repeated lumbar spine flexion and extension within available range, and lateral-glide motion) of the spine. Information synthesized from the examination is used to classify LBP into one of three McKenzie diagnostic syndromes (derangement syndrome, dysfunction syndrome, or postural syndrome) for effective management. McKenzie theory is predicated on the belief that the movements will enhance relocation of symptomatic displaced disc related structures, and stretching of adhered or shortened tissues that elicited pain (McKenzie, 2009). Symptoms centralisation and therapeutic directed exercise are sacrosant in the overall assessment and care of individuals with LBP (Lam et al., 2018), because classification results have been used to successfully direct treatment, and the presence of centralising symptoms is a prognostic factor of good, short-term and long-term outcomes (Werneke and Hart, 2004; Aina et al., 2004; Fritz et al., 2007a; Herbert et al., 2011). ME is grounded in finding association/ connection between pain provocation and the assumed postures/ movement that generated pain, and utilising acquired information to design/ develop an individualised exercise protocol aimed at centralising (alleviating) the painful symptoms (Dreisinger, 2007).

Therapeutic exercise (sustained posture or repetitive movements used during examination), back care and postural education are considered very critical for the realisation and sustenance of symptoms relief (McKenzie and May, 2003; Machado et al., 2010; Romano, 2013). Ergonomic instructions (Back care education) comprising instructional and pictorial guide on observance of different postures in daily activities as home exercise for individuals is a form of preventive mechanism – learning to self-treat pain related symptoms, minimise risk of recurrence, and rapidly dealing with recurrence if it occurs (McKenzie, 2009). McKenzie's theory philosophy that reverse force abolishes pain and restore function resulted in the emergence of extension as the prominently prescribed therapeutic exercise, with few individuals carrying out forward bending or side-gliding movement (McKenzie and May, 2003; Clare et al., 2004a; Ayanniyi et al., 2007). The term “discogenic” pain suggests intervertebral disc could be the source of painful symptoms in most individuals with LBP, and direction-specific exercise is presumed to reposition displaced spine structures/ content in derangement or dysfunction syndromes (Herbert et al., 2011; Karayannis et al., 2012). Therefore, centralisation via extension- oriented exercise may be a pointer in identifying individuals experiencing pain of intervertebral disc origin, while preference for flexion-oriented exercise could most likely be painful symptoms originating from spinal stenosis (Herbert et al., 2011; Karayannis et al., 2012).

McKenzie exercise is a popular exercise treatment with high empirical support (validity, reliability and acceptability) often used by physiotherapists because of its clinical features that makes it easy to implement in clinical practice (Razmjou et al., 2000; Clare et al., 2004a). It is a well-researched model whose examination and therapy style demonstrates good inter-rater reliability in LBP classification (Garcia et al., 2018; Lam et al., 2018). Literature evidence abound on utilisation of ME as a stand-alone treatment (Santolin, 2003; Machado et al., 2005, 2010; Ayanniyi et al., 2007; May and Donelson, 2008; Dunsford et al., 2011; Mbada, 2012; Fapojuwo, 2015), in combination with, and comparison with other exercise protocols for improved patients management/ condition (Mbada et al., 2014; Fapojuwo, 2015; Mohan et al., 2015; Bid et al., 2018). Randomised control trials and systematic reviews reported ME is very effective in CMLBP (Aina et al., 2004; Clare et al., 2004b; Machado et al., 2006, 2010; Dunsford et al., 2011; Long et al., 2011; Czajka et al., 2018; Peterson et al., 2012; Lam et al., 2018).

A study by Mbada et al. (2014) reported significant therapeutic effect of ME protocol on selected variables in individuals with CMLBP in comparison with two types of fitness exercise (static and dynamic) in CMLBP. It further recommended the addition of endurance exercises to ME for maximum improvement in general health status of individuals with CMLBP. McKenzie exercise is reported to provide greater reduction in pain intensity and better improvement in pain self-efficacy than the Back-To-Fitness protocol (Fapojuwo, 2015). Back-To-Fitness programme could be incorporated into ME in clinics with large turnout of patients and community-based physiotherapy programme for LBP as the programme can manage more patients at any given time. Although the effectiveness of ME in acute LBP is well documented (Aina et al., 2004; Machado et al., 2006), the influence of ME in CMLBP was debatable (Machado et al., 2006; Machado, 2010; Lam et al., 2018). However, recent studies (Sanadgol et al., 2015; Halliday et al., 2019; Bid et al., 2018; Abdelaziz et al., 2019) reported positive effects of ME in CMLBP.

Systematic literature reviews on ME (Clare et al., 2004b; Lam et al., 2018; Halliday et al., 2019; Kuhnow et al., 2019; Chan et al., 2021) show moderate to high evidence of effectiveness in CMLBP. According to Halliday et al (2019), ME has level "1a" rating of effectiveness in minimising symptoms associated with LBP. Meta-analysis of researches on ME by Lam et al. (2018) reported moderate to high quality evidence of the exercise in reducing PI and FD, though it does not account for widespread psychological factors that abound in individuals with CMLBP. It is generally believed in McKenzie theory that many of the psychological factors associated with CMLBP will resolve after the reversal of dysfunction and related symptoms.

2.5.5 Stabilisation exercise in Chronic Mechanical Low Back Pain

The dilemma and the unsuccessful attempts of clinical researchers at finding most effective/ superior exercise treatment in CMLBP from the available forms of therapies, resulted in the suggestion that sub-grouping individuals with LBP of similar characteristics and/ or symptoms and marching them with specific therapies could produce a better outcome (Hebert et al., 2011). The Treatment- Based Classification (TBC) sub-grouping model is recognized as one of the effective means of treating LBP via identifying baseline features that predict responsiveness to four (4) treatment strategies. Treatment-based clasification approach which classifies individuals with LBP according to clinical presentations follows step- by- step process of clinical decision making at three phases of assessment (Fritz et al., 1997b; Hebert et al., 2011); first phase determines if the individual with LBP is a candidate for physiotherapy management alone, or requires multidisciplinary approach due to the presence of yellow flags identified during the assessment, or need referral to another healthcare practitioner/ expert as a result of/ presence of serious pathology identified during the assessment; the next phase stages the individual according to symptoms duration and severity, and the extent of FD; while the final phase assign affected individuals to one of the strategic subgroups- Mobilisation, Stabilisation exercise, directional exercise, and mechanical traction subgroups . Interpretation of collections of signs, symptoms, and observations during evaluation leads to the decision of assigning patients to one of the four treatment strategies, provided such is a candidate for physiotherapy (Delitto et al., 1995; Hebert et al., 2011; Karayannis et al., 2012). Psychosocial factors are one of the critical/ predictive factors in the development of CMLBP, and Fear avoidance beliefs is a notable key psychosocial factor in CMLBP (Parish, 2002; Karayannis et al, 2012). Among the four subgroups in TBC, two are exercises that can be carried out by the patient (specific/ end-range loading exercise and stabilization exercise), while the remaining two (manipulation and traction subgroups) require external intervention (human and mechanical devises respectively). The specific exercise subgroup has similarity with the Derangement dysfunction classification of the MDT as it shares the similar concept of Centralisation of symptoms, but it does not address the loss of functions of the local stabilizers (Hebert et al., 2011).

Brummitt et al. (2013) defined Stabilisation as the process of eradicating abnormal or reducing excessive symptoms eliciting motions around articulating joint surfaces. One of the consequences of acute LBP is dysfunction in the stabilising muscles of the spine secondary to muscle inhibitory mechanism/ phenomenon. The ability of specific trunk/

paraspinal muscles acting as spine stabilisers (Multifidus [MF] and Transversus Abdominis [TA]) to contract in apparently healthy individuals preparatory to extremity movement (also known as forward-feeding mechanism) is lost in individuals with LBP, with consequent delay in contraction/ activation of spine stabilisers (Hebert et al., 2011). Lumbar segment stabilisation exercise was developed with the aim of correcting delay-contraction, activation, and co-contraction of the TA and MF muscles (Filho et al, 2008). According to Hides et al. (1996), MF muscle recuperation/ comeback post-resolution of painful symptoms is not automatic, and this could be responsible/ account for high recurrence rate of LBP and eventual progression to CMLBP. The reported lumbar MF muscle pain-related atrophy on the affected side that remain atrophied after symptoms resolution is corroborated by recent research evidence (Hodges et al., 2019) submission that changes which occur in deep back muscles persist after resolution of acute LBP, with abounding evidence suggesting structural changes in the MF muscle (fibrosis, fat infiltration, and de-conditioning of muscle fibres) are more extensive in CMLBP; reduced size/ thickness of MF in CMLBP is attributable to muscular de-conditioning from earlier neural irritation and inflammatory changes experienced. According to Russo et al. (2018), individuals with LBP loose voluntary control of the MF muscle due to arthrogenic muscle inhibition that is defined as the mechanism by which musculo-skeletal joint pain minimise neural impulse to the muscles that act upon or stabilises the adjacent joint.

Muscle inhibition is precipitated by abnormality/ blockage in the function of articulating joint receptors as a result of factors like oedema, inflammatory changes, unstable joint, and/ or traumatised joint afferents. In asymptomatic individuals, MF and TA muscles contract in anticipation (feed-forward mechanism) of extremity movements, but this mechanism is compromised in individuals with LBP with resultant delayed functioning of the TA and MF muscles. The failure of MF and TA muscles, otherwise known as lumbar stabilisers, are fingered as likely cause of recurrent LBP and evolving CMLBP (Hides et al., 1996; Hodges and Richardson, 1996, 1999; MacDonald et al., 2009). Muscular dysfunction as a result of inhibition could precipitate Lumbar Spinal Instability (LSI) and eventual CMLBP. Lumbar soine instability is considered to be a pathologic cause in CMLBP (Stankovic et al., 2008) where a normally tolerated applied force/ load results in loss of stiffness between spinal motion segments that exposes neurologic structures to risk of injury with resultant pain and deformity (Hicks et al., 2005). Systematic review (Hebert et al., 2011) recognized Lumbar Stabilisation Exercise (LSE) as the therapeutic exercise suited to address dysfunctional lumbar stabilisers through restoration of the forward-feeding actions of the stabiliser prior the initiation of extremities movement.

The concept of stabilising system of the spine conceived by Panjabi (1992) operates at three subsystems: active, passive, and control (neural) subsystems:

- Passive subsystem represents non-contractile structures (vertebrae, inter-vertebral discs, ligaments, and joint) which do not produce spinal motion, but reactive forces at end of the ranges of motion by sending signals to the neural level about the vertebral position or motion within the neutral zone.
- Active subsystem stands for muscles (the MF, TA, and erector spinae) and tendons supplying stability to the spine, while coordinated interaction between different truncal muscles in the lumbar region prevent vulnerability to injury. Some broad muscles act as initiator of movement by creating mass trunk motions, while some other function to stabilise (fixators)/support spinal structures as well as neutralise and control unwanted movements.
- Neural subsystem activates deep stabilising muscles through synchronizing information received from the passive and active subsystems to achieve lumbar spine stability (Luque-Suarez et al., 2012). Sensory feedbacks from the tramsmitters in the passive subsystem dictate amount of stability required from the active subsystem by guaging the muscle tension generated by transducers located in the tendons.

The three subsystems are inter-related/ interdependent in maintaining spinal stability, while a malfunctioning of one of the subsystem leads to increase demands on the remaining two subsystems (Luque-Suarez et al., 2012); non-contractile tissues/ ligaments supply passive support; contracting muscles provide active support; and neural control centre connects the other subsystems, acquires signals on the location of movement, trend of the harmonious movements, and oversee muscles contraction and sustenance of spinal stability. While global muscles do not play any role in the stability of the spine at segmental level, the deep/ stabilising muscles are actively involved in stability at segmental level that is made possible because of their inter-segmental attachments to adjacent vertebrae. Therefore, any form of dysfunction in the local muscles precipitates deficiency in the stabilising system, the consequent segmental instability, eventual painful discomfort and FD (Javadian et al., 2012). Richardson et al. (1999) introduced the motor control exercises (MCE) as a type of LSE in the activation and strengthening of the lumbar stabilisers in treating LBP. LSE improves nervous control as well as fitness of muscles that are sacrosanct for sustaining spinal stability by creating deep muscle corset through sustained contractions of the constituent stabilising muscles; while the pelvic region is immobilised, the weak stabilisers working across the unstable spinal segment get strengthened (van Tulder et al., 2000). The notion of LSE is premised on stabilising muscle's ability to create and sustain neutral spine position by countering abnormal lumbar spine movement that can result in damages at tissue level over a long period of time (Hagins et al., 1999, Ferreira et al., 2006; Lizier et al., 2012). Neutral position is defined as the posture of the spine requiring minimal efforts of the spinal column and stabilisers to sustain, while the neutral zone is the zone of high physiological flexibility in inter-vertebral motion (Panjabi, 1992). Lumbar stabilisation exercise can be carried out in different positions including standing, sitting, kneeling and lying down prone or supine.

Literature is replete with evidence of LSE's effects in decreased pain, reduced disability, restored/ increased muscular function of the local stabilisers, promoting segmental stability, and reduced risk of subsequent injury or LBP (Brumitt et al., 2013; Hosseinifar et al., 2013; Ali et al., 2017; Hodges et al., 2019; Suh et al., 2019). It can be administered as a stand-alone therapy or in conjunction with other therapeutic modallities (Ferreira et al, 2006; Akodu et al., 2015a; Kaka et al, 2015a; Aderibigbe, 2017; Bello and Adeniyi, 2018; Abdelaziz et al., 2019). Studies abound in literature about positive influence/ benefits of LSE in caring for individuals with LBP (Hides et al., 2001; Filho et al., 2008; Kumar, 2011; Javadian et al., 2012; Brumitt et al., 2013; Shakeri et al., 2013), in comparison with other exercises (Koumantakis et al., 2005; Franca et al., 2010; Moon et al., 2013; Muthukrishnan et al., 2013; Puntumetakul et al., 2013; Hosseinifar et al., 2013; Abhijit et al., 2015), and in combination with other specific exercises or conventional physiotherapy (Koumantakis et al., 2005; Cairns et al., 2006; Kasai, 2006; Stankovic et al., 2008; Ali et al., 2017). Aside LBP, literature evidence supports stabilisation exercise in relieving cervico-genic headache, cervical pain, uterine prolapse, and in militating against recurrenct LBP (Hides et al., 2001; Jull et al., 2002; Ferreira et al., 2006; Duncelli et al., 2009; Kaka et al., 2015a). There are currently two types of LSE, namely the Motor Control Exercise (MCE) and the Core Stability Exercise (CSE) (Brummitt et al., 2013; Vikranth et al., 2015); MCE targets isolated rehabilitation of the lumbar stabilisers, while CSE involve strengthening of the deep spinal muscles as well as superficial trunk/ global muscles, abdominal, diaphragmatic, and pelvic floor muscles. Comparative studies (Franca et al., 2010; Moon et al., 2013; Vikranth et al., 2015) reported MCE as more effective in reducing symptoms of CMLBP.

Series of evaluations of researches on LSE reported significant benefits of LSE in reducing PI and FD in CMLBP (Ferreira et al., 2006; Bystrom et al., 2013; Haladay et al., 2013; Chang et al., 2015; Alzubeidi et al., 2020). A systematic review by Kasai (2006) reported high level evidence of effectiveness of this exercise protocol. The quality appraisal of systematic reviews of LSEs in CMLBP yielded assessment scores of between 13- 26, and mean score of 20.7 point out of 26 maximum score. Percentage agreement and kappa values for individual criteria score ranged from 50-90% and 0.25-0.85 respectively, while level of therapy evidence is level 1a. The CPR advanced by Hicks et al. (2005) that help identify individuals who could benefit from LSE has a positive likelihood ratio (LR) of 6.3 when 3 or more tests are positive. CPR's construct validity was successfully tested by Teyhen et al. (2007) and Hebert et al. (2011), while research towards advancing its validation was carried out by Lariviere et al. (2022), with LR of 17.9 when 2 or more tests are positive.

Each of ME and LSE is reported to be effective in CMLBP, while comparative studies gave rise to conflicting reports (Hosseinifar et al., 2009, 2013; Ali et al., 2013; Hosseinifar et al., 2013; Smith et al., 2014; Abhijit et al., 2015; Searle et al., 2015; Mohan et al., 2015; Lam et al., 2018; Halliday et al., 2019). However, a systematic comparative review of the two exercises in CMLBP was inconclusive due to reported paucity of standard/ quality studies from researchers (Alhakami et al., 2019). In addition, there is dearth of literature on studies of Combined ME and LSE in CMLBP with aim of finding the effects of the combined exercises in addressing the identified shortcomings of each exercise regime. A literature search of studies involving ME and LSE in CMLBP was conducted through search engines such as Google scholar, Pedro, BMC, Pubmed and Hinari. Keywords were Mckenzie exercise, stabilisation, chronic pain, exercise and mechanical pain. The search revealed limited number of studies involving the two modes of exercise. Most of the studies compared LSE with other forms of exercise or conventional physiotherapy; very few studies compared between ME and LSE (Hosseinifar et al., 2013; Moon et al., 2013; Chitra et al, 2014). In the study by Hosseinifair et al. (2013) the effects of the exercises on pain intensity, functional disability, and thickness of the stabilisers in 30 individuals with CMLBP were compared in the 6-week study. The study reported LSE as more effective than ME in reducing pain intensity and functional disability. Similar reports were obtained in two similar studies that compared the effects of the two exercises on pain and disability (Chitra et al., 2014; Abhijit et al., 2015). The only inclusion factor common to the three studies was the presence of chronic mechanical low back pain, while homogeneity of the sample was not reported/ considered. However. a recent study credited ME with improving functional disability over LSE in CMLBP (Abdelaziz et al., 2019). Some of the studies that compared between LSE and other modalities revealed LSE as more effective than other forms of therapy in most studies, though one of the exercises had similar effect with LSE on the selected variables of interest (Suh et al., 2019). Although it can be seen from the studies that both exercises are effective in releving symptoms of CMLBP, there is little to no evidence on the effects of combined McKenzie and Lumbar stabilisation exercises in CMLBP. The summary of studies that involved McKenzie exercise as well as Lumbar stabilisation exercise is presented in Table2.1

Table 2.1: Summary of studies that involved McKenzie and Lumbar stabilisation exercises in chronic mechanical low back pain.

S/ No.	Author and year	Aims/ purpose of the study	Participants	Methods/ intervention	Clinical outcome	Physical/ psychosocial outcome	Conclusion/ findings
1	Hossenfair et al., (2013)	To compare the impacts of LSE and ME on PI, FD, and width of TA and MF muscles in individuals with CMLBP.	30 individuals aged 18 -50 years with CMLBP.	Group l (n = 15) performed Stabilisation exercise. Group ll (n = 15) performed ME. Exercise was thrice weekly x 6 weeks.	VAS, FRI, Sonography.	PI, FD, and muscle width.	LSE is more effective than ME in reducing PI, FD score, and TA muscle width.
2	Moon et al, (2013)	Comparing the effects of LSE and lumbar dynamic strengthening exercises on isometric strength of the trunk extensors, PI, and FD in individuals with CMLBP.	21 patients with NSLBP of > 3 months	Grp A (n) = 11 had LSE, Grp ll (n) = 10 strengthening exercises. Each group had an hour of exercise twice weekly x 8 weeks.	VAS, ODQ, MedX		LSE is an effective strategy for inproving strengthening and functions of individuals with CMLBP.

3	Chitra R, (2014)	Evaluating the effects of LSE and ME in CMLBP.	40 individuals aged 22- 70 years with CLBP.	Group A (n=20) had LSE and interferential therapy (IFT). Group B had LEE and IFT.	NPRS and ODI	Pain and function	LSE showed much improvement in both PI and FD.
4	Ali et al, 2017	Determining the effects of LSE on PI, ROM, and FD in LBP	40 individuals aged 20-60 years with CMLBP >3 months	Group l (n = 20) treated with LSE, TENS, Hot pack, stretching exercises, and spinal mobilisation. Group ll (n = 20) had TENS, Hot pack, stretching exercises, and spinal mobilisation. Treatment 4 times/ week x 2 weeks.	NPRS, Modified ODQ, Goniometer.		Both treatments showed improvement, but LSE more effective in CMLBP than CPT alone.
5	Suh et al, 2019	To compare the effects between individualized graded LSE and walking exercises	48 individuals, >20 years, with CMLBP.	Group l (n = 12) received flexibility exercise, Group ll (n = 12) treated with walking exercise, Group	VAS.	PI, frequency of medication use, endurance of specific posture.	Both LSE and walking exercise relieve LBP and improve muscle endurance.

				lll (n = 12) got LSE, Group lV (n =12) had LSE + walking exercise. Treatment was 5 times / week x 6 weeks.			
6	Costa et al, 2009	Investigating the efficacy of ME for people with CMLBP	154 patients with CMLBP of more than 12 weeks.	Group l (n = 77) received 8 weeks of ME. Group ll (n = 77) treated with detuned US and SWD for 8 weeks.	RMDQ, and PSFS.	Activities, PI, general impression about recovery, and risk of recurrent/ persistent pain.	ME enhanced activity and general impression of recovery at 8 weeks.
7	Akhtar et al, 2017	Comparative effect of LSE with CPT	120 individuals with CMLBP aged 20 -60 yrs.	Group A (n =60) had LSE, while Group B (n= 60) had routine physiotherapy. TENS and ultrasound were added to both groups treatment.	VAS	PI	LSE is more effective in greater PI reduction than routine physiotherapy in CLBP.
8	Vikranth et al, 2015	Comparing the influence of MCE versus CSE in	30 subjects aged 30-45 years with	Group l received MCE, Group ll had CSE.	VAS, ODQ.	PI and FD.	MCE showed significant improvement in

		improving PI and FD in individuals with CMLBP	CMLBP.	Exercise was for 2 weeks.			reducing PI and FD.

Key-

VAS – Visual Analogue Scale; LBP- Low Back Pain; RMDQ – Roland Morris Disability Questionnaire; MF – Multifidus; TA – Transversus Abdominis; ODQ/ODI – Oswestry Disability Questionnaire/ Index; QVAS – Quadruple Visual Analogue Scale; ME – Mckenzie exercise; LSE – Lumbar Stabilisation Exercise; CMLBP – Chronic Mechanical Low Back Pain; PI- Pain intensity; FD – Functional Disability; CLI - Chronic Lumbar instability; IFT – Interferential Therapy; CPT – Conventional Physiotherapy; PSFS – Patient Specific Functional Scale

CHAPTER THREE

MATERIALS AND METHODS

3.0 MATERIALS

3.1.1 Participants

Two hundred individuals (52 males, 148 females) attending the out-patient physiotherapy clinics of Uniosun Teaching Hospital Osogbo (formerly LAUTECH Teaching Hospital Osogbo), Osun state, LAUTECH Teaching Hospital Ogbomoso, Oyo state, and State Specialist Hospital Osogbo, Osun state, were consecutively recruited for the study. However, eleven (11) individuals declined participation, while ten (10) individuals were excluded for failing to meet-up with the inclusion criteria. One hundred and seventy-nine (179) individuals that met inclusion criteria were randomly assigned to McKenzie Exercise Group (MEG), Lumbar Stabilisation Exercise Group (LSEG), and Combined McKenzie and Lumbar Stabilisation Exercise Group (CMLSEG) as follow: MEG (n = 58), LSEG (n = 66), and CMSEG (n =55).

One hundred and forty-two (142) participants comprising 33 males (23.2%) and 109 females (76.8%) completed the 8-week study; forty-eight (48) participants in the CMSEG, and 47 participants in each of MEG and LSEG. A total drop-out rate of 12.85% was recorded. Five (5) participants in MEG dropped-out as they could not be reached by telephone while 6 participants withdrew between 4th and 6th weeks due to improvement in their condition. In the LSEG, 7 of the participants relocated, 1 participant withdrew due to non-improvement/ exacerbated symptoms, 6 participants were not compliant with clinic appointment, while 5 participants withdrew participation due to resolution of symptoms. Also in CMLSEG 4 participants could not be tracked via telephone while 3 participants withdrew due to symptoms resolution between 4th and 6th of intervention. The study flow-chart is presented in Figure 3.1

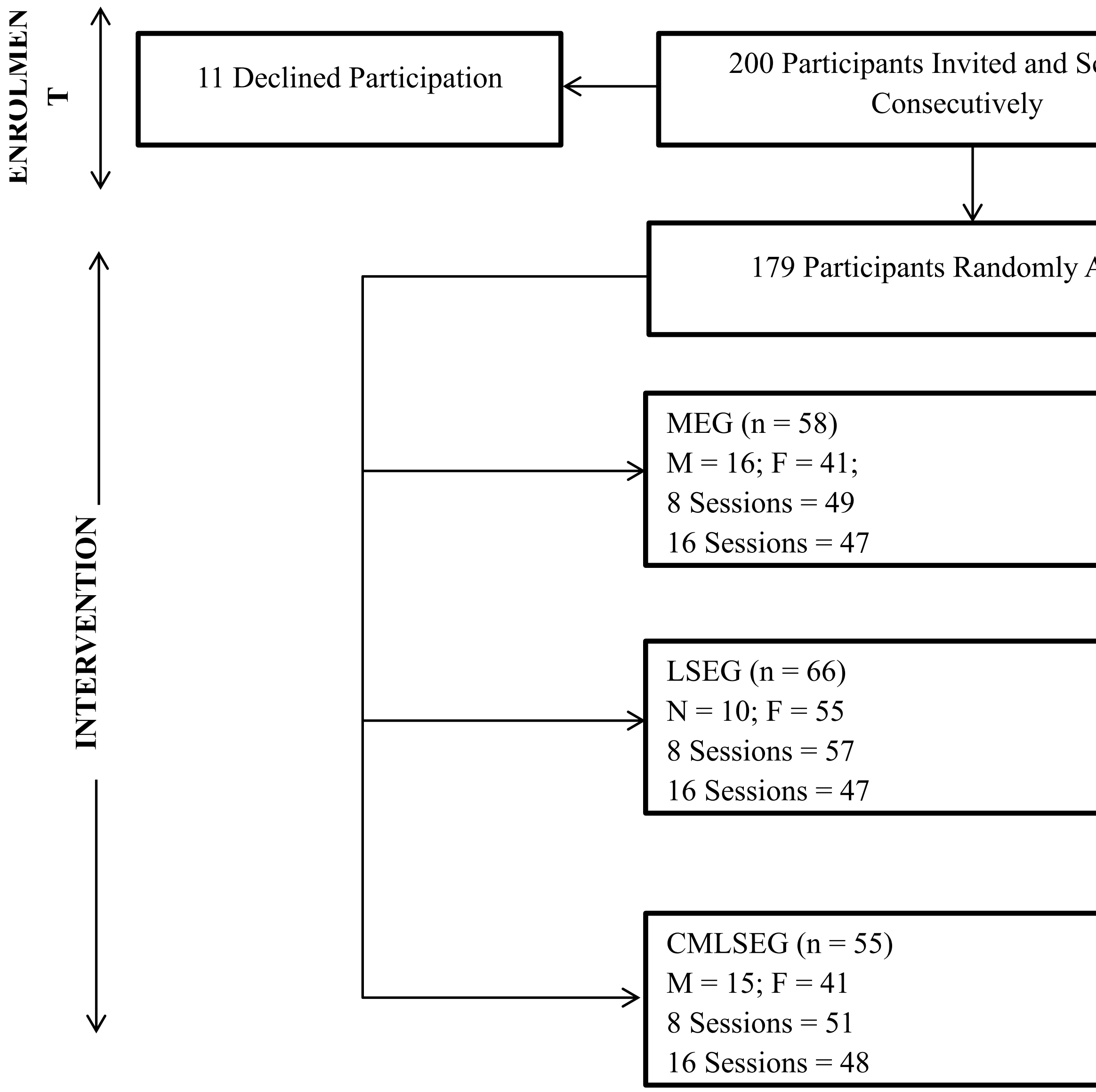


Figure 3.1: Flowchart of participants' recruitment and participation

3.1.2 Inclusion Criteria

The following categories of individuals participated in the study:

1. Candidates referred for physiotherapy with diagnosis of CMLBP.
2. First-contact individuals assessed as having CMLBP by the researcher.
3. Participants with posterior derangement presentation according to McKenzie examination format.

3.1.3 Exclusion Criteria

Exclusion criteria were individuals with:

1. individuals with non-mechanical LBP
2. Serious spinal pathology with neurological compromise exhibiting two or more of these signs and symptoms: loss of skin sensation, motor muscle weakness, reduced lower limb reflexes.
3. Spine deformity, spine surgery, or upper/ lower motor neuron disease.
4. History of cardiac diseases not amenable to exercise or uncontrolled hypertension (B.P. >140/90mmHg). The strain of stabilisation exercise could cause valsalva manoeuvre resulting in further increase in BP.
5. Obvious pregnancy, age, menstrual history, or other pregnancy examination.
6. Directional preference suggesting anterior derangement, lateral derangement, or non-responder (based on McKenzie assessment).

3.2 Instruments

The following instruments were used for the purpose of data collection:

1) Quadruple Visual Analogue Scale (QVAS) developed by Von Korff et al. (1993) was utilises in the assessment of participants perceived pain intensity (PI). QVAS (Appendix A) is a derivative of Visual Analogue Scale (VAS) that evaluates pain in four specific time frames – pain at present, on the average, at worst, and at best. The average score from total of 3-time frames of QVAS (at present, on average, and at worst) is multiplied by 10 to yield a score from zero to hundred. The final score is then categorized as either "low-intensity" pain score of below fifty or "high-intensity" pain score of above fifty (Christensen, 2007). VAS is a validated instrument with established reliability (Boonstra et al., 2008; Alghadir et al., 2018) that has been translated into three major languages in Nigeria, with demonstrated adequate alternate forms reliability

(Odole and Akinpelu, 2009). Translated Yoruba version (Mbada, 2012) was applied to participants not literate in English language (Appendix B).

2) The Oswestry Low-Back Disability Questionnaire (ODQ) developed by Fairbank et al in 1980 (Fairbank and Pynsent, 2000) was used to assess/ obtain information on functional disability. ODQ (Appendix C) contain ten (10) sections/ question designed to evaluate challenges encountered while carriying out activities of daily living. Response to each question is scored on a scale of 0–5, where ‘5’ represent the greatest functional disability (Mehra et al, 2008). The validated and improved version (ODI 2.0) recommended for general use (Rolland and Fairbank, 2000; Ehrlich, 2003) was used in the study. Yoruba version of ODQ (Mbada, 2012) was used to assess functional disability in individuals who did not comprehend English language (Appendix D).

3) Fear Avoidance Beliefs Questionnaire (FABQ) developed by Waddell et al (1993) is premised on how fear about increase pain leads to behaviours/ actions that presumably promote avoiding the pain increase, by specifically focusing on individuals' concept about how leisure activities and vocation influences their pain. FABQ was used to evaluate pain-related fear of activities that predisposed to avoidance of activities with resultant increase in FD. Two factors of avoidance beliefs are identified on the questionnaire. They are fear avoidance beliefs about work (FABW) and fear avoidance beliefs about physical activity (FABPA). The FABPA domain includes five questions based on avoidance behaviour to physical activity while the FABW comprises 11 questions based on avoidance behaviour to daily work. The responses to the questions are given on a numerical 7-point Likert scale. The scale is from zero to six (0-6) based on the level of agreeability to the questions. 0 represents ‘completely agree’ while 6 describe ‘completely disagree’. The responses to 4 questions (2, 3, 4 & 5) are summed up in the FABPA domain, while the responses to 7 questions (6, 7, 9, 10, 11, 12, & 15) are summed up in the FABW domain. The responses to the questions are summed up with each domain reported separately. The FABPA section’s score ranges from zero to twenty-four (0-24), while the FABW domain score ranges from 0- 42. High score in a domain signal high fear avoidance belief for the domain. The FABQ (Appendix E) has acceptable internal consistency, test- retest reliability, and

construct validity (Waddell et al., 1993; Grottle et al., 2006; Lee et al., 2006)). Yoruba version (Appendix F) was used for participant not literate in English language. The internal consistency (Cronbach's α) of the work and physical activity domains were reported as 0.88 and 0.77, respectively (Tan et al., 2014), as well as test-retest reliability coefficient of 0.96 in CMLBP (George et al., 2010).

4) McKenzie Institute's Lumbar Spine Assessment Format (MILSAF) was used to assess for derangement type/ syndrome in LBP (McKenzie, 2005). (Appendix G).

5) A questionnaire designed to collect socio-demographic information (Appendix H)

6) Stopwatch - Digital stopwatch DM51 (Seiko Instruments Incorporated, made in China) was used for timing exercises in the 3 groups.

7) Weighing Scale with Height meter (Lemfield Medical, England) for measuring participants' weight and height.

8) Stabilisation pressure biofeedback unit (Chattanooga group, Australia) was applied to activate and train the stabilising muscles of the spine (Plate 3.1).

3.2.1. Research venues

The study was carried out at the Outpatient clinics of the Department of Physiotherapy of the following healthcare centres:

1). LAUTECH Teaching Hospital, Ogbomoso.

2). Uniosun Teaching Hospital, (former LAUTECH Teaching Hospital), Osogbo,

3). State Specialist Hospital, Osogbo.

3.3 Methods

3.3.1 Sample size determination:

The sample size calculation for the 3 research groups was determined from sample size formula by Kirkwood and Sterne (2003).

$$n = \frac{(Z_\alpha + Z_\beta)^2 \sigma^2}{(\mu_1 - \mu_2)^2} \qquad \textbf{(Formula 3.1)}$$

Plate 3.1: Stabiliser Pressure Bio-feedback

n = required sample size

Z_α = standard normal value corresponding to 95% Confidence level set at 1.96

Z_β = standard normal value corresponding to a power of 80% set at 0.84

σ = desired standard deviation (0.75)

$\mu_1 - \mu_2$ = design effect (0.25)

$$n = \frac{(1.96 + 0.84)^2 (0.75)^2}{(0.25)^2}$$

n = 141.

10% attrition (14 participants) was added to make room for dropouts.

Total number of participants (N) needed = 155.

3.3.2 Research design

This study design was a pre-test/ post-test randomised control trial that required a minimum of 47 participants in each study group.

3.3.3 Sampling technique and assignment into treatment groups

Consenting participants who met the inclusion criteria were consecutively recruited for the 8-week study. Randomisation into the three (3) study groups through the Fish-bowl technique was done by three research assistants that were blinded to the study protocols. The research assistants picked from 3 cards indicating the names of the exercise group (CMLSEG, MEG, and LSEG). The first recruited participant was assigned to the 1st card picked, and same procedure repeated for the second and third participants that were recruited. Subsequently recruited participants were consecutively allocated to each of the exercise groups following the laid down pattern of assignment.

3.3.4 Procedure for data collection

Ethics: Ethical approvals were obtained from the joint UI/UCH Ethical Review Committee (Ref No UI/EC/17/0076) (Appendix I), Ethical Committee of LAUTECH Teaching Hospital Ogbomoso (Ref No LTH/OGB/EC/2016/135) (Appendix J), and Research Ethics Committee of Uniosun (former LAUTECH) Teaching Hospital Osogbo (LTH/EC/2017/07/328) (Appendix K). The Researcher also obtained the consent of the Headship of State Specialist Hospital, Osogbo to carry out the study with assurance of benevolence to participants. Approval was sought for and obtained from the headship of selected Physiotherapy departments of the three research venues to treat the individuals with CMLBP referred to the physiotherapy outpatient clinics ahead of commencement of study.

Pre-intervention Assessment: Participants were availed the intention and procedure for the study, their informed consents obtained using English language version (Appendix L) and Yoruba language version (Appendix M) of the informed consent form, and participants assured of the confidentiality of the data/ information collected, as well as guaranteed safety during the period of study, and freedom to opt out when they feel so. Eleven Physiotherapists (5 males, 6 females) recruited as research assistants were trained by the researcher (a Certified Spine Physiotherapist) on the procedure for assessment of eligibility for the study, data collection, and procedures of treatment peculiar to each exercise group. Participants were consecutively recruited in each study centre, while the research assistants that assigned participants to treatment groups kept records of participants invited to participate in the study, those who declined participation, those who consented but were disqualified, and the reason(s) for the disqualification/ ineligibility were slated. Participants received eight weeks of treatment. Enoka (1997) reported that the effects of exercises become apparent from 8 – 12 weeks of intensive training/ exercises, and is corroborated by Daneels et al. (2001).

Consenting participants were screened for eligibility by applying McKenzie Iinstitute Lumbar Spine Assessment Format (Appendix G). It is a well-structured examination/ assessment scheme that ensures unadulterated classification of spinal disorders. This is premised on a persistent action and reaction network between pain behaviour and individual’s response to repetitive spinal loading in the course of assessment. Assessment of participants directional preference comprised 10 repetitions of movement in standing, sitting, lying, forward bending and beackward bending while the participants’ symptomatic and movement responses were observed. After completion of the overloading movements, participants assumed standing position and asked whether painful symptoms centralized, peripheralized or remained constant in the course of carrying out the spine overloading movements in line with standardized instructions in the MILSAF (McKenzie, 2009).

3.3.5 Pre-treatment and Post-intervention Assessment

Participants' symptomatic and mechanical responses to repeated movements (centralization plus increase in range of motion) were used to establish their directional preference. Pain during movement is synonymous with Derangement syndrome, pain at end range of movement indicated Dysfunction syndrome, while pain on static assumption of a posture signal Postural syndrome. The movement that reduced, abolished, or centralised participant's painful symptoms is regarded as the directional preference of symptoms relief for the participant. Participants with anterior derangement, lateral derangement, or unresponsive to overloading movements were excluded. Only extension responders (posterior derangement) that met other criteria were eligible. Derangement syndrome is reported to be the most common/ predominant of the three LBP syndromes of McKenzie classification (Ayanniyi et al., 2008; May et al., 2008; Machado et al., 2010; Romano, 2013). Demographic information like age, gender, and other social information- educational level, job classification, marital status, episode(s) of back pain, recurrent history, onset of present complaint, and history of intervention- were recorded for the participants. Participants were evaluated at baseline with appropriate instruments/outcome measures designed for each of the selected psychosocial and clinical variables (FABQ for FABs, QVAS for PI, and ODQ for FD). The instruments were mostly physiotherapist administered.The outcome measures were administered prior to first intervention / baseline, and subsequently at the end of fourth and eight weeks of intervention, respectively.

3.3.6 Intervention

The therapeutic exercise included low intensity warm-up exercises, the main treatment exercise thereafter, and post-treatment massage of the low back. Common components for the 3 study groups were 10 minutes warm-up exercises involved unloaded bicycle ergometry for 5 minutes (biking offers low spinal pressure and loading), walking at self-determined pace within the study centre for three (3) minutes, repeated shoulder abduction- adduction, and flexion-extension exercises for 2 minutes, and post-treatment massage. Participants were treated twice a week for the eight weeks study duration.

3.3.7 McKenzie Exercise Group

Participants in the MEG received ME for posterior derangement which involved repeated extension movements that led to decrease in intensity of symptoms of pain and discomfort. This repeated extension movement was carried out in prone and standing positions (prone position, prone lying in extension, sustained extension on pillow, extension in prone position, and spine extension in standing position), and progressed through the five stages as participants' painful symptoms subsided.

1. Prone position- participants assumed prone position on an exercise mat/ treatment couch for 10 minutes, with hands on either side of the head turned to one side. If the position was uncomfortable, a small pillow was placed beneath the abdomen to lessen the stress on the lower back. As the discomfort resolved after a while, the pillow was removed so that a prone position was gradually achieved. The position was maintained for 10 minutes, and to be repeated as many as 10 times daily (Plate 3.2).

2. Prone lying-in extension- this stage is a progression to the first stage where participants maintained prone lying, elbows are placed under the shoulders with the palms on the treatment surface so that he/she leaned on the forearms and the head slightly lifted; participants maintained the position for two (2) minutes before repeatimng it ten (10) times (Plate 3.3).

3. Sustained extension on pillow - On successful completion of the prone lying exercise, a pillow was placed beneath the participants' chest for maintaining an extended position. 5 minutes after 1st pillow application, another (2nd) pillow was added to further increase spinal extension. A final (3rd) pillow was added when/ if participant is comfortable with the position. This extended position was maintained for 30 minutes (Plate 3.4).

4. **Extension in prone position-** participant's assumed prone lying position by having both palms placed beneath the shoulders as if carrying out press–up, participants straightened the elbows to lift up the upper trunk within pain tolerance, while keeping the pelvis down. The posture was sustained for 2 seconds, and repeated fifteen (15) times. After performing the exercise successfully, participants added over-pressure by locking the elbow in full extension, maintained the position for 2 seconds, and then repeated the exercise ten (10) times (Plate 3.5).

5. Spine extension in standing position- participants assumed upright position while the feet are shoulder width distance apart with both hands resting in the lower portion of the back and the fingers directed downwards. Participants thereafter leaned back as convinient while maintaining straight knees, and then repeated ten times (Plate 3.6).

McKenzie exercise protocol included back care educational programme (Appendix M) that is made up of 9-item instructional and pictorial guide on assumption of proper postures to observe while executing daily routine/ activities, and as home exercise given to each participants (Ayanniyi, 2015). The specific exercise carried out during each treatment visit was given as home exercise programme to be carried out 10 times daily.

3.3.8 Lumbar Stabilisation Exercise Group (LSEG)

Participants in LSEG were treated with LSE using abdominal draw-in protocol (Richardson et al., 1999; Koumantakis et al., 2005). Procedure to follow was explained to participants prior to commencement of the treatment, and as it progressed. For all exercises, the targeted static position was 10 seconds of sustained abdominal draw-in exercise that is repeated 10 times and further progressed based on participant's tolerance. Participants were allowed to observe rest in-between repetitions when needed to avoid fatigue and to ensure optimal performance, while the intensity (contraction time and repetitions) was gradually progressed according to the endurance/ ability of the participant. The specific LSE carried out at each treatment session was prescribed as participants home exercise programme. Participants were to perform given home exercises 10 times daily based on their ability and the stage of treatment. In addition, they were given items 1-7 of the back care education pamphlet for keep as instructional material (Appendix M).

Lumbar stabilisation exercise was carried out in 3 stages.

i; **Local segmental control**: involved activation of the local stabilisers- Multifidus (MF) and Transversus abdominis (TA) muscles- in prone, supine, sitting, and standing positions. TA muscle was activated in crook lying (putting lumbar spine in neutral position), sitting and standing positions (with observance of neutral spine position). Participants were instructed to first breathe in and out for relaxation, and then draw in the umbilicus/ belly button/ lower abdomen (abdominal draw-in) without moving the spine, upper abdominal, or pelvis. Different forms of facilitation techniques (verbal instructions, manual contact/ pressure on the stabilising muscles area, to enhance the

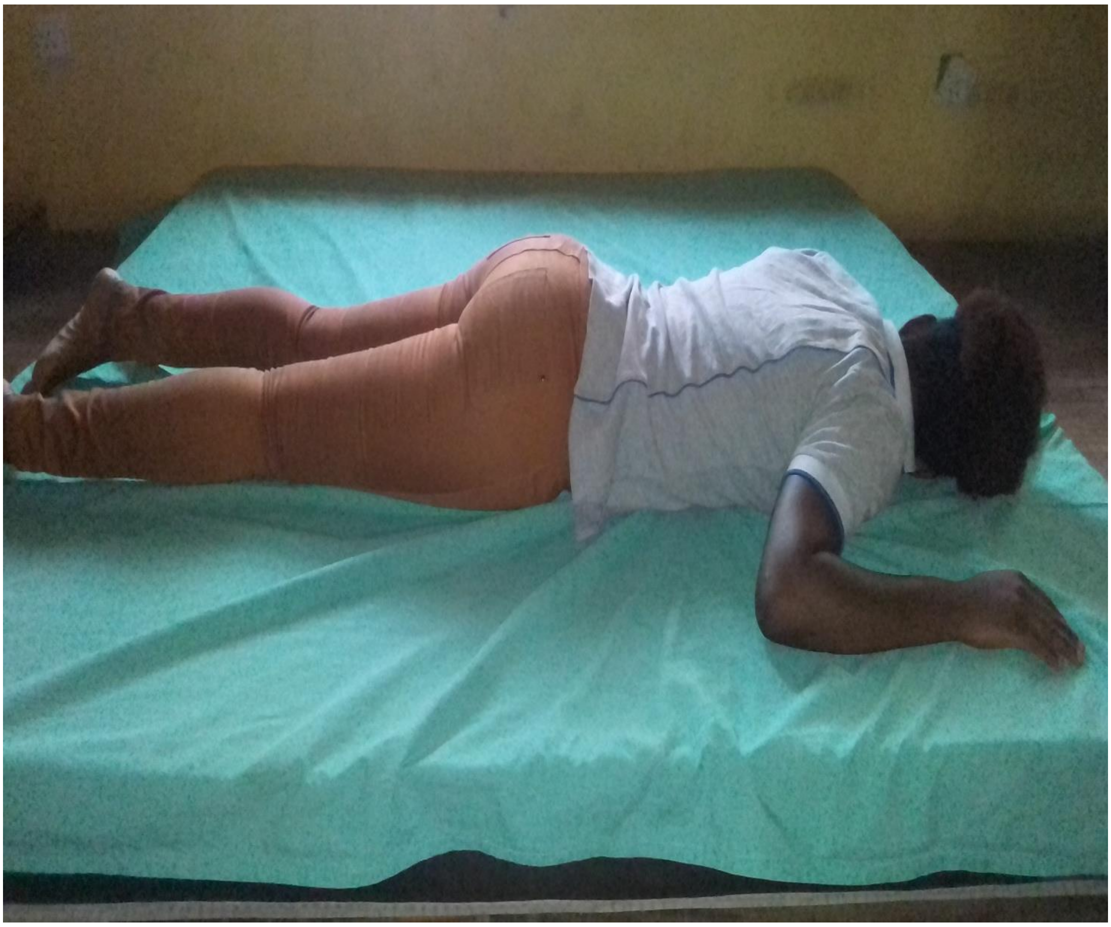


Plate 3.2: McKenzie exercise in prone position.

Plate 3.3: Prone lying in extension

Plate 3.4: Sustained extension position over pillow

Plate 3.5: Sustained extension position over two (2) pillows

Plate 3.6: Sustained extension position over three (3) pillows

Plate 3.7: Extension in prone position.

Plate 3.8: Full-extension in prone position.

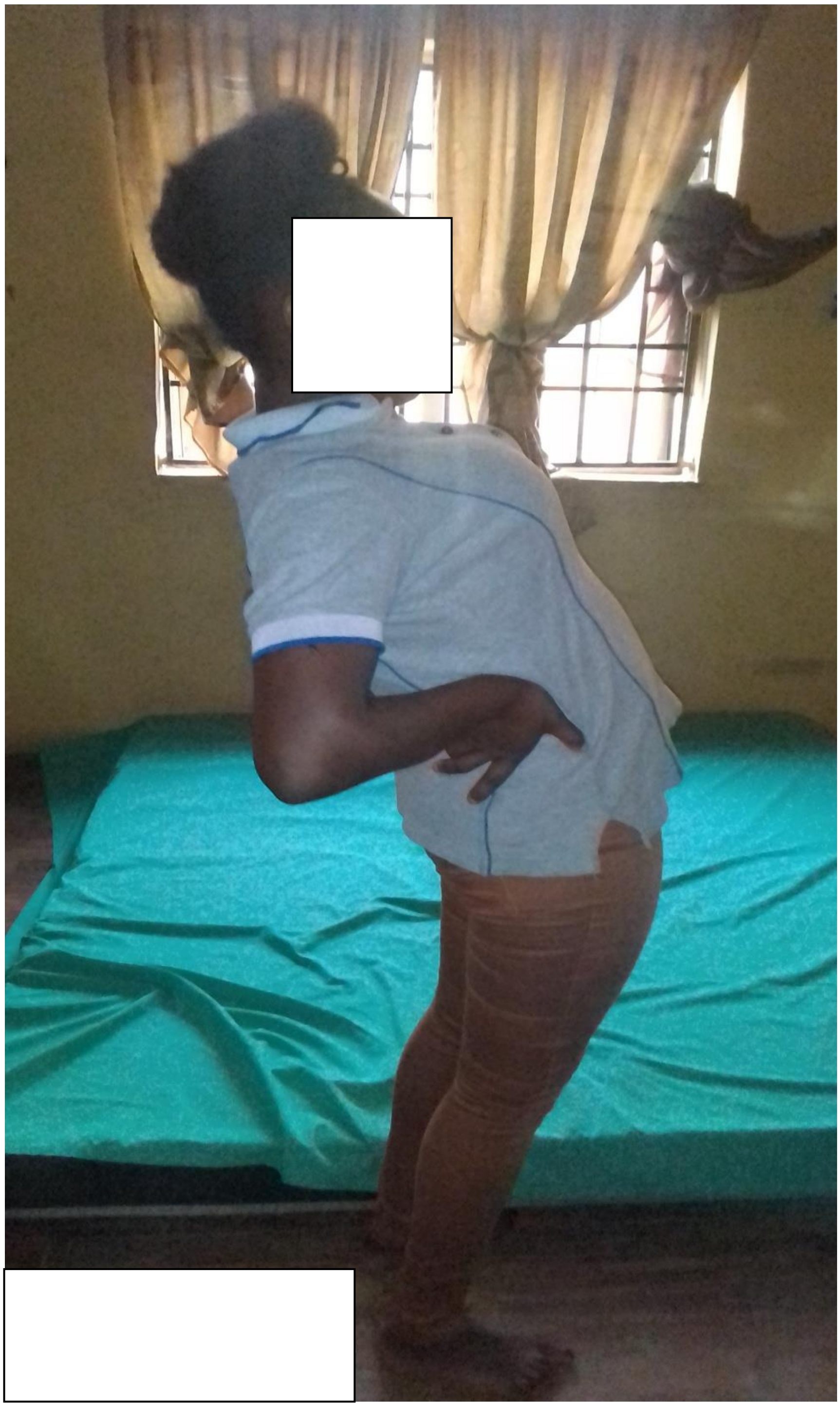


Plate 3.9: Spine extension in standing position

contractions, and pelvic-floor muscles exercise) were used to direct participants' attention to the desired pattern of muscle contractions without cessation of breathing. They were also educated on avoidance of substituting global muscle contraction for the stabilisers. MF muscle activation was carried out in prone and standing position with the same instruction as obtained in TA muscle activation.

Stabilisation Pressure Biofeedback unit was used in the reactivation of TA and MF muscles as the two inter-twine muscles acts like a corset round the low back and abdomen, thus co-contracts when one of it is contracted. A pressure decrease of 6mmHg to maximum 10mmHg recorded on the Stabilisation Pressure Biofeedback is confirmation of the TA contraction in the holding position (Richardson and Jull, 1995; Standaert et al., 2008; Aderibigbe, 2017). LSE (activation phase) was progressed weekly by increasing the number of contractions from 10 contractions to 20 contractions of 10-second duration each based on participants ability and performance. The muscle activation stage lasted 2 weeks (week 0-2) (Hicks et al, 2005). The treatment exercise carried out during each visit was prescribed as home exercise programme (Plates 3.10- 3.14).

ii; **Closed chain segmental control**: This stage involved isometric contraction of the local stabiliser muscles through progressive strenghtening of different postures in anti-gravity weight-bearing positions of side-lying, quadruped, and standing positions by first carrying out and maintaining abdominal draw-in and ensuring neutral spine were maintained while carrying out the exercise. In side-lying position, participants were instructed to lift up the flexed lower leg away (up) from the bed surface after abdominal draw-in procedure is carried out (Plate 3.15). In quadruped position, participants were asked/taught to assume neutral spine postion and carry out the abdominal draw-in procedure for 10 seconds, repeated 10 times (Plate 3.16). In standing position, participants repeatedly assumed semi-squat position and return to erect posture with the upper limbs stretched forward and slightly elevated (Plate 3.17). As a progression, therapy ball was held between the hands while assuming the semi-squat position from starting position of standing (plate 3.18). Each of the exercise at this stage was carried out for 10 seconds, and repeated 10 times following sustained contraction of the TA and MF muscles. This set of exercise was carried out for 1 week (week 3 of the study). Progression was by increasing number of contractions from

Plate 3.10: Transversus Abdominis muscle activation in crook lying position.

Plate 3.11: Transversus abdominis muscle contraction/ training post-activation.

Plate 3.12: Lumbar stabilisation exercise in prone position

Plate 3.13: Lumbar stabilisation exercise in high sitting position.

Plate 3.14: Lumbar stabilisation exercise in standing position.

Plate 3.15: Elevation/ adduction of lower leg in side-lying position.

Plate 3.16; Closed chain stabiliser muscles strenghtening in quadruped position.

Plate 3.17: Stand- squat position with elevated upper limbs.

Plate 3.18: Stand-squat position with elevated therapy ball.

iii; **Open chain segmental control**: in this final stage of LSE, arm lifts , leg lifts and alternate arms and/ or opposite legs lifts were carried out in supine, crook lying, , high sitting, prone and quadruped positions. In supine position, after isolated contraction of the stabilisers by abdominal draw-in, an upper limb (shoulder) was flexed above the head and held for 10 seconds (Plate 3.19); this was repeated 10 times for each upper limb. In crook lying, the knees were adducted after the abdominal draw-in, thereafter one of the legs was straightened for 10 seconds without separating the adducted knees (Plate 3.20); this was repeated 10 times for each leg. As a progression, opposite upper limb (shoulder) was flexed along with the extended knee joint of the contralateral side after the tummy tuck-in (Plate 3.21); this was repeated for the second contralateral upper and lower limbs. This same pattern of arm lifts, leg lifts, alternate arm and leg lifts are carried out in prone and quadruped positions (Plates 3.22- 3.26). In prone lying, after isolated contraction of the stabilisers by abdominal draw-in, an upper limb (shoulder) was lifted up and held for 10 seconds; this was repeated 10 times for each upper limb. While still in same position, one of the lower limbs was lifted up, straighetend, and held for 10 seconds after the abdominal draw-in, repeated 10 times (Plate 3.22), and repeated for opppsite lower limb. As a progression, opposite upper limb (shoulder) was lifted along with the extended knee joint of the contralateral side after the tummy tuck-in (Plate 3.23); this was repeated for the contralateral upper and lower limbs. In high sitting position, one of the leg was lifted of the bed/ treatment table after performing the abdominal draw-in, and held for 10seconds of 10 repitition (Plate 3.24); this was repeated for the opposite lower limb. Participants performed the abdominal draw-in after assuming the quadruped position, one upper limb was then sretch forward as far as possible, held for 10 seconds, and repeated 10 times (Plate 3.25); this was repeated for the contralateral upper limb too. As a progression, opposite upper limb was lifted along with the extended knee joint of the contralateral side after the tummy tuck-in (Plate 3.26); this was repeated for the contralateral upper and lower limbs. Each exercise targeted 10 seconds contractions of 10 repetitions at the onset (week 6). Progression was by increasing number of repetitions from 10 to 20 after week six, and from 20 repetitions to 30 repetitions by week seven to week eight. This final stage of the exercise lasted 3 weeks (week 6-8). In high sitting position, a flexed knee is lifted/ raised off the bed after contracting the activated muscles. These actions are repeated for both sides and lower limbs.

3.3.9 Combined McKenzie and Lumbar Stabilisation Exercise Group (CMLSEG)

The group carried out combined McKenzie and Stabilisation exercises. ME was carried out in the first 5 weeks, followed with 3 weeks LSE to complete the 8-week therapeutic exercise. For the ME, participants progressed from stage 1 to stage 5 based on symptoms relief as they carried out the exercise till the end of week 5 treatments. Each of the 3 stages LSE was carried out for a week (local segmental control or muscles activation in week 6 of treatment, closed chain segmental control in week 7 of treatment, and open chain segmental control in the final week 8 of treatment). The treatment exercise performed during the visits in each week of therapy was prescribed as home exercise programme. Participants in this treatment group also got back care education instructional hand-out for keep (Appendix J).

3.4 Data analyses

Obtained data was cleaned, entered into and analysed using SPSS version 21. Data analysis was done as itemised below:

i: Descriptive statistics of mean, standard deviation, and percentage to summarise general data obtained from the participants.

ii: One way Analysis of Variance (ANOVA) was used to compare demographic and anthropometric variables, as well as the mean score of pain, disability, and fear avoidance beliefs across-group (CMLSEG, MEG and LSEG) at baseline, weeks 4 and 8.

iii: Analysis of co-variance (ANCOVA) was used to correct the significant difference observed in the across-group baseline score.

iv: Bonferroni Post-hoc multiple comparisons test was used to detect the group with the significant difference.

v: Repeated-measure ANOVA was used for within-group comparison of mean score of pain, functional disability, FABPA, and FABW across the three time points of study (baseline, 4^{th} and 8^{th} week).

Alpha level was set at 0.05, and .0125 for between groups post hoc analysis.

Plate 3.19: Alternate arm lift in supine position.

Plate 3.20: Alternate leg lift in supine position.

Plate 3.21: Alternate arms/ opposite legs lift in supine position.

Plate 3.22: Prone position alternate leg lift.

Plate 3.23: Prone position alternate arms/ opposite legs lift.

Plate 3.24: Open chain elevation of flexed lower limb in high-sitting position.

Plate 3.25: Quadruped position alternate arms lift

Plate 3.26: Quadruped position alternate arms/ opposite legs lift.

CHAPTER FOUR

RESULTS

4.1.1 The Participants

Two hundred (200) referred individuals with chronic mechanical low back pain (CMLBP) and receiving treatment at physiotherapy clinics of LAUTECH Teaching Hospital, Ogbomoso, Uni-Osun Teaching Hospital and State Specialist Hospital, Osogbo were recruited for the study. Eleven people declined, five had anterior derangement, two had spine surgery, and three who had lateral derangement were disqualified. One hundred and seventy-nine (179) individuals were randomly and consecutively allocated into Combined McKenzie and Lumbar Stabilisation Exercise Group (CMLSEG), Lumbar Stabilisation Exercise Group (LSEG), and McKenzie Exercise Group (MEG). The data of twenty-three (23) participants' who could not complete the eight weeks study due to missed appointments, relocation, and exacerbated symptom were excluded in the final analysis. One hundred and forty-two participants (33 males, 109 females) comprising 48, 47, and 47 participants in CMLSEG, LSEG, and MEG, respectively, completed the study. 14 particpants' (7.82%) withdrew participation between week 4 to week 6 due to improvement recorded (CMLSEG - 3, MEG - 6, and LSEG 5) were observed. Attrition rate of 12.85% was recorded in the study.

4.1.2 Participants physical characteristics

The mean age, weight, height, and body mass index (BMI) of participants were 53±12 years, 72.4±14.5 kg, 1.7±0.1 m, and 27.1±5.1 kg/m^2, respectively. The mean age, h534 eight, weight and BMI of participants in MEG were 52.66±12.17 years, 1.70±0.22 m, 73.26±18.39 kg and 27.07±5.13 kg/m^2, respectively. The mean age, height, weight and BMI of participants in LSEG were 56.09±9.05 years, 1.65±0.09 m, 73.77±12.54 kg, and 28.15±5.06 kg/m^2, respectively, while those of the CMLSEG were 51.31±13.09 years, 1.65±0.09 m, 70.17±11.87 kg, and 26.23±5.09 kg/m^2, respectively. One-way

ANOVA at α =0.05 indicated no significant difference ($p > 0.05$) in the mean age, height, weight, and BMI of participants in the three exercise groups. The demographic features of the groups' participants were comparable (Table 4.1)

4.1.3 Comparison of treatment groups' baseline pain intensity, functional disability, and fear avoidance beliefs

The groups' baselines scores of pain intensity (PI), functional disability (FD), and fear voidance beliefs (FAB) are displayed in Table 4.2. One-way ANOVA followed by Post-hoc multiple analyses by Bonferroni test revealed groups PI and FAB was not significantly different at baseline ($p > 0.05$). However, baseline FD score was significantly difference ($p < 0.05$). Post-hoc analysis revealed MEG had a significantly lower baseline FD score. The baseline FD was therefore subjected to Analysis of Co-variance (ANCOVA) in order to correct the observed difference.

4.1.4: Comparison of treatment groups' functional disability at the three timed periods of the study.

The scores of FD in the three groups at the different timed periods of study are displayed in Table 4.3. One-way ANOVA followed by Post hoc multiple analyses using Bonferroni test showed that MEG had significantly lower FD score at baseline than either of LSEG or CMLSEG. Due to the difference observed, the FD was subjected to Analysis of co-variance (ANCOVA) in order to correct the difference and Post-hoc multiple analyses using Bonferroni test was carried out. The FD score was compared using ANCOVA with covariates evaluated at mean baseline FD = 42.23. Result showed that FD score was lower ($p < 0.05$) in MEG than LSEG and CMLSEG at end of weeks 4 and 8, and LSEG also had significantly lower FD score ($p < 0.05$) than CMLSEG at the end of week 4. However, FD scores of LSEG and CMLSEG was not significantly different at the end of week 8 (Table 4.3). The charts of FD for the three intervention groups (Plate 4.1) revealed MEG had lowest FD score at all three timed periods of the study while CMLSEG had the least apparent change in FD score.

Table 4.1: One-way ANOVA comparison of demographic variables by treatment groups

	Groups				
	MEG (n=47)	LSEG (n47)	CMLSEG (n=48)	F-ratio	p-value
Variables	x̄ ± SD	x̄ ± SD	x̄ ± SD		
Age (yr)	52.66±12.17	56.09±9.05	51.31±13.09	1.84	0.16
Height (m)	1.70±0.22	1.65±0.09	1.65±0.09	1.51	0.23
Weight (Kg)	73.26±18.39	73.77±12.54	70.17±11.87	1.15	0.32
BMI (Kg/m^2)	27.07±5.13	28.15±5.06	26.23±5.09	1.34	0.27

Keys - p-value not significant at $\alpha > 0.05$

BMI – Body mass index.

Table 4.2: Comparison of treatment groups' baseline fear avoidance beliefs, pain intensity and functional disability

	Groups				
	MEG	LSEG	CMLSEG		
	(n = 47)	(n = 47)	(n = 48)		
Variables	x̄±SD	x̄±SD	x̄±SD	F	p-value
Baseline PI	72.34±16.76	75.60±17.93	72.71±15.19	0.53	0.59
Baseline FD	37.57±12.71[b]	45.97±17.36[a]	43.14±15.66[a]	3.64	0.03*
Baseline FABPA	18.23±4.79	20.04±4.19	19.65±3.13	2.41	0.09
Baseline FABW	22.53±11.25	24.43±13.78	25.54±12.15	0.71	0.49

* indicates significant difference at $\alpha = < 0.05$

Keys -Superscripts (a and b) indicates post analysis comparison.

For a particular outcome, mean scores with different superscripts are significantly ($p< 0.05$) different. Mean scores with same superscripts are not significantly ($p> 0.05$) different.

FABPA= Fear avoidance belief to physical activity

FABW= Fear avoidance belief to work

FD= Functional disability

PI= Pain intensity

Table 4.3: Across-group comparison of functional disability at the three timed periods of the study.

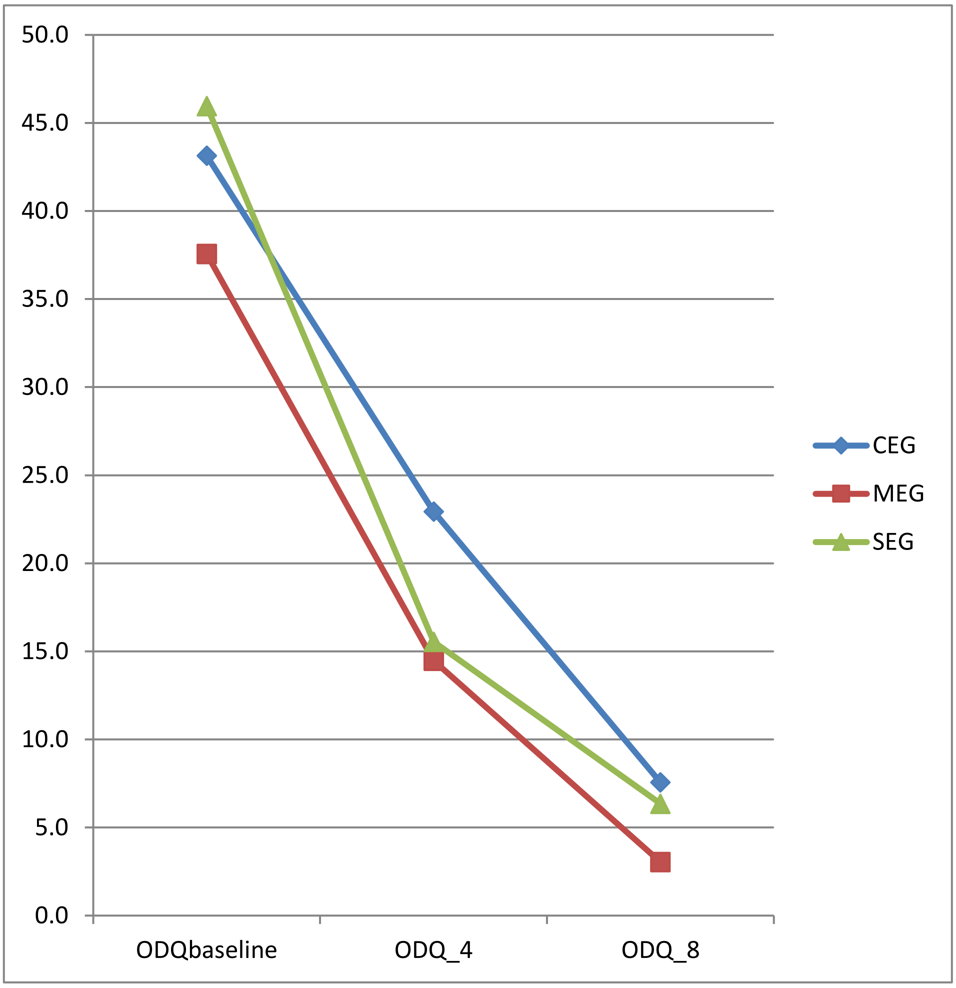
Variable	Time Frame	Groups CMLSEG (n=48) x̄±SD	 MEG (n=47) x̄±SD	 LSEG (n=47) x̄±SD	p-value
FD	Baseline	43.14±15.66[a]	37.57±12.71[b]	45.97±17.36[a]	0.03*
	Week 4	22.94 ±11.76[a]	14.47 ±10.62[b]	15.54 ±12.36[b]	0.00*
	Week 8	7.57 ±6.74[a]	3.04 ±4.07[b]	6.36 ±8.40[a]	0.02*

* indicates significant difference at $\alpha = 0.05$

Keys -Superscripts (a and b) represents post analysis comparison.

For a particular outcome, mean scores with different superscripts are significantly ($p < 0.05$) different. Mean scores with same superscripts are not significantly ($p > 0.05$) different.

% Scores



Functional disability

Plate 4.1: Charts on scores of functional disability for CMLSEG, MEG, and LSEG at baseline, weeks 4 and 8.

Keys- ODQ= Oswestry Low back pain Disability Questionnaire score for FD

4.1.5: Comparison of average pain intensity in CMLSEG, MEG and LSEG across the three timed periods of the study

Groups' PI scores at different timed periods of the study are displayed in Table 4.4. One-way ANOVA followed by Post-hoc multiple analyses by Bonferroni test showed that though the groups' pain was not significantly different (p> 0.05) at baseline, both LSEG and MEG had significantly lower pain score than CMLSEG at the end of week 4. However, PI scores of MEG was not significantly different to PI score of LSEG at the end of week 4. Groups' PI score was not significantly different at the end of week 8. The charts of PI for the three intervention groups (Plate 4.2) revealed MEG had the lowest pain score at baseline and at week 8, while LSEG had the lowest pain score at week 4. The change in pain score was least apparent in CMLSEG.

4.1.6: Comparison of groups' Fear avoidance beliefs at the three timed periods of study.

Fear avoidance belief (physical activity - FABPA): The groups' FABPA score at the three timed periods in the study are displayed in Table 4.5. One-way ANOVA and Post-hoc multiple analyses using Bonferroni test reported no significant difference in the groups' mean FABPA score at baseline, and at the end of week 8. However, MEG had a significantly lower FABPA score than CMLSEG and LSEG at the end of week 4. Participants FABPA score was also significantly lower in LSEG at the end of week 4 than CMLSEG (Table 4.5). The charts of the groups' FABPA score (Plate 4.3) shows MEG had the lowest FABPA score, while FABPA score of CMLSEG was highest across the three time points.

Fear-avoidance belief (work - FABW): The groups' FABW score at the three timed periods in the study are captured in Table 4.5. One-way ANOVA and Post-hoc multiple analyses by Bonferroni test revealed no significant difference in FABW score at baseline, while MEG had significantly lower FABW score than LSEG and CMLSEG at the end of weeks 4 and 8. The FABW score also reduced significantly in LSEG than CMLSEG at end of week 4. However, FABW scores of LSEG and CMLSEG at the end of week 8 was not significantly different (Table 4.5). The charts of FABW scores of the three intervention groups' are presented in Plate 4.4. Changes in FABW were more apparent in MEG and least apparent in CMLSEG across the three timed periods of the study.

4.1.7: Within-group comparison of pain intensity across the three timed periods of the study

Repeated-measures ANOVA revealed significant differences in the PI across the three timed periods for CMLSEG ($p < 0.00$), MEG ($p < 0.00$), and LSEG ($p < 0.00$) as reported in Table 4.6. Pain intensity reduced progressively across the three timed periods (weeks 0-4, 4-8, and 0-8) of the study in each of the intervention groups. Post hoc analysis using Bonferroni test at α-level set at 0.0125 revealed significant reductions in pain intensity of participants in each study group.

4.1.8: Within-group comparison of functional disability across the three periods of the study

Repeated-measures ANOVA revealed significant differences in functional disability across the three time points for participants in CMLSEG ($p < 0.00$), MEG ($p < 0.00$), and LSEG ($p < 0.00$) as shown in Table 4.7. Progressive reduction in functional disability was achieved across the three timed periods (weeks 0-4, 4-8, and 0-8) of the study among participants in each group. Post hoc analysis using Bonferroni test at α-level set at 0.0125 revealed significant reductions in functional disability of participants in each study group.

4.1.9: Within-group comparison of fear avoidance beliefs across the three timed periods of the study

Repeated-measures ANOVA indicated significant differences in the fear avoidance beliefs across the three time points for CMLSEG ($p < 0.00$), MEG ($p < 0.00$), and LSEG ($p < 0.00$) as reported in Table 4.8. Fear avoidance beliefs reduced progressively across the three timed periods (weeks 0-4, 4-8, and 0-8) of the study in each intervention group. Post hoc analysis using Bonferroni test at α-level set at 0.0125 revealed significant reductions in fear avoidance beliefs of participants in each study group.

Table 4.4: Across-group comparison of pain intensity at the three timed periods of the study.

		Groups			
Variable	Time Frame	CMLSEG (n=48) x̄±SD	MEG (n=47) x̄±SD	LSEG (n=47) x̄±SD	p-value
PI	Baseline	72.71 ±15.98[a]	72.34 ±16.76[a]	75.60 ±17.93[a]	0.59
	Week 4	37.64 ±14.58[a]	28.87 ±13.73[b]	26.01 ±14.79[b]	0.00*
	Week 8	13.19 ± 8.58[a]	8.80 ±7.11[a]	14.13 ±14.68[a]	0.05

*indicates significant time point difference at $\alpha = 0.05$

Keys -Superscripts (a,b) represents post analysis comparison.

For a particular group, mean scores with different superscripts are significantly ($p < 0.05$) different. Mean scores with same superscripts are not significantly ($p > 0.05$) different.

PI= Pain intensity

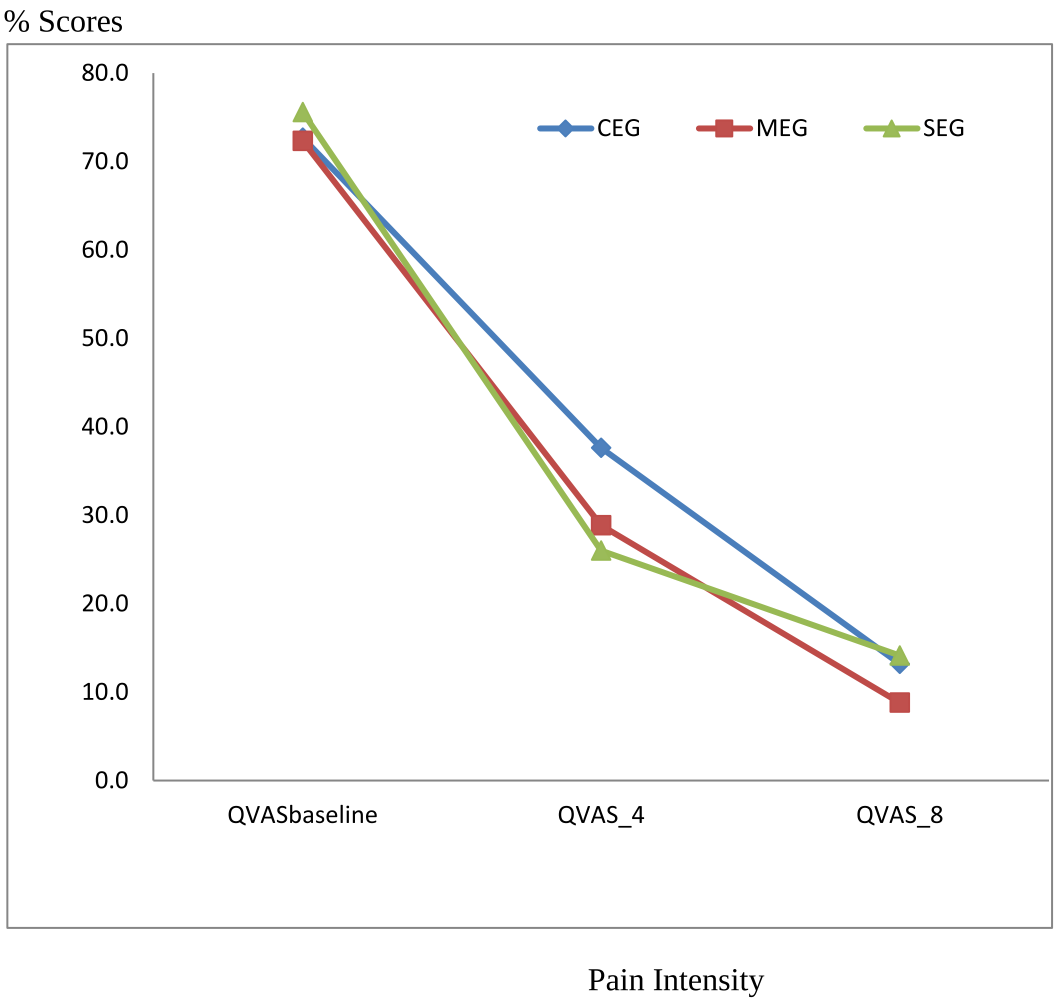


Plate 4.2: Charts on scores of pain intensity for CMLSEG, MEG, and LSEG at baseline, weeks 4 and 8.

Key- QVAS= Qadruple visual analogue scale for Pain intensity

Table 4.5: Across-group comparison of fear avoidance beliefs at the three timed periods of the study.

Variable	Time Frame	Group CMLSEG (n=48) x̄±SD	 MEG (n=47) x̄±SD	 LSEG (n=47) x̄±SD	p-value
FABPA	Baseline	19.65 ±3.1[a]	18.28 ±4.79[a]	20.04 ±4.19[a]	0.09
	Week 4	13.46 ±3.16[a]	10.85 ±2.08[b]	11.32 ±3.79[b]	0.00*
	Week 8	8.67 ±5.74[a]	6.70 ±1.77[a]	8.53 ±4.23[a]	0.05
FABW	Baseline	25.54 ±12.15[a]	22.53 ±11.25[a]	24.43 ±13.78[a]	0.49
	Week 4	15.02 ±11.08[a]	8.02 ±6.03 [b]	8.98 ±9.13[b]	0.00*
	Week 8	3.98 ±4.39[a]	0.45 ±1.02[b]	2.80 ±6.85[a]	0.00*

* Indicates significant difference at $\alpha = 0.05$

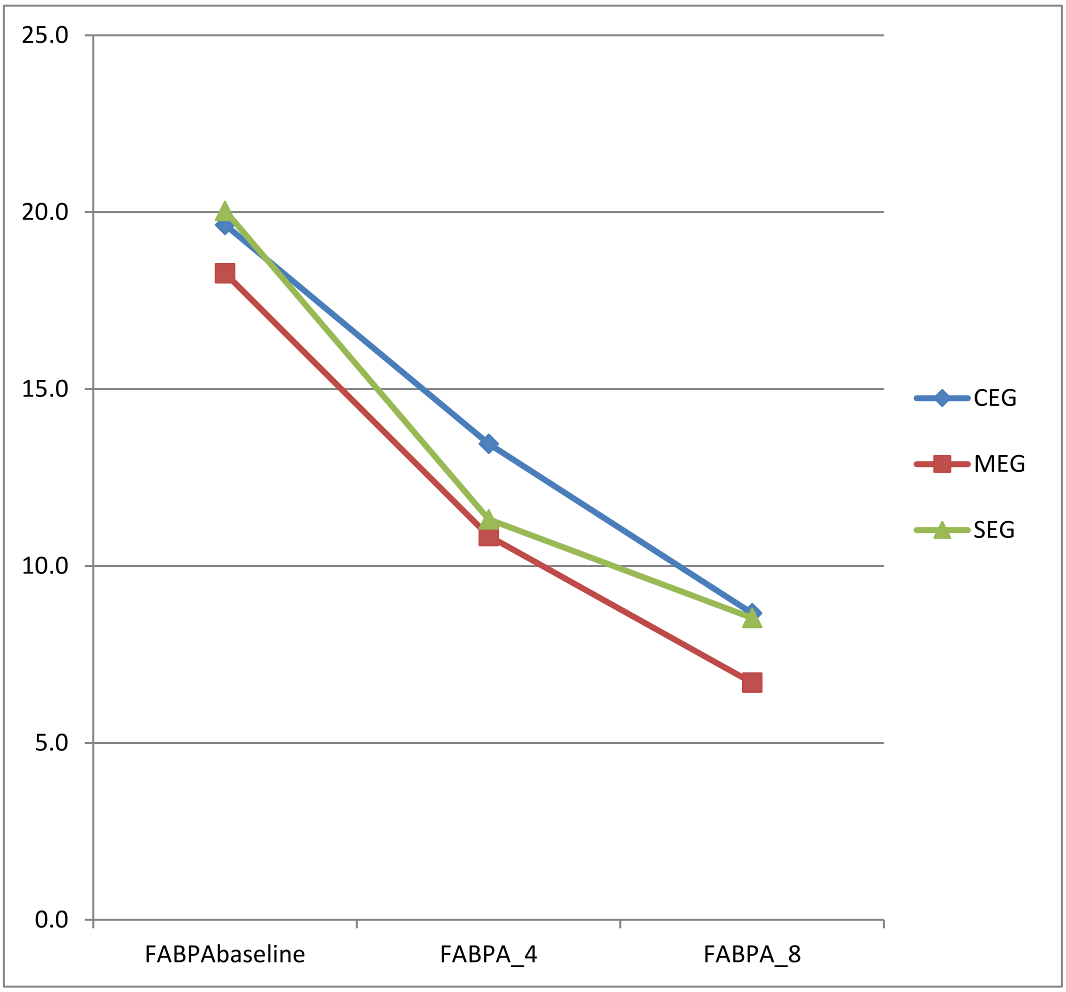
Keys -Superscripts (a,b) represents post analysis comparison.

For this particular outcome, mean scores with different superscripts are significantly different $p< 0.05$), while mean scores with same superscripts are not significantly different ($p> 0.05$).

FABPA= fear avoidance belief physical activity

FABW= fear avoidance belief work

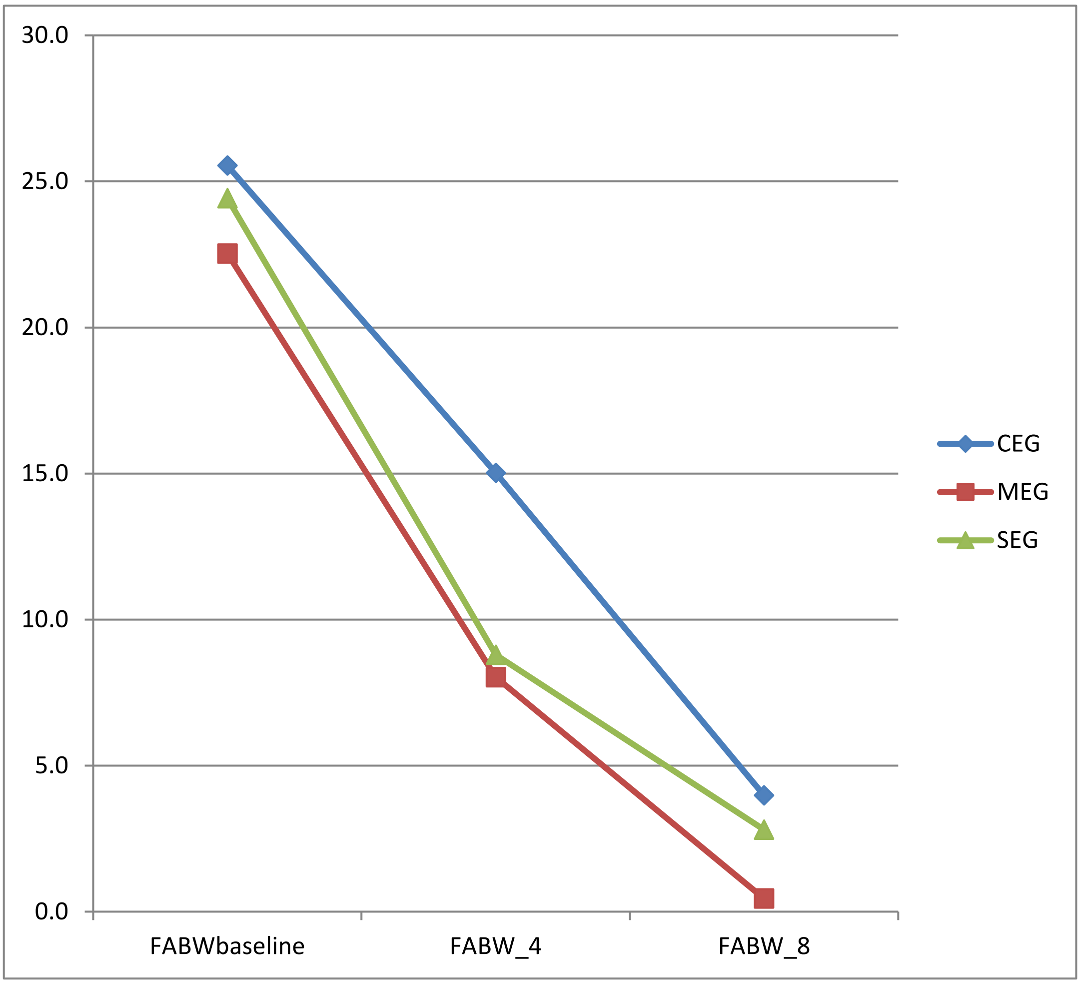
Scores



Fear-avoidance belief to physical activity

Plate 4.3: Charts on scores of fear avoidance belief to physical activity for CMLSEG, MEG, and LSEG at baseline, weeks 4 and 8.

Scores



Fear-avoidance belief to work

Plate 4.4: Charts on scores of fear avoidance belief to work for CMLSEG, MEG, and LSEG at baseline, weeks 4 and 8.

Table 4.6: Repeated-measures ANOVA and Post-hoc multiple comparison of participants' pain intensity using Bonferroni test across the three timed periods of study for the three study groups

		Groups		
Variable	Time Frame	CMLSEG (n=48) $\bar{x}$±SD	MEG (n=47) $\bar{x}$±SD	LSEG (n=47) $\bar{x}$±SD
PI	Baseline	72.71 ± 15.98^{a}	72.34 ± 16.76^{a}	75.60 ± 17.93^{a}
	Week 4	37.64 ± 14.58^{b}	28.87 ± 13.76^{b}	26.01 ± 14.79^{b}
	Week 8	13.19 ± 8.58^{c}	8.80 ± 7.11^{c}	14.13 ± 14.68^{c}
F-ratio		460.65	375.76	299.12
p-value		0.00*	0.00*	0.00*

*indicates significant time point difference at α= 0.05

Keys -PI = pain intensity

Superscripts (a, b and c) represents post analysis comparison

For a particular group, mean scores with different superscripts are significantly ($p < 0.05$) different. Mean scores with same superscripts are not significantly ($p > 0.05$) different.

Table 4.7: Repeated-measures ANOVA and Post-hoc multiple comparison of participants' functional disability using Bonferroni test across the three timed periods of study for the three study groups

		Groups		
Variable	Time Frame	CMLSEG (n=48) x̄±SD	MEG (n=47) x̄±SD	LSEG (n=47) x̄±SD
FD	Baseline	48.18 ± 15.66^{a}	37.57 ± 12.71^{a}	45.97 ± 17.36^{a}
	Week 4	22.94 ± 11.76^{b}	14.47 ± 10.62^{b}	15.54 ± 12.36^{b}
	Week 8	7.57 ± 6.74^{c}	3.04 ± 4.07^{c}	6.36 ± 8.40^{c}
F-ratio		265.76	251.43	197.47
p-value		0.00*	0.00*	0.00*

*Significant at $\alpha = 0.05$

Keys -Superscripts (a, b and c) represents post analysis comparison.

For a particular group, mean scores with different superscripts are significantly ($p < 0.05$) different. Mean scores with same superscripts are not significantly ($p > 0.05$) different.

FD= Functional disability

Table 4.8: Repeated-measures ANOVA and Post-hoc multiple comparison of participants' fear avoidance beliefs using Bonferroni test across the three timed periods of study for the three study groups

		Groups		
Variables	Time Frame	CMLSEG (n=48) x̄±SD	MEG (n=47) x̄±SD	LSEG (n=47) x̄±SD
FABPA	Baseline	19.64 ±3.13[a]	18.28 ±4.79[a]	20.04 ±4.19[a]
	Week 4	13.46 ±3.16[b]	10.85 ±2.08[b]	11.32 ±3.79[b]
	Week 8	8.67 ±5.74[c]	6.70 ±1.77[c]	8.53 ±4.23[c]
F-ratio		92.87	188.46	93.2
p-value		0.00*	0.00*	0.00*
FABW	Baseline	25.54 ±12.15[a]	22.53±11.25[a]	24.87 ±13.59[a]
	Week 4	15.02±11.08[b]	8.02 ±6.03[b]	8.98 ±9.14[b]
	Week 8	3.98±4.39[c]	0.45 ±1.02[c]	2.80 ±6.85[c]
F-ratio		127.67	132.65	95.92
p-value		0.00*	0.00*	0.00*

*significant at α= 0.05

Keys -Superscripts (a, b and c) represents post analysis comparison.
For a particular variable, mean scores with different superscripts are significantly ($p< 0.05$) different. Mean scores with same superscripts are not significantly ($p> 0.05$) different.

FABPA= Fear avoidance belief Physical activity, FABW= Fear avoidance belief work

4.1.10: Comparison of mean changes in outcome variables at the baseline - week 8 of the study

Table 4.9 shows comparison of the mean changes in the groups' clinical and psychosocial variables (PI, FD and FAB) at baseline – week 8 interval. One-way ANOVA revealed there was no significant difference between the mean changes in all the variables (PI, FD and FAB) for the three groups. This means the three groups had comparable mean changes in all the variables at baseline – week 8 of study.

Table 4.9: Comparison of mean changes in pain, functional disability, and fear-avoidance beliefs at Baseline - Week 8 of study.

Groups	Variables			
	PI	FD	FABPA	FABW
	x̄±SD (%)	x̄±SD (%)	x̄±SD (%)	x̄±SD (%)
CMLSEG	-59.52.±14.04 (82.3)	-35.58±12.93 (83.9)	-10.98±6.61 (54.7)	-21.56±10.16 (87.3)
MEG	-63.54±18.14 (87.2)	-34.52±12.21 (91.9)	-11.58±4.94 (57.9)	-22.09±11.31 (97.5)
LSEG	-61.47±22.12 (80.7)	-39.61±17.41 (84.5)	-11.51±7.40 (50.9)	-22.07±13.95 (85.1)
F-ratio	0.57	1.65	0.13	0.03
p-value	0.57	0.20	0.88	0.97

Keys- p value not significant at $\alpha > 0.05$

% = percentage change in means score from baseline to week 8 of study

4.2 Testing of Hypotheses

Hypothesis 1: The hypothesis stated that there would be no significant difference in the fear avoidance beliefs to physical activity- FABPA, and Work- FABW of participants with CMLBP in the CMLSEG, MEG, and LSEG at baseline, weeks 4, and 8 of the study.

FABPA Baseline

Alpha level: 0.05

Test statistic: One-way ANOVA

Observed p = 0.09

Since the observed p-value was higher than the 0.05 Alpha level, the hypothesis was therefore NOT REJECTED for baseline.

Week 4

Observed p = 0.00

Since the observed p-value was less than the 0.05 Alpha level, the hypothesis was therefore REJECTED for week 4.

Week 8

Observed p = 0.05

Since the observed p-value was equal to the 0.05 Alpha level, the hypothesis was therefore NOT REJECTED for week 8.

FABW Baseline

Alpha level: 0.05

Test statistic: One-way ANOVA

Observed p = 0.49

Since the observed p-value was higher than the 0.05 Alpha level, the hypothesis was therefore NOT REJECTED for baseline.

Week 4

Observed p = 0.00

Since the observed p-value was less than the 0.05 Alpha level, the hypothesis was therefore REJECTED for week 4.

Week 8

Observed p = 0.00

Since the observed p-value was less than the 0.05 Alpha level, the hypothesis was therefore REJECTED for week 8.

Hypothesis 2: The hypothesis stated that there would be no significant difference in the pain intensity of participants with CMLBP, MEG and LSEG at baseline, weeks 4, and 8 of the study.

Baseline

Alpha level: 0.0

Test statistic: One-way ANOVA

Observed p= 0.59

Since the observed p-value was higher than 0.05 alpha level, the hypothesis was therefore NOT REJECTED for baseline.

Week 4

Observed p= 0.00

Since the observed p-value was less than the 0.05 Alpha level, the hypothesis was therefore REJECTED for week 4 of the study.

Week 8

Observed p = 0.05

Since the observed p-value was equal to the 0.05 Alpha level, the hypothesis was therefore NOT REJECTED for week 8 of the study.

Hypothesis 3: The hypothesis stated that there would be no significant difference in the functional disability of participants with CMLBP in the CMLSEG, MEG, and LSEG at baseline, weeks 4, and 8 of the study.

Baseline

Alpha level: 0.05

Test statistic: One-way ANOVA

Observed p = 0.03

Since the observed p-value was less than the 0.05 Alpha level, the hypothesis was REJECTED for baseline.

Week 4

Observed p = 0.00

Since the observed p-value was less than the 0.05 Alpha level, the hypothesis was REJECTED for week 4 of the study.

Week 8

Observed p = 0.02

Since the observed p-value was less than the 0.05 Alpha level, the hypothesis was REJECTED for week 8 of the study.

Hypothesis 4: The hypothesis stated that there would be no significant difference in the fear avoidance beliefs (FABPA & FABW) of participants with CMLBP in CMLSEG at baseline, weeks 4 and 8 of the study.

Alpha level: 0.05

Test statistic: Repeated measures ANOVA

Observed p = 0.00

Since the observed p-value was less than 0.05 Alpha level, the hypothesis was REJECTED.

Hypothesis 5: The hypothesis stated that there would be no significant difference in the pain intensity of participants with CMLBP in CMLSEG at baseline, weeks 4 and 8 of the study.

Alpha level: 0.05

Test statistic: Repeated measures ANOVA

Observed p = 0.00

Since the observed p-value was less than 0.05 Alpha level, the hypothesis was REJECTED.

Hypothesis 6: The hypothesis stated that the functional disability of participants with CMLBP in CMLSEG would not be significantly different across the three time frames of baseline, weeks 4 and 8 of the study.

Alpha level: 0.05

Test statistic: Repeated measures ANOVA

Observed p = 0.00

Since the observed p-value was less than 0.05 Alpha level, the hypothesis was therefore REJECTED.

Hypothesis 7: The hypothesis stated that there would be no significant difference in the fear avoidance beliefs (FABPA & FABW) of participants with CMLBP in MEG at baseline, weeks 4 and 8 of the study.

Alpha level: 0.05

Test statistic: Repeated measures ANOVA

Observed p = 0.00

Since the observed p-value was less than 0.05 Alpha level, the hypothesis was therefore REJECTED.

Hypothesis 8: The hypothesis stated that there would be no significant difference in the pain intensity of participants with CMLBP in MEG at baseline, weeks 4 and 8 of the study.

Alpha level: 0.05

Test statistic: Repeated measures ANOVA

Observed p = 0.00

Since the observed p-value was less than 0.05 Alpha level, the hypothesis was therefore REJECTED.

Hypothesis 9: The hypothesis stated that there would be no significant difference in the functional disability of participants with CMLBP in MEG at baseline, weeks 4 and 8 of the study.

Alpha level: 0.05

Test statistic: Repeated measures ANOVA

Observed p = 0.00

Since the observed p-value was less than 0.05 Alpha level, the hypothesis was therefore REJECTED.

Hypothesis 10: The hypothesis stated that there would be no significant difference in the fear avoidance beliefs (FABPA & FABW) of participants with CMLBP in LSEG at baseline, weeks 4 and 8 of the study.

Alpha level: 0.05

Test statistic: Repeated measures ANOVA

Observed p = 0.00

Since the observed p-value was less than 0.05 Alpha level, the hypothesis was therefore REJECTED.

Hypothesis 11: The hypothesis stated that there would be no significant difference in the pain intensity of participants with CMLBP in LSEG at baseline, weeks 4 and 8 of the study.

Alpha level: 0.05

Test statistic: Repeated measures ANOVA

Observed p = 0.00

Since the observed p-value was less than 0.05 Alpha level, the hypothesis was therefore REJECTED.

Hypothesis 12: The hypothesis stated that there would be no significant difference in the functional disability of participants with CMLBP in LSEG at baseline, weeks 4 and 8 of the study.

Alpha level: 0.05

Test statistic: Repeated measures ANOVA

Observed p = 0.00

Since the observed p-value was less than 0.05 Alpha level, the hypothesis was therefore REJECTED.

Hypothesis 13: The hypothesis stated that there would be no significant difference in the mean changes in the fear avoidance beliefs (physical activity- FABPA, Work-FABW) of participants with CMLBP in the CMLSEG, MEG, and LSEG at baseline-week 8 of the study.

FABPA Baseline – week 8

Alpha level: 0.05

Test statistic: One-way ANOVA

Observed p = 0.88

Since the observed p-value was less than the 0.05 Alpha value, the hypothesis was therefore NOT REJECTED for baseline – week 8.

Hypothesis 14: The hypothesis stated that there would be no significant difference in the mean changes in pain intensity of participants with CMLBP in the CMLSEG, MEG, and LSEG at baseline-week 8 of the study.

Baseline – week 8

Alpha level: 0.05

Test statistic: One-way ANOVA

Observed p = 0.56

Since the observed p-value was higher than the 0.05 Alpha value, the hypothesis was therefore NOT REJECTED for baseline- week 8.

Hypothesis 15: The hypothesis stated that there would be no significant difference in the mean changes in functional disability of participants with CMLBP in the CMLSEG, MEG, and LSEG at baseline-week 8 of the study.

Baseline – week 8

Alpha level: 0.05

Test statistic: One-way ANOVA

Observed p = 0.20

Since the observed p-value was less than the 0.05 Alpha value, the hypothesis was therefore NOT REJECTED for baseline – week 8.

FABW Baseline – week 8

Alpha level: 0.05

Test statistic: One-way ANOVA

Observed p = 0.97

Since the observed p-value was less than the 0.05 Alpha value, the hypothesis was therefore NOT REJECTED for baseline – week 8.

CHAPTER FIVE

DISCUSSION

5.1 Participants' demographic characteristics

Out of the 189 participants that consented, 179 had posterior derangement, thus confirmring reports from previous studies that posterior derangement is the commonest of the the 3 syndromes (McKenzie and May, 2003; Ayanniyi et al., 2007). The age range of participants in the study was 18-75 years, with a mean age of 53.00±12.00 years. The mean ages of participants in the CMLSEG, MEG, and SEG groups were 51.31±13.09 years, 52.66±12.17 years, and 56.09±9.05 years, respectively. The age ranges and mean ages compared favourably with the findings rom previous stusies on CMLBP (Mbada et al., 2012; Fapojuwo, 2016; Aderibigbe, 2017). It could be infered that CMLBP is a serious health condition that affects people of all ages, from the adolescent to the elderly. This corroborates the reports of previous studies on the high prevalent rate of CMLBP in different societies (Hoy et al., 2012; Adegoke et al., 2015). Also, the high participatory rate (76%) of females in the study gives credence to the previously reported high incidence of CMLBP among females. This could be attributed to high influx of the gender into professions that were previously the exclusive right of men which could be due to the increasing economic demands on families that have turned many women to bread winners. Work is one the major factor for developing CMLBP.

The BMI of participants was 27.1±5.1 kg/m^2, while mean BMI for CMLSEG, MEG, and LSEG were 26.23±5.09 kg/m^2, 27.07±5.13 kg/m^2, and 28.15±5.06 kg/m^2, respectively. This finding compare favourably with reports of other studies on CMLBP (Mbada et al., 2012; Fapojuwo, 2016; Abdelaziz et al., 2019. Even though groups BMI were fairly below the 30 mark set by World Health Organization (WHO, 2000) to classify individuals as obese, high BMI score could still be assumed as a risk factor for the CMLBP observed among the participant

5.2 Drop-out rate in the study

An attrition rate of 12.85% was recorded in the study. Different rates have been reported from earlier studies on CMLBP from both advanced and developing nations (Akosile et al., 2006 ; Johnson et al., 2010; Albert et al., 2010; Petersen et al., 2011; Bronfort et al., 2011; Akosile et al., 2006; Mbada et al., 2012; Fapojuwo, 2016; Aderibigbe, 2017). The reasons for drop out differ from one facility or geographical location to another. Reasons given in literature for withdrawal from clinical trials include but not limited to exacerbation of symptoms, relocation to a new residence/locality, busy schedule, inflexibility of time, and improvement in health condition. Reasons given by participants who dropped-out of the study were similar to those given in previous studies on CMLBP. More than 50% of the participants who dropped-out could not be contacted by telephone or relocated due to family needs or job-related matter. The fourteen participants that recorded significant symptoms resolution between weeks 4 and 8 of the study gives credence to the effectiveness of both ME and LSE in resolving the painful dysfunction and psychosocial trauma associated with CMLBP. The mean values of pain (37.64±14.58, 28.87±13.73, 26.01±14.79) for CMLSEG, MEG, and LSEG at the end of week 4 when most of these participants dropped out provided evidence in support of the positive effects of treatment among participants in LSEG and MEG.

5.3 Comparison of participants’ baseline fear avoidance beliefs, pain intensity and functional disability

Baseline features are known determinants of outcome of intervention in trials on LBP (Child et al., 2004; Hagen et al., 2005; Underwood et al., 2007). The result showed that the three groups were not significantly difference in the baseline pain intensity and fear-avoidance beliefs. This is a confirmation of homogeneity of the study samples as spelt out in the inclusion criteria. Although the functional disability was significantly lower in the MEG, and was subjected to analysis of co-variance to correct the baseline difference, it could be said that the result is a true reflection of the effects of the three exercise interventions on the selected variables/treatment outcomes among participants in the treatment groups.

5.4 Effects of Combined McKenzie and Lumbar stabilisation exercises, McKenzie exercise, and Lumbar stabilisation exercise on psychosocial and clinical variables of participants

Within-group comparison across the timed periods of study (weeks 0, 4, and 8) showed that each exercise regimen (CMLSE, ME, and LSE) produced significant improvement in PI, FD, and FAB in CMLBP. It could be said that the combined exercise truly adressesd the root cause of LBP and LSE addressed the consequence segmental instability due to muscle inhibition. The recorded significant improvement achieved by each exercise regimen corroborates the outcome of studies on the influence of exercise on symptoms experienced by individuals with CMLBP. The results of the study has demonstrated that when homogeneous individuals are subjected to specific treatment strategies there is more likelihood of better outcome.

5.4.1 Effects of McKenzie exercise on psychosocial and clinical variables in chronic mechanical low back pain

Within-group comparison revealed that McKenzie exercise (ME) resulted in significant improvement in clinical psychosocial (FAB) and clinical (PI and FD) symptoms across the three timed periods of study. Post hoc analysis by Bonferroni test revealed significant reduction in all the variables at the end of weeks 4 and 8. The results corroborates findings of previous studies recognizing ME in effectively minimizing PI, and reduce FD in CMLBP (Hayden et al., 2005; Costa et al., 2009; Araora et al.,2012; Mbada et al, 2012; Mohan et al., 2015; Sanadgol et al., 2015; Fapojuwo, 2015; Halliday et al., 2016, 2019; Aderibigbe, 2017; Hasanpour-Dehkordi et al., 2017; Bid et al., 2018; Czajka et al., 2018; Abdelaziz et al., 2019).

Reduced PI and subsequent improvement in FD as a result of ME intervention is attributable to anterior displacement of the symptomatic disc related structures preceding resultant restoration of symptomatically displaced para-vertebral structures (Karayannis et al., 2012), as confirmed by Shemshaki et al'.s (2013) reported identifying the spine as the main source of LBP across different age groups. The reduction in FD observed in this study supports findings from previous studies on ME in CMLBP (Sanagdol et al., 2015; Fapojuwo, 2015; Bid et al., 2018; Abdelaziz et al., 2019). According to Bid et al. (2018) and Abdelaziz et al. (2019), FD is pain-related, and since ME brought about reduction in PI it will enhance reduced FD. In a study by

Araora et al. (2012), PI and FD significantly reduced following a 4- week ME intervention in agreement with the submission of Koes et al. (2006) that PI and FD are the main symptoms of CMLBP. Findings of the study compares favourably with Araora et al. (2012) as ME provoked significant reduction in PI and FD by week 4 of intervention.

McKenzie exercise is primarily focussed on pain and the associated functional disability, but does not cater for gamut of psychological and social factors associated with CMLBP. However, it is generally believed in McKenzie theory that many of these psycho-social factors will ameliorate when the bio-mechanical dysfunction, and accompanying painful symptoms subsides (Clare et al., 2005; Koes et al., 2006). The latter submission is further supported by evidence in literature (Kuhnov et al., 2020). The significant reduction in FAB observed in this study support the belief that psychosocial factors improves when dysfunction is corrected and pain subsides. The results also corroborate the reported significant reduction in FAB in a study on ME in CMLBP (Bid et al., 2018), thus agreeing with reports of other studies (Werneke et al., 2000; Udermann et al., 2004; Long et al., 2011; Bid et al., 2018) that ME precipitate reduced psychosocial symptoms and improvement in the twin symptoms of pain and functional disability in CMLBP. Therefore, it could be inferred that ME does not just promote relief in pain and functional disability, but also influence early return to activities and vocation through prompt resolution of fear of movement.

5.4.2 Effects of Lumbar stabilisation exercise on psychosocial and clinical variables in chronic mechanical low back pain.

The Post hoc analysis revealed LSE achieved significant reduction in all the outcome variables (FAB, PI, and FD) at the end of weeks 4 and 8 of study. This finding corroborates findings of previous related studies on LSE in CMLBP (Ferreira et al., 2006; Costa et al., 2009; Franca et al., 2010; Hosseinifar et al., 2013; Moon et al., 2013; Puntumetakul et al., 2013; Akodu et al., 2015a,b; Aderibigbe, 2017; Akhtar et al., 2017; Ali et al., 2017; Bello and Adeniyi, 2018; Suh et al., 2019). According to Akhtar et al. (2017), LSE significantly reduced PI at 2nd, 4th, and 6th weeks that the study lasted. Hosseinifar et al. (2013) gave similar report of significant reduction in pain and functional disability following 6 weeks of LSE intervention. Akodu et al (2015a) reported similar effectiveness of reduced pain and improved of functional disability. It has been reported that after pain remission in individuals with LBP, proper reactivation of deep spinal muscle (lumbar stabilisers) functions often did not happen due to muscle weakness and de-conditioning (Hides et al., 1996; Hodges et al., 2019) which results in functional disability, pain, and general reduction in the quality of life (QOL) of persons with CMLBP (Stankovic et al., 2008). Hosseinifar et al. (2013) and Akhtar et al. (2017) attributed increase segmental stability which is enhanced by reactivation of the stabilizers as reason for improved function and consequent reduction in pain as recorded in the study. The finding is in agreement with findings on the effect of LSE in CMLBP where LSE resulted in improved quality of life and functions (Shaughnessy and Caulfield ,2004; Stankovic et al., 2008; Costa et al., 2009; Muthukrishnan et al., 2010; Hosseinifar et al., 2013; Moon et al., 2013). Eight weeks of LSE significantly improved pain and disability in this study.

Delitto et al., 2012 identified psychosocial factors as critical/ predictive factors in the development and perpetuation of CMLBP. The study recorded significantly reduced fear avoidance beliefs which is in agreement with findings of researches on the effects of LSE on fear avoidance beliefs in CMLBP (Muthukrishnan et al., 2010; Karayannis et al., 2012; Akodu, 2015b; Pinto et al., 2022). Akodu et al (2015b) studied the impact of LSE on PI and QOL in CMLBP and reported significant reduction in pain, psychological and social domains of CMLBP including fear avoidance beliefs, as well as improved functions in the participants. The observed significant reduction in the initial high fear avoidance beliefs score corroborates Hick's et al.'s (2005) submission that pre-treatment fear avoidance beliefs score of greater than 8 (as observed at baseline) is a predictor of improvement when LSE is utilised in CMLBP. Reports from studies by Mannion et al. (2001), Vlaeyen et al. (2001), Woby et al. (2004) has it that reduction in disability following exercises is proportional to the degree of positive change in activity related fear, thus agreeing with Karayannis et al.'s (2012) submission that fear avoidance beliefs is key psychosocial symptom/ variable amenable by LSE. The reduced fear avoidance beliefs could have brought about improved function and consequent reduction in pain among the participants. The finding differs from the reported insignificant difference in the effect of LSE on FAB in CMLBP (Hedayati et al., 2015).

5.4.3 Effects of Combined McKenzie exercise and Lumbar stabilisation exercise on psychosocial and clinical variables of individuals with chronic mechanical low back pain

Within-group comparison of combined ME and LSE (CMLSE) on FAB, PI and FD, across the three timed periods of the study demonstrated significantly reduced outcome variables in individuals with CMLBP. Javadian et al. (2012) and Abdelaziz et al. (2019) submitted that combined exercises produced significant reduction in CMLBP symptoms. Though there is dearth of literature study on CMLSE, findings from this study compare favourably with that obtained from a recent similar study (Abdelaziz et al., 2019) where 8-week CMLSE in CMLBP significantly reduced in PI and FD, as well as increased spinal flexibility of participants. This finding agrees with Kankaapaa et al. (1999) and Kuijpers et al. (2011) that therapeutic exercises promote significant reduction in pain and functional disability. It could be inferred that combined CMLSE is effective in alleviating symptoms of pain and functional disability, the muscle inhibition following pain, and the likely segmental instability. The findings also support Kasai (2006) submission that exercise is the optimal treatment in the management of CMLBP.

Though the few available studies on combined exercise in CMLBP did not focus/ consider its effect on fear avoidance beliefs, the finding of this study revealed combined CMLSE promote significant reduction in the fear avoidance beliefs of participants. This could be attributed to the benefits that the combined effect of each of the component exercise offered the participants. However, the finding differs to the reported findings of no benefit of combined exercise in CMLBP (Koumantakis et al., 2005; Searle et al., 2015). Eliminating the fear of aggravating the symptoms through movement or activities via progressive LSE could have resulted in the improved function, and subsequent reduction in the initial pain expressed/ experienced by the participants.

5.5 Comparative effects of Combined McKenzie exercise and Lumbar stabilisation exercise, McKenzie exercise, and Lumbar stabilisation exercise on psychosocial and clinical variables in individuals with CMLBP

The study’s main objective is finding out the effect of CMLSE on psychosocial symptoms (FAB), and the common clinical symptoms (PI and FD) associated with

CMLBP, and compare the findings with the effects of ME, and LSE on the selected variables. Groups' baseline scores for FAB and PI were not significantly different, thus confirming the homogeneity of the sample population, PI significantly reduced in LSEG than CMLSEG at end of week 4. The reason for LSEG recording better improvement than CMLSEG could be attributed to the ability of the reactivated stabilisers to delay onset of pain by eliminating abnormal movement that elicits pain despite the fact that the root cuase of pain was not yet addressed. However, failure of CMLSEG to record same improvement could be due to uncertainty about presence of instability among the participants, and also the level of compliance with back care instruction and home exercise programme could not be ascertained. The significantly reduced PI by MEG than CMLSEG at week 4 despite the fact that both groups were carrying out same exercise at that period could be a reflection of compliance in one group and non-compliance in the other group. The result of the study at week 4 compare favourably with the findings of Akhar et al. (2017) and Bid et al. (2018). In a 6-week LSE study by Akhtar et al. (2017), PI significantly reduced by the second and fourth weeks of treatment via reactivation and strengthening of the stabiliser muscles with resultant improved function and consequent pain reduction. Bid et al. (2018) similarly reported ME achieved significant reduction in pain at week 4 of a study involving individuals with CMLBP. However, groups' PI was not significantly reduced at week 8, in agreement with findings of a similar study on combined exercises (Abdelaziz et al., 2019). The fact that CMLSEG recorded similar improvement in PI at week 8 could be a confirmation of suspected prevalence of instability among the participants because LSE which was carried out in the last 3 weeks of treatment by the group is credited with reactivation and strengthening of weak stabilisers, especially in the presence of lumbar spine instability. Abdelaziz et al. (2019) carried out a study that compared CMLSE with LSE, and reported no significant difference in PI at week 8 of study. The finding of this study on effects of CMLSE on PI is in line with the reported outcome of previous studies on combined exercise (Koumantakis et al., 2005; Searle et al., 2015), and ME compared with LSE (Halliday et al., 2016; Bid et al., 2018) not resulting in significant reduction of PI at end of 8 week of study. This is in agreement with the submissions of van Middelkoop et al. (2010) that various studies failed to establish the superiority of one form of exercise over another, even though exercise therapy is still recognized as the best form of pain treatment in CMLBP (Lizier et al., 2012). Most available literature on combined exercise involved LSE with different types of exercise (Koumantakis et al., 2005; Cairns et al., 2006; Javadian et al., 2012) and the results were unimpressive, while only Abdelaziz et al. (2019) combined ME, it could be inferred that CMLSE is not effective in reducing PI than ME or LSE in CMLBP.

The three types of exercise effectively reduced functional disability, but MEG had more significantly reduced functional disability at end of weeks 4 and 8 than CMLSEG and LSEG, thus supporting literature evidence in favour of ME in CMLBP (Mohan et al., 2015; Abdelaziz et al., 2019). Mohan et al. (2015) compared between ME and LSE, and reported significant reduction of FD in the MEG. Similarly, Abdelaziz et al. (2019) recorded significant reduction in FD in comparison with CMLSEG at the end of eight weeks of study. The finding of this study is not in agreement with findings of Halliday et al. (2016) and Alhakami et al. (2019). In a study by Halliday et al. (2016), the reduced FD between MKE and LSE in an 8-week study on CMLBP was not significantly different. Alhakami et al. (2019) in literature review similarly reported insignificant difference in the reduced FD between ME and LSE. The significant effect of ME on FD as noted in this study could be attributed to correction/ restoration of displaced intervetebral disc and surrounding structures as mentioned by Shemshaki et al (2013). McKenzie principle believe that restoration of disc related structures will enhance reduction in pain, consequent reduction in FD, and eventual resolution of psychosocial problems associated with CMLBP as reported in the study. The finding of this study is in conformity with report of systematic review on LSE in CMLBP (May and Johnson, 2008). LSE was found not superior to other forms of exercises in CMLBP with respect to reduction of pain and functional disability by the reviewers.

Psychosocial factors are real challenges associated with CMLBP that is not given much consideration in many research studies, and literature evidence identified fear-avoidance beliefs (FAB) as a critical factor contributing to the occurrence-cum-perpetuation of CMLBP (Leeuw et al., 2007; Karayannis et al., 2012). According to Leeuw et al. (2007), the fear of pain leads to aggravated pain that graduate to chronic pain, and eventual functional disability. Chronic pain and associated functional disability are countered by ME and LSE through conquering fear of pain and pain avoidance behaviours, and the resultant effects is reduction in PI and FD post-intervention. The across-group comparisons conducted at week 4 revealed fear avoidance beliefs was significantly reduced in MEG than CMLSEG. Similarly, LSEG had significantly reduced fear avoidance beliefs than CMLSEG at week 4, but only MEG recorded across-groups' reduction in fear avoidance beliefs (work subscale) at end of the 8-week study. The finding compare favourably with the findings of systematic reviews by Karayannis et al. (2012) and Kuhnov et al. (2020) on the influence of LSE and ME on FABPA. Karayannis et al. (2012) submission that LSE effectively reduces fear avoidance beliefs is corroborated by Hodges et al.'s (2020) reports that activation of stabilising muscles promotes reduction in FAB and consequently encourages increased physical activities. The review by Kuhnov et al (2020) submitted that ME is associated with improvement in FAB in CMLBP, which is in accord with similar report of positive association, in form of improvement, between FAB and ME (Werneke et al., 2020). Kuhnow et al. (2020) reported that ME is associated with improved pain self- efficacy, reduced FAB, countering depressed emotion, and distresses common to CMLBP. The study's report furher corroborates Bid et al. (2018) report on how ME effectively reduces PI, FD, and FAB in CMLBP, thus supporting the earlier submissions that FD, pain, and psychosocial variables will improve once the mechanical dysfunction in CMLBP is corrected by ME (Clare et al., 2005; Koes et al., 2006). McKenzie exercise could have enbolden individuals to confront pain and FD by first overcoming fear of movement with resultant evidential reduction in PI and FD (Kuhnov et al., 2020).

Airaksinen et al. (2006) in one of the treatment guidelines for CMLBP recommended researches on the use of individual and combined exercise to promote the development and promotion of varieties of effective exercise regimen. It could be inferred from this study that CMLSE is not more effective in reducing pain, functional disability, or fear-avoidance beliefs than ME or LSE in CMLBP. The finding corroborates the submission of previous studies on combined exercise (Koumantakis et al., 2005; Javadian et al., 2012; Searle et al., 2015; Abdelaziz et al., 2019). This could be attributed to the short duration of the constituent exercises (ME- 5weeks; LSE-3 weeks), the difficulty of mastering the abdominal draw-in technique in LSE until second or third visits by most participants, and the uncertainty of presence or absence of lumbar spine instability among participants. Alhough ME could have helped correct the root cuase of LBP in CMLSEG, the introduction of some aspect of LSE that involve arching the back could have nullified the initial gain. Also, the delayed introduction of LSE in been carried out along with ME from the onset could have enhanced further muscle inhibition at the segmental level resulting in delayed recovery. Each of Koumantakis et al. (2005) and Javadian et al. (2012) concluded that LSE will be an effective treatment (and when combined with other form of exercise) in individuals with CMLBP presenting with clinical symptoms consistent with lumbar spine instability. However, CMLSE could not be totally rejected because the comparison of mean changes between the three groups revealed no significant difference. This prove that the CMLSE was still effective in CMLBP as reported in the within group analysis, but not better than the other groups of exercises in improving the symptoms of CMLBP.

5.6 Clinical implications of findings

The study's outcome revealed CMLSE, ME, and LSE are all effective in improving psychosocial and clinical variables (FAB, PI and FD) of individuals experiencing CMLBP. However, CMLSE is not more effective than ME in producing better treatment outcomes in CMLBP. While the three modes of exercise have similar effect on pain, ME is more effective in reducing FD and FAB than CMLSE in CMLBP. Combined McKenzie and Lumbar stabilisation exercise in individuals with CMLBP as a result of posterior derangement syndrome did not produce/result in better outcomes in term of reduced FD and FABW. This study has demonstrated the effectiveness of ME in restoring function and reducing fear of work-related activities that are prominent complaints of individuals with CMLBP in addition to pain.

CHAPTER SIX

SUMMARY, CONCLUSIONS, AND RECOMMENDATIONS

6.1 Summary

Chronic mechanical low back pain (CMLBP) is a musculoskeletal menace that is commonly associated with psychosocial symptoms. It is a global health challenge with huge financial demand and associated socio-economic cost to the individuals and society at large. There is no known cure, but management based on severity and response to treatment comprises conservative approach, non-conservative approach, and combination of both approaches. Exercise therapy is recognized as the most effective conservative modality and at lesser cost to the individuals, though none of the different exercises is known to possess superior effect due to heterogeneous population of individuals with CMLBP involved in most studies. Classification based approach was recommended to solve the dilemma of appropriate exercise to used in CMLBP, and both McKenzie exercise and lumbar stabilisation exercise were identified as meeting the classification criteria. Though studies have shown the effectiveness of each exercise in CMLBP, there were recommendations to research on combining the exercises because McKenzie exercise is believed to address likely cause of initial pain, lumbar stabilisation exercise is used to reactivate weakened stabilisers as a result of pain and muscular de-conditioning, while neither of the two exercise can produce combined aforementioned effects, and the effects of the two exercises on psychosocial variables are mostly overlooked in studies. The comparative effects of 8-week Combined McKenzie exercise and lumbar stabilisation exercise, McKenzie exercsie, and lumbar stabilisation exercise on psychosocial and clinical variables of individuals with CMLBP were investigated.

The literature review considered definition, aetiology, epidemiology, classification, and predisposing factors for CMLBP. The anatomy of the back, models in LBP, as well as psychosocial factors in CMLBP were also reviewed. Management of the condition, especially the two exercise of interest, was extensively discussed. The review concluded on justification for the study based on identified lacuna from numerous studies on the two exercise regime.

A pre-test/ post-test randomised controlled trial was performed. Ethical approvals were acquired from the Health Research Ethics Committee of University of Ibadan/ University College Hospital (Ref No. No UI/EC/17/0076), Ethical Committee of LAUTECH Teaching Hospital Ogbomoso (Ref No. LTH/OGB/EC/2016/135), and Research Ethics Committee of former LAUTECH Teaching Hospital Osogbo (Ref No. LTH/EC/2017/07/328). Participants consentented to partake in the study after explaining the rationale and procedure to them. One hundred and seventy-nine individuals who met the inclusion criteria were consecutively recruited through first contact or referrals to the physiotherapy departments of three the study centres, namely LAUTECH Teaching Hospital Ogbomoso, Uniosun Teaching Hospital (former LAUTECH Teaching Hospital) Osogbo, and State specialist Hospital Osogbo. Diagnoses of posterior derangement syndrome based on McKenzie Institute Lumbar Spine Assessment Format were established. Participants were randomly and consecutively allocated to the three exercise groups; combined ME and LSE group (CMLSEG), McKenzie exercise group (MEG), and Lumbar Stabilisation exercise group (LSEG). CMLSEG had 48 participants; LSEG had 47 participants, and MEG had 47 participants. Participants in MEG had 8-week McKenzie exercise comprising exercise in prone lying position, prone lying in extension, sustained extension on pillow, extension in prone lying postiton, and extension in standing. LSEG participants had 8-week of LSE consisting of local, closed chain, and open chain segmental controls. The CMLSEG participants had 5-week of MKE followed by 3-week LSE to complete an 8-week therapy. All participants had a pre-treatment warm up period, individualised exercise therapy session, post-exercise massage of the painful back, and home exercise programme peculiar to each treatment group during the period of the study, in addition to back care instruction leaflet given to each individual. Treatment was twice weekly

Participants' pain, functional disability and fear avoidance beliefs were assessed using Quadruple Visual Analogue Scale, Oswestry Disability Questionnaire, and Fear Avoidance Beliefs Questionnaire, respectively. Also, the activation and strengthening of the stabilisers were assessed using the Pressure Biofeedback Unit, and the timing of contraction was assessed using stop watch. Data were analyzed using descriptive statistics of mean and standard deviation, as well as inferential statistics of analysis of variance (ANOVA), Repeated measures ANOVA, analysis of Co-variance (ANCOVA) at 0.05 alpha level, and post-hoc multiple comparisons with Bonferroni test.

The age, weight, height, and BMI of participants were 53.00±12.00 years, 72.4±14.5 kg, 1.7±0.1 m, and 27.1±5.1 kg/m^2, respectively. An attrition rate of 26.95% was observed in the study. The three groups were comparable in age, physical characteristics and baseline outcomes, except baseline functional disability. The baseline functional disability was subjected to Analysis of Co-variance (ANCOVA) to correct the observed difference. Across-group comparisons at the end of week 4 revealed both MEG and LSEG compared to CMLSEG had significantly reduced pain scores (28.87±13.73, 26.01±14.79, 37.64±14.58), functional disability scores (14.47 ±10.62, 15.54 ±12.36, 22.94 ±11.76), fear avoidance beliefs scores to physical activity (10.85 ±2.08, 11.32 ±3.79, 13.46 ±3.16), and work (8.02 ±6.03, 8.98 ±9.13, 15.02 ±11.08). At the end of week 8, across-group comparisons revealed MEG had significantly reduced functional disability score (3.04 ±4.07) than LSEG (6.36 ±8.40) and CMLSEG (7.57±6.74), and fear avoidance beliefs to work score (0.45 ±1.02) than LSEG (2.80 ±6.85) and CMLSEG (3.98 ±4.39). At the end of week 8, groups' were not significantly different in pain scores (8.80±7.11, 14.13±14.68, 13.19±8.58) and fear avoidance beliefs score to physical activity (6.70±1.77, 8.53±4.23, 8.67±5.74) for MEG, LSEG, and CMLSEG, respectively.

Extensive discussion on obtained results from this study were analysed by juxtaposing with the findings of similar studies on CMLBP. The appropriate literature to explain the results of this study were also cited. Literature evidence and clinical reasoning were adduced as reasons for the results obtained.

6.2 Conclusions

The conclusions drawn from the findings of this study are as follow:

1. Iindividually, each exercise regimen achieved reduction in fear avoidance beliefs, pain intensity, and functional disability

2. Combined ME and LSE recorded similar improvement on pain in individuals with CMLBP when compared with ME and LSE.

3. Combined ME and LSE did not show better improvement on disability in individuals with CMLBP than ME and LSE.

4. Combined ME and LSE did not show better improvement in fear avoidance beliefs to work in individuals with CMLBP than ME and LSE.

5. McKenzie exercise showed better effects in reducing functional disability in individuals with CMLBP than either LSE or combined ME and LSE.

6. McKenzie exercise showed better effects in reducing fear avoidance belief to work in individuals with CMLBP than either LSE or combined ME and LSE.

6.3 Recommendations

The following recommendations were derived findings of this study

1. Physiotherapists are encouraged to use ME in the management of individuals with CMLBP presenting with posterior derangement syndrome.

2. Future research to find out the influence of the three exercise regimes on CMLBP individuals with clinical signs of lumbar instability is recommended.

3. Future studies to find out the influence of the three exercise regimes on individuals with CMLBP presenting with both posterior derangement and lumbar instability is further recommended.

4. Future research to include follow up period aimed at investigating sustained improvement or recurrent/ relapse in symptoms after the 8-week intervention is also recommended.

5. Future research to find out what point/ period of effectiveness of exercise resulted in drop-outs.

6.4 Contributions to knowledge

1. McKenzie exercise is provides better resolution of functional disability and fear-avoidance belief to work associated with chronic mechanical low back pain in individuals presenting with posterior derangement in the lumbar spine.

2. Combined exercise has no added benefit when treating chronic mechanical low back pain that is as a result of posterior derangement.

REFERENCES

Abdelaziz, N.G., Ahmed, G.M., Ramzy, G.M. and Rezk, M.Y.E. 2019. The effects of McKenzie assessment and treatment method on patients with chronic low back pain with radiculopathy. *International Journal of Health sciences*, 7(1): 7-17.

Abenhaim, L., Rossignol. M., Valat, J.P., Nordin, M., Avouac, B., Blotman, F.,Charlot, J., Dreiser, R.L., Legrand, E., Rozenberg, S. and Vautravers, P. 2000. The role of activity in the therapeutic management of back pain. Report of the international Paris task force on back pain. *Spine*, 25;pp 1S-33S

Abhijit, D., Anjali. S. and Simson, K.S. 2015. A comparative study to find out the effectiveness between core stabilisation and McKenzie exercises in the treatment of patients with mechanical low back pain. *International Journal of Physiotherapy*. Vol. 2(5).doi.org/10.15621/ijphy/2015/73236. Accessed on 15-05-2020

Adedoyin, R.A., Idowu, B.O., Adagunodo, R.E. and Idowu, P.A. 2005. Musculoskeletal pain associated with the use of computer systems in Nigeria. *The Internet Journal of Pain, Symptoms control and Palliative care*. 3(2): ISSN: 1528-8277.

Adegoke, B.O.A., Akodu, A.K. and Adewale, A.L. 2008. Work-related musculoskeletal disorders among Nigerian Physiotherapists. *BMC Musculoskeletal Disorders*. 9:11-12

______________ , Odole. C.O. and Adeyinka, A.A. 2015. Adolescent low back pain among secondary school students in Ibadan, Nigeria. African Health Sciences,15(2):429-437

Aderibigbe, O.I. 2017. Effects of McKenzie and Lumbar Stabilisation protocols on sexual dysfunction in patients with chronic mechanical low back pain. A thesis in the Department of Physiotherapy, College of Medicine, University of Ibadan.

Aina, A., May, A. and Clare, H. 2004. The centralization phenomenon of spinal symptoms-systematic review. *Manual Therapy*, 9(3): 134- 143.

Airaksinen, O., Brox, J.I., Cedraschi, C., Hildebrandt, J., Klaber-Moffet, J. and Kovacs, F. 2006. European guidelines for the management of chronic non-specific low back pain, Chapter 4. *European Spine Journal*, 15(2): S192-300.

Akhtar, M.W., Karimi, H. and Gilani, S.A. 2017. Effectiveness of core stabilisation exercise and routine exercise therapy in the management of pain in chronic non-specific low back pain. A RCT. *Pakistan Journal of Medical sciences*. 33(4): 1002-1006.

Akodu, A.K..2014. Effects of stabilisation exercise on pain, cross-sectional area and muscle thickness of lumbar multifidus in patients with chronic low back pain. A thesis submitted to the postgraduate studies, University of Lagos library. Accessed on 20/ 07/ 2022.

_________., Akinbo, S.R.A. and Odebiyi, D.O. 2015. Effects of stabilisation exercise on pain and disability in patients with non-specific chronic low back pain. *Indian Journal of Physical Therapy and Occupational Therapy*, 9(2): 175-180.

__________., Tella, B.A. and Olujodi, O.D. 2015. Effects of stabilisation exercise on pain and quality of life of patients with non-specific chronic low back pain. *African Journals of Physiotherapy and Rehabilitation Sciences*, 7(1&2): 7-11.

Akosile, C.O., Nwakwo, E.I., Johnson, O.E. and Raji, F.S. 2006. Comparative effect of different McKenzie extension- based protocols on spinal flexibility of low back pain patients. *Journal of the International Council for Health Physical education, Recreation Sport and Dance* 1: 14-18.

Ali, S., Ali, S.M. and Memon, K.M. 2013. Effectiveness of core stabilisation exercises versus McKenzie's exercises in chronic lower back pain. *WHO Medical Forum Monthly*, 24(12): 82-85

_____., Sayaid, A.G., Keranat, K.U. and Darian. H. 2017. Chronic low back pain: effects of the lumbar stabilisation exercises on pain, range of motion, and functional disability in the management. *Professional Medical Journal*, 24 (4): 526-533.

Alghadir, A.A., Awer, S., Igbai, A. and Igbai, Z.A. 2018. Test-retest reliability, validity, and detectable change of Visual analogue, numerical rating, and verbal rating scales for measurement of osteoathritic knee pain. *Journal of Pain Research*, 11:851- 856.

Alhakami, A.M., Davis, S., Quasheesh, M., Shaphe, A. And Chahal, A. 2019. Effects of Mckenzie and Stabilisation exercises in reducing pain intensity and functional disability in individuals with non- specific chronic low back pain; a systematic review. *Journal of Physical Therapy Science (*31) 7:590- 597.

Alzubeidi, S.A., Alfawaz, A.A., Algharaw, I.M., Alrashidi, A.A., Alamrani, N. and Alsayed, A. 2020. The effectiveness of stabilisation exercises in treating patients with chronic low back pain; a systematic review. *Asian Journal of Orthopaedic Research*, 3(2): 30-46

American Physical Therapy Association (A.P.T.A.). 2001. Guide to Physical Therapist Practice. 2nd Edition. Physical Therapy; 81:009-746.

Anderson, J.C. 2011. Is immediate imaging important in managing low back pain? *Journal of Athletic Training*, 46(1): 99-102.

Araora, L., Araoara, R., Singh, J. and Kaur, H. 2012. A single (investigator) blind RCT comparing McKenzie exercise and lumbar stabilisation exercise in chronic low back pain. *European Journal of Experimental Biology*, 2(6): 2219-2228. Accessed on 15/07/22.

Ayanniyi, O., Lasisi, O.T., Adegoke, B.O.A. and Oni-Orisan, M.O. 2007. Management of low back pain: attitude and treatment preferences of physiotherapists in Nigeria. *African Journal of Biomedical Research*, Vol. 10; 41-49.

___________, Mbada, C.E. and Muolokwu, C.A. 2011. Prevalence and profile of back pain in Nigerian adolescents. *Medical Principles and Practice*, 20(4): 368–373.

___________, Nudamajo, O.S. and Mbada, C.E. 2016. Pattern of work-related musculoskeletal disorders among Nigerian Hospital Workers. *Journal of Environmental and Occupational Science*. 5(1): 18-24.

Balague, F., Mannion, A.F., Pellise, F. and Cedraschi, C. 2011. Non-specific low back pain. *The Lancet*, 379(9814): 482-491. www.thelancet.com/journal. Accessed on 09-09-15

_________ and Dudler, J. 2011. An overview of conservative treatment for back pain. *International Journal of Clinical Rheumatology*. 6(3):281-290.

Bandura, A. 1997. Self-efficacy: toward a unifying theory of behavioural change. *Psychological Revolution*, 84:191-215.

Bello, B. and Adeniyi, A.F. 2018. Effects of lumbar stabilisation and treadmill exercise on function in patients with chronic mechanical low back pain. *International Journal of Therapy and Rehabilitation*, 25(9): 493-499.

Bid, D.D., Soni, C.C., Yadan, A.S. and Rathod, P.V. 2018. The effects of McKenzie exercise in Chronic low back pain patients with central sensitization. A RCT. *Physiotherapy*-The Journal of Indian association of Physical Therapists, 12(1): 37-42.

Blenkiron, P. 2013. Cognitive Behavioural Therapy. Leaflet Department, Royal College of Psychiatrists, 21 Prescott Street, London.

Boucher, J.A., Preuss, R., Henry, S.M., Dumas, J.P. and Lariviere C. 2016. The effects of an 8-weeks Stabilisation exercise programme on lumbar movement sense in patients with low back pain. *BMC Musculoskeletal Disorders*, 17:pp23.DOI: 10.1186/s12891-016-0875-4. Accessed on 16-01-2016

Bratton, R.L. 1999. Assessment and management of acute low back pain. *American Family Physician*, 15(60): 2299-2306.

Bronfort, G., Maiers, M.J., Evans, R.L., Schulz, C.A., Bracha, Y., Svendsen, K.H. Grimm, R.H., Owens, E.F., Garvey, T.A. and Transfeldt, E.E. 2011. Supervised exercise, spinal manipulation, and home exercise for chronic low back pain: a randomised clinical trial. *The Spine Journal*, 11:585-598.

Brumitt, H.J., Matheson, J.W. and Meira, E.P. 2013. Core stabilisation exercise prescription, Part 1. *Sports Health*, 5(6): 504- 509.

Bruno, P. 2014. The use of Stabilisation exercises to affect neuromuscular control in the lumbo-pelvic region. *The Journal of the Canadian Chiropractic Association*, 52(2): 119-130.

Burton, A,K., Waddell, G., Tillosten, K.M. and Summerton, N. 1999. Information and advice to patients with back pain can have a positive effect: a randomised controlled trial of a novel educational booklet in primary care. *Spine,* 24: 2874-2879.

Bystrom, M.G., Rasmussen-Barr, E. and Grooten, W.J. 2013. Motor control exercises reduce pain and disability in chronic and recurrent low back pain: a meta-analysis. *Spine*, 38(6):350-358.

Cairns, M.C., Foster, N.E. and Wright, C. 2006. Randomised control trial of specific spinal stabilisation exercises and conventional physiotherapy for recurrent low back pain. *Spine*, 31(19):ppE670-E681. Doi:10.107/01.brs.0000023278771938.5d. Accessed 0n 21-04-2020.

Carey, M.P. and Forsyth, A.D. 2016. Self-Efficacy. American Physiological Association. 750 First St. NE, Washington, DC.

Chang, W.D., Lin, H.Y. and Lai, P.T. 2015. Core strength training for patients with chronic low back pain. *Journal of Physical Therapy Science*, 27(3): 619–622.

Chen, J. 2016. Cognitive Behavioural Therapy for Social Anxiety Disorders. A workshop paper by the Australian Association of Cognitive Behavioural Therapy.

Childs, J., Fritz, J., Flynn, T., Irgang, J., Johnson, K., Majkowski, G., and Delitto, A. A. (2004): A clinical prediction rule to identify patients with low back pain most likely to benefit from spinal manipulation: a validation study. *Annals of Internal Medicine*, 141(12): 920-938.

Chiodo, H.E., Alvarez, D.J., Graziano, G., Haig, A.J., Van Harrison, R., Park, P. and Standiford D.J. 2011. Acute Low back pain: guidelines for clinical care ambulatory. Quality Management Programme, University of Michigan. Pp1-14.

Chou, R., Qaseem, A., Snow, V., casy, D., Cross, J.T., Shekelle, P. and Owens, D.K. 2007. Diagnosis and Treatment of Low Back Pain: A Joint Clinical Practice Guideline from the American College of Physicians and the American Pain Society. *Annals of Internal Medicine* , 147(7):478-491.
_______ 2011. Low Back Pain (chronic). *Physician*, 84(4): 437-438.

Clare, H.A., Adams, R. and Maher, C.G. 2004a. Reliability of the McKenzie spinal pain classification using patient assessment forms. *Physiotherapy*, 90(3): 114-119.

___________________________________2004b. A systematic review of efficacy of McKenzie therapy for spinal pain. *Australian Journal of Physiotherapy*, 50.

____________________________________2005: Reliability of the McKenzie classification of patients with cervical or lumbar pain. *Journal of Manipulative Physiological Therapy*, 28:122-127.

Costa, L.O.P., Maher, C.G., Latimer, J., Hodges, P.W., Herbert, R.D., Refshauge, K.M., McAuley, J.H. and Jennings, M.D. 2009. Motor control exercise for chronic low back pain: a randomised placebo-controlled trial. *Physical Therapy*, 89(12).DOI:10:2522/ptj.20090218. Accesed on 14-02-2020, Critchley, D.J., Ratcliffe, J., Noonan, S., Jones, R.H. and Hurley, M.V. 2007. Effectiveness and cost-effectiveness of three kinds of physiotherapy commonly used to reduce disability in Chronic Low Back Pain: a pragmatic randomised trial with economic evaluation. *Spine,* 32(14): 1474-1481.

Czajka, M., Truszczynska, A. and Kowalczyk, M. 2018. The effectiveness of McKenzie method in diagnosis and treatment of low back pain – a literature review. *Advances in Rehabilitation,* (1):5- 11.

Daneels, L.A., Vanderstraeten, G.G., Cambier, D.C., Witvrouw, E.E., Bourgois, J., Dankaerts, W. and De Cuyper, H.J. 2001. The effects of three different training modalities on the cross-sectional area of paravertebral muscles. *Scandinavian Journal of Science and Sports,* 11: 335- 341.

Delitto, A., Erhard, R.E., Bowling, R.W., DeRosa, C.P. and Greathouse, D.G. 1995. A treatment-based classification approach to low back syndrome: identifying and staging patients for conservative treatment. *Physical Therapy*. 756:470-485.

_______, George, S., Dillen, L.V., Whitman, J.M., Sowa, G., Shekelle, P., Denninger, T.R. and Godges, J.J. 2012. Low Back Pain. Clinical Practise Guidelines linked to the ICF: Disability & Health from Orthopaedic section of *APTA Journal of Sports Physical Therapy*, 42(4): ppA1-A51.

de Wet, A. 2003. Low back pain in the corporate workplace – a South Africa review. M.Sc dissertation in the Department of Chiropractic at the Technikon Witwatersrand. South Africa. pp01-108

Dienye, P.O., Birabi, B.N., Diete-Spiff, K.O. and Dienyae, N.P. 2015. The burden of low back pain among fishermen. A survey in a rural fishing settlement in Rivers state Nigeria. *American Journal of Men's Health*.doi:10-1177/155798315584375

Dreisinger, T.E. 2007. McKenzie Therapy for mechanical low back pain. Spine-health. www.spine-health.com. Accessed on 04-04-16

Dunn, K.M. and Croft, P.R. 2004. Epidemiological and natural history of low back pain. *Europa Medicophysica*, 40(1):9-13.

Dunsford, A., Kumar, S. and Clarke, S. 2011. Integrating evidence into practice: use of McKenzie based treatment for mechanical low back pain. *Journal of Multidisciplinary Healthcare*, 4: 393-402.

Duque, I., Parra, J.H. and Duvallet, A. 2009. Physical deconditioning in chronic low back pain. *Journal of Rehabilitation Medicine*, 41(4): 262-266.

Edomwonyi, E.O. and Ogbue, I.A. 2017. Epidemiology of Low back Pain in a suburban Nigerian tertiary centre. *Nigerian Journal of Medical Sciences,* 27(1): 20-25.

Ehrlich, G.E. 2003. Low Back Pain. Bulletin of the World Health Organisation. 81:9. Pp671-676

Enoka, R.M. 1997. Neural adaptations with chronic physical activity. *Journal of Biomechanics,* 30: 447- 455.

Eyichukwu, O. and Ogugua, P.C. 2012. Epidemiology of low back pain in Enugu, Nigeria. *Nigerian Journal of Orthopaedic and Trauma*, 11(1).

Fabunmi, A.A., Oworu, J.O. and Odunaiya, N.E. 2008. Prevalence of Musculoskeletal Disorders among Nurses in University College Hospital, Ibadan. West African *Journal of Nursing*. 19(1):21-25.

Fairbank, J. and Pynsent, P.B. 2000. The Oswestry Disability Index. *Spine,* 25.22: 2940–2952.

Fapojuwo, O.A. 2015. Comparative efficacy of McKenzie and Back-to-fitness protocols on selected clinical and psychosocial variables in patients with chronic mechanical low back pain. A thesis in the department of Physiotherapy, College of Medicine, University of Ibadan in partial fulfilment of the requirements for the award of Doctor of Philosophy degree.

Ferreira, P.H., Ferreira, M.L., Macer, C.G., Herbert, R.D. and Refshauge, K. 2006. Specific Stabilisation exercise for spinal and pelvic pain. A systematic review. *Australian Journal of Physiotherapy*, 52:79-88.

______, M.L., Rob, J.E.M., Kamper, S.J., Ferreira, P.H. and Machado, L.A.C. 2010. Can we explain heterogeneity among randomised clinical controlled trials of exercises for chronic back pain? A meta-regression analysis of randomised controlled trials. *Physical Therapy*,9(10). DOI:10.2522/ptj/20090332. Accessed on 14-02-20.

Filho, N.M., Santos, S. and Rocha, R.M. 2008. Long term effect of a stabilisation exercise for chronic low back pain. *Manual Therapy*. 1-4. www.researchgate.net/ publications. Accessed on 17-06-2015.

Flynn, T., Fritz, J., Whitman, J., Wainner, R., Magel, J., Rendeiro, D. and Allison, S. 2002. A clinical prediction rule for classifying patients with low back pain who demonstrate short-term improvement with spinal manipulation. *Spine,* 27(24): 2835–2843.

Franca, R.F., Burke, T.N., Hanada, E.S. and Marques, A.P. 2010. Segmental stabilisation and muscular strengthening in chronic low back pain – a comparative study. *Clinics,* 65(10): 1013- 1017.

Fritz, J.M., Delitto, A., and Erhard, R.E. 2007. Comparison of classification-based physical therapy with therapy based on clinical practice guidelines for patients with acute low back pain: a randomised clinical trial. *Spine,* 28:1363-1372.

_______, Cleland, J.A. and Childs, J.D. 2007. Subgrouping patients with low back pain; Evolution of a classification approach to Physical therapy. *Journal of Orthopaedic and Sports Physical Therapy,* 37 (6): 290- 302.

Garcia, A., Menezes Costa, L.C, Hancork, L.J., de Almeda, M.O., de Souza, F. and Pena Costa, L.O. 2018. Reliability of the MDT system in patients with spinal pain. A systematic review. *Journal of Orthopaedic Sports Physical Therapy*, 48(12): 923-933

Gatchel, R.J., Neblett, R., Kishino, N. and Ray, C.T. 2016. Fear-avoidance beliefs and chronic pain. *Journal of Orthopaedic and Sports Physical Therapy,* 46(2): 38-43.

George, S.Z., Teyhen, D. S., Wu, S. S., Wright, A. C., Dugan, J. L., Yang, G. and Childs, J.D. 2010. Psychosocial education improves low back pain beliefs: Results from a cluster randomised clinical trial (NCT00373009) in a primary prevention setting. *European Spine Journal*, 18(7): 1050–1058.

Green, B.N., Johnson, C.D., Snodgrass, J., Smith, M. and Dunn, A.S. 2016. Association between smoking and back pain in a cross-section of adult Americans. *Cureus Journal of Medical Science*, 8(9): e806.

Grotle, M., Vollestad, N.K. and Brox, J.I. 2006. Clinical course and impact of fear-avoidance beliefs in low back pain: prospective cohort study of acute and chronic low back pain II. *Spine*, 20(31): 1038-46.

Hagen, E.M., Svensen, E. and Eriksen, H.R. 2005 Predictors and modifiers of treatment effect influencing sick leave in subacute low back pain patients. *Spine*. 30:2717-2723

Hagins, M., Adler, K., Cash, M., Daugherty, J. and Mitrani, G. 1999. Effects of practice on the ability to perform lumbar stabilisation exercise. *Journal of Orthopaedic and Sports Physical Therapy*, 29(9): 544- 551.

Haladay, D.E., Miller, S.J., Challis, J. and Denegar, C.R. 2013. Quality of systematic reviews on specific spinal stabilisation exercise for chronic low back pain. *Journal of Orthopaedic Sports Physical Therapy*, 43(4): 242-250.

Halliday, M.H., Pappas, E., Hancock, M.J., Clare, H.A., Pinto, R.Z., Robertson, G. and Ferreira, P.H. 2016. A Randomised Controlled Trial Comparing the McKenzie Method to Motor Control Exercises in People With Chronic Low Back Pain and a Directional Preference. *Journal of Orthopaedic and Sports Physical Therapy*, 46(7): 514-522.

Halliday, M.H., Garcia, A.N., Amorim, A.B., Machad G.C., Hayden, J.A., Pappas, E, Ferreira, P.H. and Hancock, M.J. 2019. Treatment effects of Mechanical Diagnosis and Therapy for pain and disability in patients with low back pain: A systematic review. *Journal of Orthopaedic and Sports Physical Therapy*, 49(4): 219- 229.

Hasaneen, B.H., Eweda, R.S.A. and Hakim-Balba, A.E.A. 2018. Effects of the suboccipital muscle inhibition technique on pain intensity, range of motion, and functional disability in patients with chronic mechanical low back pain. Springerlink. Bulletin of Faculty of Physical Therapy, 23: 15-21

Hasanpour-Dehkordi, A., Dehghani, A. and Solati, K. 2017. A comparison of the effects of Pilates and McKenzie training on pain and general health in men with chronic low back pain: A randomised trial. *Indian Journal of Palliative Care*, 23:36-40.

Hayden, J.A., van Tulder, M.W., Malmivaara, A. and Koes, B.W. 2005. Meta analysis: Exercise therapy for treatment of non-specific low back pain. Annals of Internal Medicine, 142(9): 765-775.

Hebert, J.J., Koppenhaver, S.L., Magel, J.S. and Fritz, J.M. 2010. The relationship of transversus and lumbar multifidus activation and prognostic factors for clinical success with a stabilisation exercise program: a cross-sectional study. *Archives of Physical Medical Rehabilitation*, 91(1): 78-85.

____________________________, and Walker, B.F. 2011. subgrouping patients with low back pain: A treatment-based approach to classification. *Sports Health*, 3(6): 534-542.

Hedayati, R., Kahrizi, S., Parnionpuor, M. and Bahrami, F. 2015. Stabilisation exercises and their effect on Fear avoidance beliefs in patients with recurrent Non-specific low back pain. *Koomesh Journal*, 17(1): 142-151. Researchgate.net. Accessed on 20/11/2022.

Hepple, P. and Robertson, A.R. 2006. Back pain reducing long-term problems. *British Journal of General Practise*, 56(526): 324-326.

Hicks, G.E., Fritz, J.M., Delitto, A. and McGill, S.M. 2005. Preliminary development of a Clinical Prediction Rule for determining which patients with low back pain will respond to a stabilisation exercise programme. *Archives of Physical Medicine and Rehabilitation*, 86(9): 1753-1762.

Hochscholer, S.H. 2008. Back pain risk factors; what can increase the potential for back problems? Spine-health. www,spine-health.com 3.15.042-3.15.011. Accessed 04-04-16.

Hodges, P.W. and Richardson ,C.A. 1996. Inefficient muscular stabilisation of the spine associated with low back pain; a motor control evaluation of Transversus abdominis. *Spine*, 21(22): 2640-2650.

________________________________. 1999. Altered trunk muscle recruitment in people with low back pain with upper limb movement at different speeds. *Archives of Physical Medicine and Rehabilitation*, 80(9): 1005-1012.

_____________ and Danneels, L. 2019. Changes in structure and function of the back muscles in Low Back Pain: different time points, observations, and mechanisms. *Journal of Orthopaedic & Sports Physical Therapy*, 49(6): 464-476.

Hosseinifar, M., Akhari, M., Behtash, H., Amiri, M. and Sarrafzadeh, J. 2013. The effects of Stabilisation and McKenzie exercises on transversus abdominis and multifidus thickness, pain, and disability: a randomised controlled trial in Non-specific chronic low back pain. *Journal of Physical Therapy Science*, 25(12): 1541-1545.

Hoy, D., Bain, C., Williams, G., March, L., Brooks, P., Blyth, F., Woolf, A., Vos, T. and Buchbinder, R. 2012. A systematic review of the global prevalence of low back pain. *Arthritis and Rheumatology*, 64(6): 2028- 2037.

_____, March, L., Brooks, P., Blyth, F., Woolf, A., Bain, C., Williams, G., Smith, E., Vos, T., Barendregt, J., Murray, C., Buirstein, R. and Buchbinder, R. 2014. The global burden of low back pain: estimates from the Global Burden of Disease 2010 study. *Annals of the Rheumatic Diseases*, 73: 968- 974.

Institute of Health Economics (I.H.E). 2009. Guidelines for the evidence-informed primary care management of low back pain. Pp1-21.www.topalbertadoctors .org Accessed on 04-10-15.

International Association for the Study of pain (I.A.S.P). 2010. Low Back Pain. Pain *Clinical Updates*, 28(6):1-6. IASP, Seattle, USA.

Jacobs, G. 2003. Biopsychosocial perspectives on low back pain; patient provider communications. *Journal of Invasive Spinal Technology,* 3: 27- 35.

Javadian, Y., Behtash, H., Akbari, M., Taghipour-Darzi, M. and Zekavat, H. 2012. The effects of stabilisation exercises on pain and disability of patients with lumbar segmental instability. *Journal of Basic Musculosletal Rehabilitation*, 25(3): 149- 155.

Johnson, O.E., Adegoke, B.O.A. and Ogunlade, S.O. 2010. Comparison of four physiotherapy regimens in the treatment of long term mechanical low back pain. *Journal of the Japanese Physical Therapy Association*, 13: 1-8.

Kaka, B., Ogwumike, O.O., Idowu, O.A., Odole, A.C., Saidu, A.M., fawole, H.O. and Ibrahim, M. 2015. Translation of the Fear-Avoidance Beliefs Questionnaire into Hausa language. *Global Journal of Health Science,* 7(3):116-123.

___________________, Ogunlade S.O. and Adeniyi, A.F. 2015. Effects of neck stabilisation and dynamic exercises on pain, disability and fear avoidance beliefs in patients with non-specific neck pain; a randomised controlled trial. *Archives of Physiotherapy Global Resource*, 19(3):17-29.

Kamper, S.J., Apeldoorn, A.T., Chicarotto, A., Smeets, R.J.E.M., Ostelo, R.W.J.G., Guzman, J. and van Tulder, M.W. 2015. Multidisciplinary Biopsychosocial rehabilitation for chronic low back pain: Cochrane systematic review and meta-analysis. *British Medical Journal*, 350: h444

Kankaanpaa, M., Tameila, S., Airaksinen, O. and Hanninen, O. 1999. The efficacy of active exercises in chronic low back pain. Effects on pain intensity, self-experienced disability, and lumbar fatigability. *Spine*, 24(10): 1034-1042.

Karayannis, N,V., Jull, G.A. and Hodges, P.W. 2012. Physiotherapy movement based classification approach to low back pain: comparison of subgroups through review and developer/ expert survey. *BMC Musculoskeletal Disorders*, 13(24). doi:10.1186/1471-2474-13-24. Accessed on 14-02-2020

Kasai, R. 2006. Current trends in exercise management for chronic low back pain: comparison between strengthening exercise and spinal segmental stabilisation exercise. *Journal of Physical Therapy Science*, 18(1): 97-105.

Katz, J.N. 2006. Lumbar Disc Disorders and Low-Back Pain: Socioeconomic factors and consequences. *The Journal of Bone & Joint Surgery*, 88 (suppl 2): 21 -24.

Kirkwood, B.R. and Sterne, J.A.C. 2003. Essential Medical Statistics (2ndEd). Willey Blackwell Publishing. Page 420.

Ko, K.J., Ha, G.C., Yook, Y.S. and Kang, S.J. 2018. Effects of 12 weeks lumbar stabilisation exercise and sling exercise on lumbosacral region angle, lumbar muscle strength, and pain scale of patients with chronic low back pain. *Journal of Physical Therapy Science*, 30(1): 18-22

Koes, B.W., van Tulder, M.W. and Thomas, S. 2006. Diagnosis and treatment of low back pain. *British Medical Journal*, 332(7555): 1430-1434.

Koumantakis, G.A., Watson, P.J. and Oldham, J.A. 2005. Trunk muscle stabilisation training plus general exercise versus general exercise only: Randomised controlled trial of patients with recurrent low back pain. Physical *Therapy*, 85(3): 209- 225.

Krismer, M. and van Tulder, M. 2007. Low Back Pain (non-specific). *Clinical Rheumatology*, 21(1): 77-91.

Kuhnov, A., Kuhnov, J., Ham, D. and Rosedale, R. 2020. The McKenzie method and its association with psychosocial outcomes in low back pain; a systematic review. *Physiotherapy Theory and Practise*, DOI: 10.1080/09593985.2019.171088.

Kuijpers, T., van Middelkoop, M., Rubinstein, S.M., Ostelo, R., Verhagen, A., Koes, B.W. and van Tulder, M.W. 2011. A systematic review on the effectiveness of pharmacological interventions for chronic non-specific low-back pain. *European Spine Journal*, 20(1): 40-50.

Kumar, S.P. 2011. Efficacy of segmental stabilisation exercise for lumbar segmental instability in patients with mechanical low back pain: a randomised placebo controlled cross-over study. *North American Journal of Medical sciences*, 3(10): 456-461.

Ladeira, C.E. 2011. Evidence-based practice guidelines for management of low back pain: Physical Therapy implications. *Rev Brasilia Fisioterapia*, 15(3): 190- 199.

Lam, O.T., Strenger, D.M., Chan-Fee, M., Pham, P.T., Preuss, R.A. and Robbins, S.M. 2018. Effectiveness of the McKenzie method of Mechanical Diagnosis and Therapy for treating low back pain: Literature review with meta-analysis. *Journal of Orthopaedic & Sports Physical Therapy*, 28(6): 476-490.

Last, H.R. and Hulbert, K. 2009. Chronic low back pain: Evaluation and management. *American Family Physician*, 79(12): 1067-1074.

Lariviere C, Rabhi K., Preuss, R., Coutu, M-F., Roy, N and Henry, S.M. 2022. Derivation of clinical prediction rules for identifying patients with non-acute low back pain who respond best to a lumbar stabilisation exercise program at post-treatment and sixth month follow up. *PlOS ONE*, 17(4): e0265970. Accessed on 20/07/2022.

Lederman, E. 2010. The fall of the postural-structural-Biomechanics model in Manual and Physical Therapies: Exemplified by Lower back pain. *CPDO Online Journal*, 1-4.

Leeuw, M., Goossens, M.E.J.B., Linton, S.J., Crombez, G., Boersma, K. and Vlaeyen, J.W.S. 2007. The fear-avoidance model of musculoskeletal pain: current state of scientific evidence. *Journal of Behavioural Medicine*, 30: 77–94.

Lemeunier, N., Leboeuf-Yde, C. and Gagey, O. 2012. The natural course of low back pain; a systematic clinical literature review. *Chiropractic and Manual Therapies*, 20(33). DOI 10. 1186/2045-709X-20-33. Accessed on 14-02-2020

Lizier, D.T., vas Perez, M. and Sakata, R.K. 2012. Exercises for non-specific low back pain treatment. *Revista Brasileira de Anestesiologia*, 62:6. Accessed on 14-02-2020

Long, A., Donelson, R. and Fung, T. 2011. Does it matter which exercise? A randomised control trial exercises for low back pain. *Spine*, 29: 2593-2602.

Lorimer, M.G. 2011. A new direction for the fear avoidance model? *Pain*, 152(11): 2447-2448.

Luque-Suarez, A., Diaz-Mohedo, E., Medina-Porqures, I. and Ponce-Garcia. 2012. Stabilisation exercise for the management of Low Back Pain. *INTECH Open Science*, 1: 261- 292. www.intechopen.com Accessed on 15-02-2020

Louw, Q.A., Morris, L.D. and Grimmer-Somers, K. 2007. The prevalence of low back pain in Africa; a systematic review. *BMC Musculoskeletal Disorders*, 8:105. DOI: 10.1186/1471-2474-8-105. Accessed on 14-02-2020

Machado, L.C., Maher, C.G., Herbert, R.D., Clare, H. and McAuley, J. 2005. The McKenzie method for the management of acute non-specific low back pain; design of a randomised controlled trial. *BMC Musculoskeletal Disorders*, 6; 50-55

___________, de Souza, M.V.S. and Ferreira, M.L. 2006. The McKenzie method for low back pain: A systematic review of the literature with a meta-analysis approach. *Spine*, 31(9): E254- E262.

____________, Maher, C.G., Herbert, R.D., Clare, H. And McAuley, J.H. 2010. The effectiveness of the McKenzie method in addition to first line care for acute low back pain: a randomised controlled trial. *BMC Medicine*, 8:10.DOI:10.1186/1741-7-15-8

Maher, C.G. 2004. Effective physical treatment for chronic low back pain. *Orthopaedic Clinician of North America*, 35(1): 57-64.

Manek, N.J. and MacGregor, A.J. 2005. Epidemiology of back disorders: prevalence, risk factors, and prognosis. *Current Option in Rheumatology*, 17: 134-140.

Mannion, A.F., Junge, A., Taimela, S., Müntener, M. and Dvorak, J. 2001. Active therapy for chronic low back pain, part 3: factors influencing self-rated disability and its change following therapy. *Spine*, 26: 920 – 929.

Marshall, H., Keri, A., Michael, C., Daugherty, J. and Mitrani, G. 1999. Effects of practice on the ability to perform lumbar stabilisation exercise. *Journal of Orthopaedic & Sports Physical Therapy*, 29(9): 546-555.

Martin Ginis, K.A., van der Scheer, J.W., Latimer-Cheung, A.E., Barrow, A., Bourne, C., Carruthers, P., Bernadi, M., Ditor, D.S., Gaudet, S., de Groot, S., Hayes, K.C., Hicks, A.L., Leicht, C.A., Lexell, J., Macaliso, S., Manns, P.J., McBride, C.B., Noonan, V.K., Pomerleau, P., Rimmer, J.H., Shaw, R.B., Smith, B., Smith, K.M., Steeves, J.D., Tussler, D., West, C.R., Wolfe, D.L. and Goosey-Tolfrey, V.L. 2018. Evidence-based scientific exercise guidelines for adults with spinal cord injury: An update and a new guideline. *Spinal Cord*, 56(4): 308–21. Accessed 21/07/2022.

Maughan, E.F. and Lewis, J.S. 2010. Outcome measures in Chronic Low Back pain. *European Spine Journal*, 19(9): 1484- 1494.

May, S. and Donelson, R. 2008. Evidence informed management of chronic low back pain with McKenzie method. *Spine*, 8(1): 134-141.

______ and Johnson, R. 2008. Stabilisation exercises for low back pain: a systematic review. *Physiotherapy*, 94: 179-189.

Mbada, C.E. 2012. Effect of back extensors endurance exercises on physiological and psychosocial variables in patients with long-term mechanical low back pain. A Thesis in the Department of Physiotherapy, College of Medicine, University of Ibadan.

__________, Ayanniyi, O., Ogunlade, S.O., Orimolade, E.A., Oladiran, A.B. and Ogundele, A.O. 2014. Influence of McKenzie protocol and two modes of endurance exercises on health-related quality of life of patients with long-term mechanical low-back pain. *The Pan African Medical Journal*, 17(1): 5-10.

McKenzie, R.A. 1989. The lumbar Spine. Mechanical Diagnosis and Therapy. McKenzie Institute International, Waikanae: New Zealand: Spinal Publications Ltd.

_____________, and May, S. 2003. The lumbar spine: mechanical diagnosis and therapy. Eds. New Zealand: Spinal publications. Pp 501-513.

_____________. 2009. The Lumbar Spine, Part A. Mechanical Diagnosis and Therapy. McKenzie Institute International, Raumati Beach, 5255, New Zealand

_____________. 2005. The McKenzie Institute Lumbar Spine Assessment. McKenzie Institute International, Rauamti Beach, 5255, New Zealand

Menezes-Costa, L.C., Maher, C.G., McAuley, J.H., Hancoch, M.J. and Smeets, R.J.E.M. 2011. Self efficacy is more important than fear of movement in mediating relationship between pain and disability in chronic low back pain. *European Journal of Pain*, 15: 213-219.

Miyamoto, G.C., Costa, L.O.P. and Cabral, C.M.N. 2013. Efficacy of the Pilates method for pain and disability in patients with chronic non-specific low back pain: a systematic review with meta-analysis. *Brazillian Journal of Physical Therapy*, 17: 6. http://dx.doi.org/10.1590/S1413-35552012005000127. Accessed on 27-04-20

Moon, H.J., Choi, K.H., Kim, D.H., Kim, H.J., Cho, Y.K., Lee, K.H., Kim, J.H. and Choi, Y.J. 2013. Effect of lumbar stabilisation and dynamic strengthening exercises in patients with chronic low back pain. *Annals of Rehabilitation Medicine*, 37(1): 110-117.

Mohan, K.G. 2015. Effects of trunk muscle stabilisation exercise and McKenzie exercise on pain in recurrent nonspecific low back pain. *International Journal of Physiotherapy and Occupational Therapy*, 1(1): 55-64.

Moore, K.L., Dalley, A.F. and Agur, A.M.R. 2014. Clinically Oriented Anatomy. 7th edition Lippincott Williams and Wilkins, Philadelphia, PA 19103.

Muthukrishnan, R., Shenoy, S.D., Jaspal, S.S., Nellikunja, S. And Fernandes, S. 2010. The differential effects of Core stabilisation regime and conventional physiotherapy on postural control parameters during perturbation in patients with movement and control impairment chronic low back pain. *Sports Medicine Arthroscopy Rehabilitation Therapy Technology*, 2: 13. doi: 10.1186/1758-2555-2-13. Accessed on 16-01-16

Nascimento, P.R.C. and Costa, L.O.P. 2015. Low back pain prevalence in Brazil: a systematic review. *Cad Sau/de publication, Rio de Janeiro*, 31(6):1-13. http://dx.doi.org/10.1590/0102-311X00046114.

Netter, F.H. 2014. Atlas of Human Anatomy, 6th edition. Saunders Elsevier, Philadelphia.

Nicholas, M.K. 2007. The Pain Self-Efficacy Questionnaire: taking pain into action. *European Journal of Pain*, 11(2): 153- 163.

Nielson, W.R. and Weir, R. 2001. Biopsychosocial approaches to the treatment of chronic pain. *Clinical Journal of Pain*, 17(4): S114-127.

Nwuga, V.C.B. 1990. Manual treatment of back pain. Shaneson C. I Ltd, Ibadan, Nigeria. Chapter 1 & 2; 6-33.

Odole, A.C. and Akinpelu, A.O. 2009. Translation and alternate forms reliability of the VAS in the 3 major languages. *The Internet Journal of Allied Health Sciences and Practise*, 7(3): 1- 7.

__________, Akinpelu, A.A., Adekanla, B.A.and Obisanya, O.B. 2011. Economic Burden of Low Back Pain on Patients Seen at the Outpatient Physiotherapy Clinics of Secondary and Tertiary Health Institutions in Ibadan. *Journal of the Nigeria Society of Physiotherapy*, 18 & 19:43-48.

Oliveira, C.B., Maher, C.G., Pinto, R.Z., Traeger, A.C., Lin, C-W.C., Chenot, J-GF., van Tulder, M. and Koes, B.W. 2018. Clinical practice guidelines for the management of non-specific low back pain in primary care: an updated overview. *European Spine Journal*, 27(11):2791–2803. Accessed on 21/07/2022.

O'Sullivan, P. 2005. Diagnosis and classification of chronic low pain disorders: maladaptive movement and motor control impairment as underlying mechanism. *Manual Therapy*, 10: 242-255.

Panjabi, M.M. 1992. Part 1: Function, dysfunction, adaptation and enhancement. Journal of Spinal Disorder, 5:383-389.

Parish, K.A. 2002. A biopsychosocial approach to chronic low back pain and disability in a private chiropractic practice: a case study. *The Journal of Canadian Chiropractic Association*, 46(2): 93-100.

Patel, A.T. and Ogle, A.A. 2000. Diagnosis and management of acute low back pain. *American Family Physician*, 16:1779-1786.

Peterson, T., Laslett, M., Thorsen, H., Manniche, C., Ekdahl, C. and Jacobsen, S. 2003. Diagnostic classification of non-specific low back pain. A new system integrating patho-anatomic and clinical categories. *Physiotherapy Theory and Practise*, 19:213-237.

Pinto, S.M., Cheung, J.P.Y., Samartzis, D., Karppinen, J., XZheng, Y-p., Pang, M.Y.C. and Wong, A.Y.L. 2022. Are morphometric and Biomechanical characteristics of Lumbar Multifidus related to pain intensity or disability in people with Chronic Low Back Pain after considering Psychological factors or insomnia? *Front Psychiatry,* 13: 809-891. Accessed on 20/ 07/ 2022.

Punnett, L., Pruss-Ustun, A., Nelson, D.I., Fingerhut, M.A., Leigh, J., Tak, S. and Phillips, S. 2005. Estimating the global burden of low back pain attributable to combined occupational exposures. *American Journal of Industrial Medicine* (pre-print version):1-14.

Puntumetakuul, E., Areeudomwong, P., Emasithi, A. and Yamauchi, J. 2013. Effects of 10 weeks core stabilisation exercise training and detraining on pain-related outcomes in patients with chronic lumbar instability. Dovepress. *Patient Preference and Adherence*, 19(7): 1189- 1199. www.dovepress.com

Rainville, J., Hartigan, C., Martinez, E., Limke, J., Jouve, C. and Finno, M. 2004. Exercise as a treatment for Chronic Low Back Pain. *The Spine Journal*, 4(1): 106-115.

__________ , Nguyen, R. and Suri, P. 2009. Effective conservative treatment for chronic lowback pain. *Seminars in Spine Surgery*, 21.4: 257–263.

__________, Smeets, R.J.E.M., Bendix, T., Tveito, T.H., Poiraudeau, S. and Indahl, A.J. 2011): Fear avoidance beliefs and pain avoidance in low back pain: translating research into clinicalpractice. *The Spine Journal*, 11(9): 895–903.

Razmjou, H., Kramer, J.F. and Yamada, R. 2000. Intertester reliability of the McKenzie evaluation in assessing patients with mechanical low back pain. *Journal of Orthopaedic Sports Physical Therapy,* 30(7): 368-383.

___________, C.A., Jull, G., Hodges, P. and Hides, J, 1999. Therapeutic exercise for spinal stabilisation in low back pain: Scientific Basis and Clinical approach. New York, NY: Churchill Livingstone.

Romano, A. 2013. McKenzie method. Physical Therapy treatment for lower back pain. www.Spine-Health.com. Accessed on 15-10-15.

Rose, S.J. 1989. Physical therapy diagnosis: role and function. *Physical Therapy*; 69:535-537.

Ross, M.D. and Boissonnault, W.G. 2010. Red flags: to screen or not to screen. *Journal of Orthopaedic Sports Physical therapy*, 40(11): 682-684.

Rubin, D.I. 2007. Epidemiology and Risk factors for spine pain. *Neurology Clinical*, 25(2): 353-71.

Russo, M., Deckers, K., Eldabe, S., Kiesel, K., Gilligan, C., Vieceli, J, and C rosby, P. 2018. Muscle Control and Non-specific Chronic Low Back Pain. *Neuromodulaion*, 21(1): 1–9.

Sahrmann, S.A. 2002. Diagnosis and treatment of movement impairment syndrome. St. Louis; Mosby Incorporated.

Sanders, T., Foster, N.E., Bishop, A. and Ong, .B.N 2013. Biopsychosocial care and the physiotherapy encounter: Physiotherapist's account of back pain consultations. *BMC Musculoskelatal Disorders*, 14; 64. DOI. 10.1186/1471-2474-14-65. Accessed on 14-02-2020.

Sanadgol, R., Atri, A.E. and Javaheri, S.A.A.H. 2015. Evaluating the efficacy of McKenzie, massage, and foot reflexology on pain and disability of women with chronic mechanical low back pain. *Cienca e Natura*, 37(2): 69-75.

Santolin, S.M. 2003. McKenzie diagnosis and therapy in the evaluation and management of a lumbar disc derangement syndrome. A case study. *Journal of Chiropractic Medicine*, 2(2): 60-65.

Sanya, A.O. and Ogwumike, O.O. 2005. Low back pain prevalence amongst industrial workers in the private sector in Oyo State, Nigeria. *African Journal of Medicine and Medical Sciences*, 34(3): 245-249.

Savigny, P., Kuntze, S., Watson, P., Underwood, M., Ritchie, G., Cotterell, M., Hill, D., Browne, N., Buchanan, E., Coffey, P., Dixon, P., Drummond, C., Flanagan, M., Greenough, C., Griffiths, M., Halliday-Bell, J., Hettinga, D., Vogel, S. and Walsh, D. 2009. Low Back Pain: early management of persistent non-specific low back pain. Royal College of General Practitioners. Full guidelines.; 001-209

Scanlon, V.C. and Sanders, T. 2007. Essentials of anatomy and physiology. 5th ed. Philaldelphia: FA Davis.104-113.

Searle, A., Spink, M., Ho, A., and Chuter, V. 2015. Exercise interventions for the treatment of chronic low back pain: a systematic review and meta-analysis of randomised controlled trials. *Clinical Rehabilitation*, 29 (12): 1155- 1167.

Shakeri, H., Fatholahi, Z., Karimi, N. and Arab, A.M. 2013. Effect of functional lumbar stabilisation exercise on pain, disability and kinesiophobia in women with menstrual low back pain. *Journal of Chiropractic Medicine*, 12(3): 160-167.

Shaughnessy, M. and Caulfield, B. 2004. A pilot study to investigate the effect of lumbar stabilisation exercise training on functional ability and quality of life in patients with chronic low back pain. *International Journal of Rehabilitation Research*, 27(4): 297-301.

Shiri, R., Karppinen, J., Leino-Arjas, P., Solovieva, S. and Viikari-Juntura, E. 2010. The association between smoking and low back pain: a meta-analysis. *American Journal of Medicine*, 123: 87–35.

Sikiru, L. and Shmaila, H. 2009. Prevalence and risk factors of low back pain among nurses in Africa: Nigerian and Ethiopian specialized hospital survey study. *East African Journal of Public Health*, 6(1): 22-25.

Smith, B.E., Littlewood, C. and May, S. 2014. An update of stabilisation exercises for low back pain: a systematic review with meta-analysis. *BMC Musculoskeletal Disorders*, 14(416): 2-21.

Spitzer, W.O. 1987. Scientific approach to the assessment and management of activity related spinal disorders. A monograph for clinicians. Report of Quebec Task Force on Spinal Disorders. *Spine*, 12: S1-S59

Spoto, M.M. and Collins, J. 2008. Physiotherapy diagnosis in clinical practice: a survey of Orthopaedic Certified Specialists in the USA. *Physiotherapy Research International*, 13(1): 31- 41.

___________. 2012. Conservative management of low back pain.www.intechopen.com pp 199-224.

Stankovic, A., Lazovic, M., Kococ, M. and Zlatanovic, D. 2008. Spinal segmental stabilisation exercises combined with traditional strengthening exercise programme in patients with chronic low back pain. *ACTA faculty of Medicine*, 25(3): 165-170.

Standring, S. 2008. Gray's anatomy: the anatomical basis of clinical practice. 39th Ed. Philaldelphia: Elsevier. 727-777.

Suh, J.H., Kim, H., Jung, G.P., Ko, J.Y. and Ryu, J.S. 2019. The effects of lumbar stabilisation and walking exercises on chronic low back pain. *Medicine*, 98(26): e16173.

Teyhen, D.S., Flynn, T.W., Childs, J.D. and Abraham, L.D. 2007. Arthrokinetics in a subgroup of patients likely to benefit from a lumbar stabilisation exercise program. *Physical Therapy*, 87(3): 313- 25.

Tinubu, B.M.S., Mbada, C.E., Oyeyemi, A.L. and Fabunmi, A.A. 2010. Work-Related Musculoskeletal Disorders among Nurses in Ibadan, South-west Nigeria; a cross – sectional survey. *BMC Musculoskeletal Disorders*. 11:12.

Tonkin, L. 2008. The Pain Self-Efficacy Questionnaire. *Australian Journal of Physiotherapy*, Vol 54:77

Turk, D.C. and Okifuji, A. 2002. Psychosocial factors in chronic pain: evolution and revolution. *Journal of Consultant Clinical Psychology*, 70: 678-690.

_________, Dworkin, R.H., Allen, R.R., Bellamy, N., Brandenburg, N., Carr, D.B., Cleeland, C., Dionne, R., Farrar, J.T., Galer, B.S., Hewitt, D.J., Jadad, A.R., Katz, N.P., Kramer, L.D., Manning, D.C., McCormick, C.G., McDermont, M.P., McGrath, P., Quessy, S., Rappaport, B.A., Robinson, J.P., Royal, M.A., Simon, L., Stauffer, J.W., Stein, W., Tollett, J. and Witter, J. 2003. Core outcome domains for chronic pain clinical trials: IMMPACT recommendations. *Pain*, 106: 337–345.

Udermann, B.E., Mayer, J.M., Donelson, R.G., Graves, J.E. and Murray, S.R. 2004. Combining Lumbar extension training with McKenzie therapy: Effects on pain, disability, and psychosocial functioning in chronic low back pain patients. *Gundersen Lutheran Medical Journal*, 3: 7- 12.

Underwood, M.R., Morton, V., Farrin, A. and UK BEAM trial team. 2007. Do baselinecharacteristics predict response to treatment for low back pain? Secondary analysis of the UK BEAM dataset. *Rheumatology*, 46 (8): 1297-1302.

Valat, J.P., Goupille, P., and Ve/dere, V. 1997. Low Back Pain: Risk factors for chronicity. Reve de Rhumatisme (English Ed): 64(3): 189-194.

van Middelkoop, M., Rubinstein, S.M., Verhagen, A.P., Ostelo, R.W., Koes, B.W. and van Tulder, M.W. 2010. Exercise therapy for chronic non-specific low back pain. *Best Practise and Research Clinical Rheumatology*, 24.2: 193–204.

van Tulder, M., Malmivaara, A., Esmail, R. and Koes, B. 2000. Exercise therapy for low back pain: a systematic review within the framework of the Cochrane collaboration back review group. *Spine*; 25(21): 2784-2796.

Verbunt, J., Seelen, H.A., Vlaeyen, J.W., van de Heijden, G.J., Heuts, P.H., Pons, K. and Knottnerus, J.A. 2003. Disuse and deconditioning in chronic low back pain: Concepts and hypothesis on contribution mechanisms. *European Journal of Pain*, 7(1): 9-21.

Vikranth, G.R., Mathias, L. and Ghori, M.M. 2015. Effectiveness of core stabilisation exercises and motor control exercises in patients with low back ache. *International Journal of Physiotherapy*, 2(3): 544- 551.

Vlaeyen, J.W., Kole-Snijders, A.M.J., Boeren, R.G.B. and van Eek, H. 1995. The role of fear of movement/ (re)injury in pain disability. *Journal of Occupational Rehabilitation*, 5(5): 235-252.

Von Korff, M., Deyo, R.A., Cherkin, D. and Barlow, S.F. 1993: Back pain in primary care: Outcomes at 1 year; *Spine*, 55: 862.

Vos, T., Floyman, A., Naghavi, F., Koppenhanen, S.L. and Magel, J.S. 2012. Years lived with disability (YLDs) for 1160 sequelae of 289 diseases and injuries 1990–2010: a systematic analysis of the Global Burden of Disease Study 2010. *Lancet*, 380: 2163–2196.

Waddell, G., Newton, M., Henderson, I., Somerville, D. and Main, C. 1993. A Fear-Avoidance Belief Questionnaire and the role of fear-avoidance beliefs in chronic low back pain and disability. *Pain*, 52(2): 157- 168.

Wang, X.Q., Zheng, J.J., Yu, Z.W., Bi, X., Lou, S-J.,Liu, J., Cai, B., Hua, Y-H., Wu, M., Wei, M-L., Shen, H-M., Chen, Y., Pan, Y-J., Xu, G-H. and Chen, P-J. 2012. A meta-analysis of core stability exercises versus general exercise for low back pain. *PLoSOne*, 7(12): 1-7. e5082. www.plosone.org

Werneke, M.W., Hart, D.L. and Cook, B. 1999. The centralization phenomenon. *Spine*, 24(7): 676- 683.

______________ and Hart, D.L. 2003. Discriminant validity and relative precision for classifying patients with non-specific neck and back pain by anatomical pain patterns. *Spine*, 28:161-166

___________________________. 2004. Categorizing patients with occupational low back pain by use of the Quebec Task Force classification system versus pain pattern classification procedures. *Physical Therapy*, 84(3): 243-254.

______________, Edmond, S., Young, M., Grigsby, D., McClenahan, B. and McGill T. 2020. Association between changes in function among patients with lumbar impairments classified according to the STarT Back Screening Tool and managed by McKenzie credentialed physiotherapists. *Physiotherapy Theory & Practise*, 36(5): 589-593.

Wertli, M.M., Rasmussen-Barr, E., Held, U., Weiser, S., Bachmann, LM. and Brunner, F. 2014. Fear-avoidance beliefs – a moderator of treatment efficacy in patients with low back pain; a systematic review. *Spine Journal*, 14(11): 2658- 2678.

Woby, S., Watson, P., Roach, N. and Urmston , M. 2004. Are changes in fear-avoidance beliefs, catastrophizing, and appraisals of control, predictive of changes in chronic low back pain and disability? *European Journal of Pain*, 8: 201–210.

World Health Organization WHO-ICF 2001. International Classification of Functioning; Disability and Health. Geneva: World Health Organization

APPENDIX A

-

QUADRUPLE VISUAL ANALOGUE SCALE

Patient Name ______________________________ Date ____________________

Please read carefully:

Instructions: Please circle the number that best describes the question being asked.

Note: If you have more than one complaint, please answer each question for each individual complaint and indicate the score for each complaint. Please indicate your pain level right now, average pain, and pain at its best and worst.

Example:

Headache Neck Low Back

No pain ______________________________ **worst possible pain**

0 1 2 3 4 5 6 7 8 9 10

1 – What is your pain RIGHT NOW?

No pain ______________________________ **worst possible pain**

0 1 2 3 4 5 6 7 8 9 10

2 – What is your TYPICAL or AVERAGE pain?

No pain ______________________________ **worst possible pain**

0 1 2 3 4 5 6 7 8 9 10

3 – What is your pain level AT ITS BEST (How close to "0" does your pain get at its best)?

No pain ______________________________ **worst possible pain**

0 1 2 3 4 5 6 7 8 9 10

4 – What is your pain level AT ITS WORST (How close to "10" does your pain get at its worst)?

No pain ______________________________ **worst possible pain**

0 1 2 3 4 5 6 7 8 9 10

OTHER COMMENTS: ______________________________

APPENDIX B

ÌWÒN ÀFOJÚRÍ ASÒNKÀ

Ìtósónà:- Jòwó, fi àmì kan si orí ìlà tí ó bá se àpèjúwe ìdáhùn tí ó bá bá o mu jù lo. Bí ohun tó ń se ó bá ju òkan lo, jòwó dáhùn ìbéèrè kòòkan fún ohun kòòkan tó ń se ó, kí o sì fi ìwòn ìmòlára rè hàn. Fi ìwòn bí ìrora re se máa ń tóhàn; èyí tó kéré jù lo/èyí tó ga jù lo láàrin osù méta tó kojá. Bí o bá ti gba fóòmù yií télè rí, fi bí ìwòn ìrora rè se máa ń tó láti ìgbà náà hàn.

Fún àpeere:

Orí fífó orùn ríro èyìn dídùn

Kò sí ìrora ìrora tó burú jùlo

###

1. Kí ló jé ìrora re báyìí?

Kò sí ìrora ____________________________________ ìrora tó burú ju lo

2. Irúfé ìrora wo gan-an ní pàtó tàbí díè lo sábà máa ń ní?

Kò sí ìrora ____________________________________ ìrora tó burú ju lo

3. Báwo ni ìrora re se máa ń tó bó bá burú tán?

Kò sí ìrora ____________________________________ ìrora tó burú ju lo

4. Kí ni ìwòn ìrora re tó BURÚ JÙ LO?

Kò sí rora ____________________________________ ìrora tó burú ju lo

ORÚKO __________ OJÓ ORÍ_________ DÉÈTÌ _________ MÁÀKÌ_________

Ìwòn: #1 ________ +#2 ______ +#4________ = _______ 13 x 10 _________

(Ìwòn kékeré = < 50; ìwòn gíga = > 50).

APPENDIX C

OSWESTRY LOW BACK PAIN DISABILITY QUESTIONNAIRE (Version 2)

(Fairbank et al, 2000)

INSTRUCTIONS :

This questionnaire has been designed to give us information as to how your back or leg pain is affecting your ability to manage in everyday life. Please answer by checking ONE line in each section for the statement which best applies to you. We realise you may consider that two or more statements in any one section apply but please just shade out the spot that indicates the statement which most clearly describes your problem.

Section 1 – Pain Intensity
_ I have no pain at the moment.
_ The pain is very mild at the moment.
_ The pain is moderate at the moment.
_ The pain is fairly severe at the moment.
_ The pain is very severe at the moment.
_ The pain is the worst imaginable at the moment.

Section 2 – Personal Care (washing, dressing, etc.)
_ I can look after myself normally but it is very painful.
_ It is painful to look after myself and I am slow and careful.
_ I need some help but manage most of my personal care.
_ I need help every day in most aspects of my personal care.
_ I need help every day in most aspects of self-care.
_ I do not get dressed, wash with difficulty, and stay in bed.

Section 3 - Lifting
_ I can lift heavy weights without extra pain.
_ I can lift heavy weights but it gives extra pain.
_ Pain prevents me from lifting heavy weights off the floor, but I can manage if they are conveniently positioned (i.e. on a table).
_ Pain prevents me from lifting heavy weights, but I can manage light to medium weights if they are conveniently positioned.
_ I can lift only very light weights.
_ I cannot lift or carry anything at all.

Section 4 – Walking
_ Pain does not prevent me walking any distance.
_ Pain prevents me walking more than 1mile.
_ Pain prevents me walking more than ¼ of a mile.
_ Pain prevents me walking more than 100 yards.
_ I can only walk using a stick or crutches.
_ I am in bed most of the time and have to crawl to the toilet.

Section 5 – Sitting
_ I can sit in any chair as long as I like.
_ I can sit in my favourite chair as long as I like.
_ Pain prevents me from sitting for more than 1 hour.
_ Pain prevents me from sitting for more than ½ hour.
_ Pain prevents me from sitting for more than 10 minutes.
_ Pain prevents me from sitting at all.

Section 6 – Standing
_ I can stand as long as I want without extra pain.
_ I can stand as long as I want but it gives me extra pain.
_ Pain prevents me from standing more than 1 hour.
_ Pain prevents me from standing for more than ½ an hour.
_ Pain prevents me from standing for more than 10 minutes.
_ Pain prevents me from standing at all.

Section 7 – Sleeping
_ My sleep is never disturbed by pain.
_ My sleep is occasionally disturbed by pain.
_ Because of pain, I have less than 6 hours sleep.
_ Because of pain, I have less than 4 hours sleep.
_ Because of pain, I have less than 2 hours sleep.
_ Pain prevents me from sleeping at all.

Section 8 – Sex life (if applicable)
_ My sex life is normal and causes no extra pain.
_ My sex life is normal but causes some extra pain.
_ My sex life is nearly normal but is very painful.
_ My sex life is severely restricted by pain.
_ My sex life is nearly absent because of pain.
_ Pain prevents any sex life at all.

Section 9 – Social Life
_ My social life is normal and cause me no extra pain.
_ My social life is normal but increases the degree of pain.
_ Pain has no significant effect on my social life apart from limiting my more energetic interests, i.e. sports.
_ Pain has restricted my social life and I do not go out as often.
_ Pain has restricted social life to my home.
_ I have no social life because of pain.

Section 10 – Traveling
_ I can travel anywhere without pain.
_ I can travel anywhere but it gives extra pain.
_ Pain is bad but I manage journeys of over two hours.
_ Pain restricts me to journeys of less than one hour.
_ Pain restricts me to short necessary journeys under 30 minutes.
_ Pain prevents me from traveling except to receive treatment

APPENDIX D

Ìgbéléwòn Bèbèré Èyìn Dídùn ti Oswestry

Ìwé ìbéèrè yìí wà láti pèsè àlàyé fún dókítà nípa bí ìrora orùn re se ń kópa nínú ìgbé-ayé òòjó re. Jòwó fi àmì sí NÓŃBÀ KAN soso ni abala kòòkan, èyí tí ó bá ìsòro re mu jù lo. A mò pé o se é se kí gbólóhùn méjì bá ohun tó ńse ó mu ní abala kan, èyí tí ó bá kàn ó jù lo ni kí o fi àmì sí.

Abala kìn-ín-ní - Bí ìrora se le tó

(0) Ìrora náà máa ń wá, ó máa ń lo ni sùgbon kòle
(1) Ìrora náà kò le sùgbón kìí yàtò púpò.
(2) Ìrora náà máa ń wá, ó máa ń lo ni sùgbón kòkojá àfaradà
(3) Ìrora náà kò kojá àfaradà kìí sì yàtò púpò.
(4) Ìrora náà máa ń wá, ó máa ń lo ni, ó sì le púpò
(5) Ìrora náà le púpò, kìí sìí yàtò púpò

Abala Kejì - Ìtójú ara eni (fifo nnkan, aramúmú, ati bebelo)

(0) N kò ní láti yí ònà tí mò ń gbà fo nnkan àti ònà tí mò ń gbà múra padà kí n lè yàgò fún ìrora
(1) N kìí sáábà yí ònà tí mò ń gba fo nnkan tàbítí mò ń gbà múra padà bí ó tilè jé pé ó máa ńmú ìrora díe dání.
(2) Nnkan fifò àti ara mímú túbò máa ń mú kí ìrora náà pò síi ni sùgbón mò ń gbìyànjú láti má yí bí mo se ń se é padà.
(3) Nnkan fífò àti ara mímú máa ń mú kí ìrora náà pò síi ni, mo sì rí pé ó ye kí n yí bí mo se ń se wón padà.
(4) Nítorí ìrora náà, n kò lè fo nnkan díè tàbí múra lâì rí ìrànlówó
(5) Nítorí ìrora náà, n kò lè fo nnkan kan, tàbí múra rárá lâì rí ìrànlówó

Abala Kéta – Gbígbé Nnkan

(0) Mo lè gbé ohun tó wúwo lâì sí àfikún ìrora
(1) Mo le gbé ohun tó wúwo sùgbón ó máa fún mi ní àfikún ìrora.
(2) Ìrora máa dí mi lówó láti gbé erù tó wúwo kúrò nílè
(3) Ìrora máa ń di mi lówó láti gbé erù tó wúwo kúrò nílè sùgbón mo lè gbé e bí ó bá wà ni ipò tó rò mí lórùn fún àpeere, lórí tábìlì
(4) Ìrora máa ń di mi lówó láti gbé erù tó wúwo sùgbón mo lè gbìyànjú láti gbè èyí tó fúyé tàbí tí kò wúwo púpò bí wón bá wà ní ipò tó rò mí lórùn.
(5) Erù tó fúyé nìkan ni mo lè gbé tó pò jù.

Abala Kérin - Ìrìn rínrìn

(0) N kò ní ìrora nípa ìrìn rínrìn
(1) Mo ní ìrora tó je mó ìrìn sùgbón kìí pò síi bí ibi tí mò ń lo bá se jìnnà sí
(2) Mo lè rìn ju máìlì kan lo lâì jé pé ìrora náà pò síi
(3) N kò lè rin ju ìlàjì máìlì lo lâì sí àfikún ìrora
(4) N kò lè rìn ju ìdámérin máìlì kan lâì sí àfikún ìrora
(5) N kò lè rìn rárá lâì sí ìrora

Abala Kárùn-ún – Ipò ìjókòó

(0) Mo lè jókòó lórí àgakága bí mo bá se fé
(1) Orí àga tí mo féràn jù ni mo le jókòó lé bí mo bá se fé
(2) Ìrora máa ń di mi lówó láti jókòó kojá wákàtí kan
(3) Ìrora máa ń di mi lówó láti jókòó kojá ìdàjì wákàtí kan
(4) Ìrora máa ń dí mi lówó láti jókòó kojá ìséjú méwàá.
(5) Mo máa ń yàgò fún jíjókòó nítorí lésèkesè ló máa ń fi kún ìrora mi

Abala Kefà – Ìnàró
(0) Mo lè nàró fún iye àkókò tí mo bá fé láìsí ìrora
(1) Mo máa ń ní ìrora pèlú ìnàwó sùgbón kìí pò sí pèlú àkókó
(2) N kò lè nàró kojá wákàtí kan láì sí àfikún ìrora
(3) N kò lè nàró kojá ìdajì wákàtí láì sí àfikún ìrora
(4) N kò lè nàró kojá ìséjú méwàá láì sí àfikún ìrora
(5) Mo máa ń sá fún ìnàwó nítorí lésèkesè ló máa ń fi kún ìrora mi

Abala Kéje – Oorun sísùn
(0) Ara kìí ro mí lórí béèdì
(1) Ara máa ń ro mí lórí béèdì sùgbón kò dí mi lówó láti sùn
(2) Nítorí ìrora, oorun alé mi máa ń dínkù pèlú bí i ìdámérin
(3) Nítorí ìrora, oorun alé mi ti dínkù sí bí ìdajì
(4) Nítorí ìrora, oorun alé mi ti dínkù sí bí ìdá kan nínú ìda mérin
(5) Ìrora máa ń di mi lówó láti sùn rárá ni

Abala Kéjo - Ìgbé-ayé ní àwùjo
(0) Ìgbé-ayé mi láwùjo kò fún mi nì ìròra
(1) Ìgbé-ayé mi láwùjo dára sùgbón ó máa ń fi kún ìrora mi
(2) Ìrora kò ní ipa kan pàtó lórí ìgbé-ayé mi láwùjo ju pé ó ń di mi lónà láti se àwon nnkan tó wù mí to sì la agbára lo, fún àpeere, ijó jíjó ati bebelo.
(3) Ìrora ti dí ìgbé-ayé mi láwùjo lówó, n kò sì sáábà máa ń jáde mó
(4) Ìrora ti dé mi mólé
(5) Kò sí igbé-ayé kankan fún mi láwùjo nítorí ìrora

Abala Késàn-án – Rínrin ìrìnàjò
(0) N kìí ní ìrora bí mo bá ń rìnrìn-àjò
(1) Mo máa ń ní ìrora díè bí mo bá ń rìnrìn-àjò sùgbón kò sí èyí tó mú un búni síi
(2) Mo máa ń ni àfikún wòra bí mo bá ń rìnrìnàjò sùgbón kò fi ipá mú mi láti wà irúfé ònà mìíràn láti rìnrìn-àjò
(3) Mo máa ń ni àfikún ìrora bí mo bá ń rìnrìnàjò tó sì máa ń fipá mú mi láti wá irúfé ònà mìíràn láti rìnrìn-àjò
(4) Ìrora ń di mi lówó láti máa rìnrìn-àjò tó bá ti kojá ìdajì wákàtí. Àwon tó se pàtàkì ni mò ń rìn.
(5) Ìrora dí mi lówó gbogbo ìrìn-àjò

Abala Kéwàá – Bí ìwòn ìrora se ń yípadà
(0) Ìrora mi ń dínkù jojo
(1) Ìrora mi máa ń lo, ó máa n bò ní sùgbón ó ń dínkù jojo
(2) Ìrora mi ń dínkù jojo sùgbón ó ń lóra láti dínkù
(3) Ìrora mi kò dínkù béè ni kò burú síi
(4) Ìrora mi ń pele síi díè díè
(5) Ìrora mi ń pele síi léraléra ni

APPENDIX E

FEAR AVOIDANCE BELIEFS QUESTIONNAIRE (Waddell et al, 1993)

Here are some of the things, which other patients have told us about their pain. For each statement please circle any number from 0 to 6 to say how much, physical activities, such as bending, lifting, walking or driving affect or would affect your back pain.

	Completely Disagree			Unsure			Completely Agree
1. My pain was caused by physical activity	0	1	2	3	4	5	6
2. Physical activity makes my pain worse	0	1	2	3	4	5	6
3. Physical activity might harm my back	0	1	2	3	4	5	6
4. I should not do physical activities which (might) make my pain worse	0	1	2	3	4	5	6
5. I cannot do physical activities which(might) make my pain worse	0	1	2	3	4	5	6

The following statements are about how your normal work affects or would affect your back pain

	Completely Disagree			Unsure			Completely Agree
6. My pain was caused by my work or by an accident at work	0	1	2	3	4	5	6
7. My work aggravated my pain	0	1	2	3	4	5	6
8. I have a claim for compensation for my pain	0	1	2	3	4	5	6
9. My work is too heavy for me	0	1	2	3	4	5	6
10. My work makes or would make my pain worse	0	1	2	3	4	5	6
11. My work might harm my back	0	1	2	3	4	5	6
12. I should not do my normal work with my present pain	0	1	2	3	4	5	6
13. I cannot do my normal work with my present pain	0	1	2	3	4	5	6
14. I cannot do my normal work till my pain is treated	0	1	2	3	4	5	6
15. I do not think that I will be back to my normal work within 3 months	0	1	2	3	4	5	6
16. I do not think I will be able to ever go back to that work	0	1	2	3	4	5	6

APPENDIX F

FEAR-AVOIDANCE BELIEFS QUESTIONNAIRE (ÌWÉ ASÈBÉÈRÈ L'ÓRÍ ÌGBÀGBÓ NÍNÚ YÍYÀGÒ FÚN ÌBÈRÙ)

DÉÈTÌ: / / (Osù/ojó/Odún)

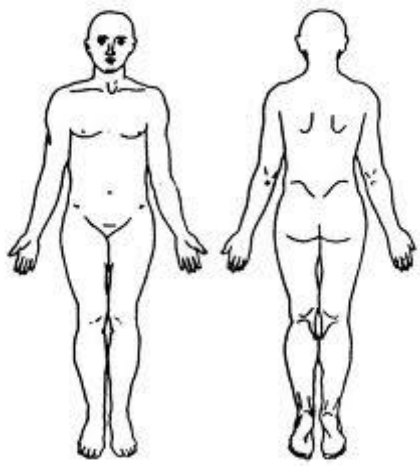
Èyí ni àwon nkan tí àwon míràn t ó n gba ìtójú so fún wa nípa ìrora won. Fún gbólóhùn kànkan, jówó yí àmì òdo sí nómbà láti '0' sí '6' tó so nípa irú eré ìdárayá bíi bíbèrè, gbígbérù, rínrìn tàbí wíwakò tó n ní ipá tàbí tí ó le ní ipa lórí èhìn dídùn re.

	Mo lòdì síi pátápátá			Kò dámi l'ójú			Mo fara móo pátápátá
1. Eré ìdárayá ló fa ìrora mi.	0	1	2	3	4	5	6
2. Eré ìdárayá n jé kí ìrora mi burú jáì.	0	1	2	3	4	5	6
3. Eré ìdárayá le se ìjàmbá fún èhìn mi.	0	1	2	3	4	5	6
4. Kò yen kí n se àwon eré ìdárayá tó le mú kí ìrora mi burú jáì.	0	1	2	3	4	5	6
5. Mi ò lè se eré ìdárayá tó le mú kí ìrora mi burú jáì.	0	1	2	3	4	5	6

Àwon gbólóhùn ìsàlè yìí ní se pèlú bí isé òòjó re se n ní ipa tàbí tí ó le ní ipa l' órí èhìn re.

	Mo lòdì síi pátápátá			Kò dámi l'ójú			Mo fara móo pátápáta
6. Isé mi tàbí ìjàmbá lénu isé ló fa ìrora mi.	0	1	2	3	4	5	6
7. Isé mi máa n mú ìrora mi le si.	0	1	2	3	4	5	6
8. Mo ní ètó sí gbà-máà-bínú nítorí ìrora mi.	0	1	2	3	4	5	6
9. Isé mi wúwo púpò fún mi	0	1	2	3	4	5	6
10. Isé mi máa n mú tàbí le mú ìrora mi burú jáì.	0	1	2	3	4	5	6
11. Isé mi le se ewu fún èhìn mi.	0	1	2	3	4	5	6
12. Kò ye kí n se àwon isé tí mo má n sábà se pèlú ìrora tí mo ní lówólówó.	0	1	2	3	4	5	6
13. Mi ò lè se àwon isé tí mo má n sábà se pèlú ìrora tí mo ní lówólówó.	0	1	2	3	4	5	6
14. Mi ò lè se àwon isé tí mo má n sábà se àyàfi tí mo bá tójú ìrora mi.	0	1	2	3	4	5	6
15. Mi ò rò wípé mo lè pàda s'énu isé mi láàárín osù méta.	0	1	2	3	4	5	6
16. Mi ò rò wípé mo lè pàda s'énu isé mi mo.	0	1	2	3	4	5	6

APPENDIX G
THE MCKENZIE INSTITUTE LUMBAR SPINE ASSESSMENT
(McKenzie, 2005)



Date ____

No. ______________________________Sex M/F__________

Date of Birth ___________________________Age ____________

Referral: GP/Orth./Self/Other ______________________________

Work: Mechanical Stresses _________________________________

____

Leisure: Mechanical Stresses ______________________________

Functional Disability from present episode ______________________

Functional Disability score _________________________________

VAS Score (0-10) _____________________________________

HISTORY

Present Symptoms____

Present Since ____________________________________ Improving/Unchanging/Worsening

Commercial as a result of ______________________________________ or no apparent reason

Symptoms at onset: back/thigh/leg ____________________

Constant symptoms: back/thigh/leg ____________________ Intermittent symptoms: back/thigh/leg

Worse bending sitting/rising standing walking lying

Am/as the day progresses/pm when still / on the move

Other ____

Better bending sitting/rising standing walking lying

Am/as the day progresses/pm when still / on the move

Other ____

Disturbed Sleep Yes / No Sleeping postures: prone /sup / side / R/L Surface: firm / soft/ sag

Previous Episodes 0 1-5 6-10 11+ Year of first episode ______________

Previous History____

____

Previous Treatments ____

____

SPECIFIC QUESTIONS

Cough/Sneeze /Strain /+ ve / -ve Bladder: normal / abnormal Galt: normal / abnormal

Medications: Nil / NSAIDS / Analgesics / Steroids / Anticoagulants/ Other ____________________

General Health: Good / Fair/ Poor ____

Imaging: Yes / No ____

Recent or major surgery: Yes / No ____________________ Night Pain: Yes / No ____________

Accidents: Yes / No ______________________________ Unexplained weight loss: Yes / No

Other ____

The McKenzie Institute Lumbar Spine Assessment
EXAMINATION

POSTURE

Sitting: Good /Fair/Poor Standing: Good/Fair/Poor Lordosis: Red/Acc/Normal Lateral Shift: Right/Left Nil

Correction of Posture: Better/Worse/No effect ________________________ Relevant: Yes/No
Other Observations: ____

NEUROLOGICAL
Motor Deficit __________________________ Reflexes ___________________________
Sensory Deficit ___________________________ Dural Signs _________________________

MOVEMENT LOSS

	Maj.	Mod.	Min.	Nil	Pain
Flexion					
Extension					
Side Gliding R					
Side Gliding L					

TEXT MOVEMENTS: **Describe effect on present pain – During**: produces. Abolishes, increases, decreases, no effect. Centralising, peripheralising. **After**: better, whose, no better, no worse, no effect, centralising, peripheralised.

	Symptoms During Testing	Symptoms After Testing	Mechanical Response		
			↑Rom	↓Rom	No Effect
Pretest Symptoms Standing					
FIS					
Rep FIS					
EIS					
Rep EIS					
Pretest Symptoms lying:					
FIS					
Rep FIS					
EIS					
Rep EIS					
If required pretest symptoms					
SGIS - R					
Rep SGIS - R					
SGIS - L					
Rep SGIS - L					

STATIC TESTS
Sitting slouched ____________________ Sitting erect ____________________________
Standing slouched ___________________ Standing erect ____________________________
Lying prone in extension ______________ Long Sitting _____________________________

OTHER TESTS ____

PROVISIONAL CLASSIFICATION
Department Dysfunction Postures Others
Derangement: Pain location ____

PRINCIPLES OF MANAGEMENT
Education _______________________________ Equipment provided _______________________
Mechanical Therapy Yes/No ____
Extension Principles _______________________ Lateral Principle _____________________
Flexion Principle _______________________ Other __________________________________
Treatment Goals ____

APPENDIX H

SOCIODEMOGRAPHIC DATA FORM

NAME:……………………………………………………………………………………………….

SEX: MALE ☐ FEMALE ☐

MARITAL STATUS: MARRIED ☐ DIVORCED ☐ WIDOWED ☐ SINGLE ☐

EDUCATIONAL LEVEL: GRADUATE ☐ SECONDARY SCHOOL ☐

PRIMARY SCHOOL ☐ NONE ☐

OCCUPATION: CIVIL SERVANT ☐ SELF EMPLOYED ☐ UNEMPLOYED ☐

TELEPHONE NUMBER(S):…………………………………………………………………...

CONTACT PERSON TEL. NUMBER:……………………………………………………......

WEIGHT (IN KG):……………………….... HEIGHT (IN METERS):……………………

OCCUPATION:…………………………………………………………………………...

ONSET OF BACK PAIN:……………………………………………….........................

DURATION OF SYMPTOMS:…………………………………………………………...

RECURRENCE(S):……………………………………………………………………….

PREVIOUS INTERVENTION:…………………………………………………………...

PRESCRIBED MEDICATIONS:…………………………………………………………

…………………………………………………………...

APPENDIX I

INSTITUTE FOR ADVANCED MEDICAL RESEARCH AND TRAINING (IAMRAT)
College of Medicine, University of Ibadan, Ibadan, Nigeria.

Director: **Prof. Catherine O. Falade,** *MBBS (Ib), M.Sc., FMCP, FWACP*
Tel: 0803 326 4593, 0802 360 9151
e-mail: cfalade@comui.edu.ng lillyfunke@yahoo.com

UI/UCH EC Registration Number: **NHREC/05/01/2008a**

NOTICE OF FULL APPROVAL AFTER FULL COMMITTEE REVIEW

Re: Effects of McKenzie, Stabilisation and Combined McKenzie and Stabilisation protocols on clinical and psychosocial variables in individuals with chronic mechanical Low Back Pain

UI/UCH Ethics Committee assigned number: UI/EC/17/0076

Name of Principal Investigator: **Oluwasegun S. Nudamajo**
Address of Principal Investigator: Department of Physiotherapy, College of Medicine, University of Ibadan, Ibadan

Date of receipt of valid application: 06/03/2017

Date of meeting when final determination on ethical approval was made: **N/A**

This is to inform you that the research described in the submitted protocol, the consent forms, and other participant information materials have been reviewed and *given full approval by the UI/UCH Ethics Committee.*

This approval dates from **09/05/2017 to 08/05/2018.** If there is delay in starting the research, please inform the UI/UCH Ethics Committee so that the dates of approval can be adjusted accordingly. Note that no participant accrual or activity related to this research may be conducted outside of these dates. *All informed consent forms used in this study must carry the* UI/UCH EC *assigned number and duration of* UI/UCH EC *approval of the study.* It is expected that you submit your annual report as well as an annual request for the project renewal to the UI/UCH EC at least four weeks before the expiration of this approval in order to avoid disruption of your research.

The National Code for Health Research Ethics requires you to comply with all institutional guidelines, rules and regulations and with the tenets of the Code including ensuring that all adverse events are reported promptly to the UI/UCH EC. *No changes are permitted in the research without prior approval by the* UI/UCH EC *except in circumstances outlined in the Code. The* UI/UCH EC *reserves the right to conduct compliance visit to your research site without previous notification.*

UI/UCH EC
9 MAY 2017
APPROVED
COLLEGE OF MEDICINE, U.I.

Professor Catherine O. Falade
Director, IAMRAT
Chairperson, UI/UCH Ethics Committee
E-mail: uiuchec@gmail.com

Research Units • Genetics & Bioethics • Malaria • Environmental Sciences • Epidemiology Research & Service • Behavioural & Social Sciences • Pharmaceutical Sciences • Cancer Research & Services • HIV/AIDS

• Behavioural & Social Sciences • Pharmaceutical Sciences • Cancer Research & Services • HIV/AIDS

INSTITUTE FOR ADVANCED MEDICAL RESEARCH AND TRAINING (IAMRAT)

College of Medicine, University of Ibadan, Ibadan, Nigeria.

Director: **Prof. Catherine O. Falade,** MBBS (Ib), M.Sc., FMCP, FWACP
Tel: 0803 326 4593, 0802 360 9151
e-mail: cfalade@comui.edu.ng lillyfunke@yahoo.com

UI/UCH EC Registration Number: NHREC/05/01/2008a

Notice of Renewal of Approval

Re: Effects of McKenzie, Stabilisation and Combined McKenzie and Stabilisation protocols on clinical and psychosocial variables in individuals with chronic mechanical Low Back Pain

UI/UCH Ethics Committee assigned number: UI/EC/17/0076

Name of Principal Investigator: **Oluwasegun S. Nudamajo**
Address of Principal Investigator: Department of Physiotherapy,
College of Medicine,
University of Ibadan, Ibadan

Date of receipt of annual report: 08/07/2019

Status: **2nd Approval**

This is to inform you that the UI/UCH Ethics Committee has received your application for the renewal of approval on the above titled research. The report indicates that there was delay in starting the research due to some logistics to facilitate the commencement of the study.

The Committee notes the contents of the report and having found it satisfactory, hereby approves your request for renewal of approval for **one year of study only.**

This renewed approval dates from **11/07/2019 to 10/07/2020**. Note that no participant accrued or activity related to this research may be conducted outside of these dates. *All informed consent forms used in this study must carry the UI/UCH Ethics Committee assigned number and duration of UI/UCH EC approval of the study*. It is expected that you submit your annual report as well as an annual request for the project renewal to the UI/UCH EC at least four weeks before the expiration of this approval in order to avoid disruption of your research.

The National Code for Health Research Ethics requires you to comply with all institutional guidelines, rules and regulations and with the tenets of the Code including ensuring that all adverse events are reported promptly to the UI/UCH EC. No changes are permitted in the research without prior approval by the UI/UCH EC except in circumstances outlined in the Code. The UI/UCH EC reserves the right to conduct compliance visit to your research site without previous notification.

UI/UCH EC
11 JUL 2019
APPROVED
COLLEGE OF MEDICINE, U.I.

Professor Catherine O. Falade
Director, IAMRAT
Chairperson, UI/UCH Ethics Committee
E-mail: uiuchec@gmail.com

Research Units • Genetics & Bioethics • Malaria • Environmental Sciences • Epidemiology Research & Service • Behavioural & Social Sciences • Pharmaceutical Sciences • Cancer Research & Services • HIV/AIDS

APPENDIX J

ETHICAL COMMITTEE

LADOKE AKINTOLA UNIVERSITY OF TECHNOLOGY TEACHING HOSPITAL
OGBOMOSO, OYO STATE, NIGERIA
Address: P.M.B 4007, Ogbomoso **Phone:** 08034305136 / 08038188308 **E-Mail:** Lthogbethcom@yahoo.com

Our Ref: LTH/OGB/EC/2016/135 *Your Ref:* ______ *Date:* 5^{TH} JANUARY, 2017

CLEARANCE CERTIFICATE

PROTOCOL NUMBER: **LTH/OGB/EC/2016/135**

PROJECT TITLE: ***Effects of Mckenzie, Stabilisation and Combined Mckenzie and Stabilisation Exercises/ Protocols on Clinical and Psychosocial variables in Individuals With Chronic Mechanical Low Back Pain***

INVESTIGATOR(S): Mr Nudamajo O.S

DEPARTMENT/ INSTITUTION: Department of Physiotherapy, LAUTECH Teaching Hospital Ogbomoso, Oyo State.

DATE OF SUBMITION OF PROTOCOL: 11^{TH} NOVEMBER, 2016

DATE CONSIDERED: 3^{RD} JANUARY, 2017

ETHICAL REVIEW COMMITTEE
Lautech Teaching Hospital
Ogbomoso

DECISION OF THE COMMITTEE: **APPROVED**

CHAIRMAN: Prof. Adeniji A.O.

SIGNATURE AND DATE: 05/01/2017

Cc: Supervisors:

NOTE: THE COMMITTEE IS EXEMPTED FROM LIABILITY OF THE PROPOSAL AND THIS CERTIFICATE WILL BE REVOKED IF PROTOCOLS STATED IN THE PROPOSAL IS DEVIATED FROM.

....

DECLARATION BY INVESTIGATOR(S)

PROTOCOL NUMBER (Please quote in all enquiries): **LTH/OGB/EC/2016/135**

To be completed in four and three copies returned to the Secretary, Ethical Review Committee, Ladoke Akintola University of Technology Teaching Hospital, Ogbomoso, Oyo State, Nigeria.

I /We fully understand the conditions under which I am/we are authorized to conduct the above mentioned research and I/We will ensure compliance with these conditions. Should any departure be contemplated from the research procedure as approved, I/We undertake to resubmit the protocol to the Ethical Review Committee.

Signature.. Date 16-01-17

APPENDIX K

RESEARCH ETHICS COMMITTEE

LADOKE AKINTOLA UNIVERSITY OF TECHNOLOGY TEACHING HOSPITAL

OSOGBO, OSUN STATE, NIGERIA.

Address:
P.M.B 5000, Osogbo
039-200309,
e-mail: researchethicscommittee.lth@gmail.com

PROF. OLUWADIYA K.S - CHAIRMAN
MRS SAM-ASIEGBU Y.U - SECRETARY

Our Ref: LTH/REC/2017/07/25/328
Your Ref:
Date: 25th July, 2017.

CLEARANCE CERTIFICATE

PROTOCOL NUMBER	**LTH/EC/2017/07/328**
PROJECT TITLE:	***Effects of Mckenzie stabilization and combined Mckenzi and stabilization exercises on clinical and psychosocial variables in individuals with chronic mechanical low backpain.***
INVESTIGATOR(S):	Nudamajo Olusegun Sunday
DEPARTMENT / INSTITUTION:	Department of Physiotheraphy, LAUTECH Ogbomoso.
SUBMISSION OF PROTOCOL:	NOVEMBER,2016.
FINAL CONSIDERATION:	JULY, 2017.
DECISION OF THE COMMITTEE:	**APPROVED**
CHAIRMAN:	**Prof. Oluwadiya K. S (FMCS)**
SIGNATURE & DATE:	....

NOTE: THE COMMITTEE IS EXEMPTED FROM LIABILTY OF THE PROPOSAL AND THIS CERTIFICATE WILL BE REVOKED IF PROTOCOLS STATED IN THE PROPOSAL IS DEVIATED FROM.

DECLARATION BY INVESTIGATOR (S)

PROTOCOL NUMBER (Please quote in all enquiries): **LTH/EC/2017/07/328**

To be completed in four and three copies returned to the secretary, Ethics and Research Committee, Ladoke Akintola University of Technology Teaching Hospital, Osogbo, Osun State, Nigeria.

I/We fully understand the conditions under which I am/we are authorized to conduct the above – mentioned research and I/We will ensure compliance with these conditions. Should any departure be contemplated from the research procedure as approved, I/We undertake to resubmit the protocol to the Ethics and Research Committee.

Signature.. Date 4th Aug., 2017.........................

APPENDIX L

INFORMED CONSENT FORM

IRB Research approval number……………………

This approval will lapse on: / /

Title of the research: **Effects of combined McKenzie technique and Lumbar stabilisation exercise on psychosocial and clinical symptoms of individuals with chronic mechanical low back pain.**

Names and affiliation of research applicant:

This study is being conducted by NUDAMAJO, Oluwasegun Sunday of the Physiotherapy Department, College of Medicine, University of Ibadan.

Purpose of research:

The purpose of the research is to find out the effects of two exercise protocols on chronic mechanical low back pain, and which of the exercise will help better in alleviating/ managing the symptoms experienced by chronic low back pain patients.

Procedure of the research, what will be required of each participant and approximate total number of participants that would be involved in the research:

A total of 141 participants will be recruited into the study. The participants will be divided into 3 groups recruited from 3 study centres. You will receive instruction/ explanation on the specific exercise protocol peculiar to your study centre. You will go through the stages of the exercise protocol, and equally receive back care education and the pamphlet, in addition to home exercise programme. You are not expected to carry out any other form of exercise during the course of this study. You will be treated in the clinic with the exercise 2 times in a week, and your improvement with exercise assessed at the end of every 4 weeks of treatment.

Expected duration of research and of participant's involvement:

In total, I expect you to be involved in this research for 8 weeks. You should not spend more than 1 hour at each clinic visit.

Risk:

There are no known risk(s) to the utilisation of the exercises in clinical practise.

Costs to the participants:

Your participation in this research will be at no extra cost to you aside the usual fee for clinic attendance.

Benefits:

The goal of the research is to find ways of relieving your symptoms quickly. It is hoped that the exercise protocol will help in early resolution of the symptoms you presently have.

Confidentiality:

All information collected in this study will be coded in numbers, and no name will be recorded. This is to ensure that the information cannot be linked to you in anyway, and your name or any form of identification will not be used in any publication or reports from this study.

Voluntariness:

Your participation in this study is entirely voluntary.

Alternatives to participation:

If you choose not to participate, this will in no way affect your treatment in this hospital.

Consequences of participants' decision to withdraw from research and procedure for orderly termination of participation:

You can also choose to withdraw from the research at any time. Please note that some of the information that has been obtained about you before you choose to withdraw may have been modified or used in reports and publications. These cannot be removed anymore. However I promise to make good effort in good faith to comply with your wishes as much as is practicable.

Modality of providing treatment and action to be taken I case of injury or adverse event:

If you suffer any adverse effect as a result of participating in this research, you will be treated in the facility where you are participating at no cost to you. I will bear the cost of treatment.

What happens to research participants and communities when the research is completed?

The outcome of the research will be published for the benefit of larger society.

Statement of person obtaining informed consent:

I have fully explained this research to…………………………………………………………………………………………

and have given sufficient information, including about risks and benefits, to make an informed decision.

DATE:……………………………………………….
SIGNATURE:…………………………………………………………

NAME:………

Statement of the person giving consent:

I have read the description of the research and have had it translated in to language I understand. I have also discussed with the physiotherapist to my satisfaction. I understand that my participation is voluntary. I know enough about the purpose, methods, risks and benefits of the research study to judge that I want to take part in it. I understand that I may freely stop being part of this study at any time. I have received a copy of this consent form and additional information sheet to keep for myself.

DATE:………………………………………………
SIGNATURE:…………………………………………………………………….

NAME:………

Detailed contact information including contact address, telephone, and e-mail of researcher, institutional HREC and Head of Department:

This research has been approved by the Ethics Committee of the University of Ibadan and the Chairman of this Committee can be contacted at Biode Building, Room 210, 2nd Floor, Institute for Advanced Medical Research and Training, College of Medicine, University of Ibadan, E-Mail: uiuchirc@yahoo.com and uiuchec@gmail.com

In addition, if you have any question about your participation in this research, you can contact the principal investigator: NUDAMAJO, Oluwasegun Sunday

Department: Physiotherapy Phone: 08035261430/ 08055602316

E-mail: segun_nuda@yahoo.com

APPENDIX M

IWE IFOWOSI OLUKOPA

I R B Research Approval Number……………………………………………..

Iyonda yi yio dopin ni……………………………………………..

Koko Iwadi naa:

Ipa ti ere idaraya Mckenzie, Stabilization, ati apapo re yio ni lori awon abala asayan ni ara awon ti ogooro eyin didun olojo pipe nda lamu.

Oruko ati eka eko oluwadii:

Eko yii wa ni abe akoso NUDAMAJO, Oluwasegun Sunday ti eka imo isegun ilera ara ni Yunifasiti Ilu Ibadan (Physiotherapy Department, College of Medicine, University of Ibadan).

Eredi iwadii:

Eredi iwadi naa ni lati se awari okan ti o dara ju ninu elo iwadi naa ti yoo kapa imolara ogooro eyin didun. (Chronic Low Back Pain)

Igbese inu iwadii, ohun ti a n reti lodo olukopa kookan ati iye olukopa ti a nilo ninu eto iwadii:

Apapo Olukopa labe eko yii yoo je ogojoodinmerin (52). A o pin awon olukopa yii si ona meta labe eto meteeta ti a o ti ko won lekoo. A o gba itoni/alaye lorii eto eko won ni ibamu pelu ibi ikekoo re, o o la gbogbo ipele eto eko naa koja. Bakan naa, o o ko eko lori bi ase nse itoju eyin ati iwe itoni sona. Ni afikun si eto idaraya ninu ile, ko nilo ki o se ohun miran. Ni akoko yii iwo yoo gba itoju ni iyara ilera (clinic) pelu idanilekoo leemeji lose (2 times in a week). A o si maa ye bi o ba se n bo sipo wo leyin ose meji ti o ba ti gba itoju.

Iduwon iwadii ati ikopa olukopa:

Iye awon olukopa ti mo n reti ninu iwadii yii yoo lo ose mejo (8 week). O ko gbodo lo, ju wakati kan ni ile eleto ilera ti o bakan si.

Ewu:

Ko si ewu kan ti o ro mo sisanmuto eto ilera yii.

Ohun ti yoo na olukopa:

Ikopa re ninu iwadi yii ko nii na o ni ohun miiran yato si iye ti o o san fun awon eleto ilera.

Anfaani:

Afojusun iwadi yii ni lati din imolara ailera reku. A lero wipe awon to wa ni igbonnu eto yii yoo se iranlowo lati pinwo imolara ti oni lowolowo

Idaniloju:

Gbogbo alaye ti o wa ninu eko yii ni a o lo nomba fun ti a ko si ni ko oruko ati ohun idanimo kankan si fun ipolongo tabi jabo eko yii.

Yiyonda ara eni:

Ikopa re ni ibi eto eko yii je ofe.

Awon igbese miran si kikopa:

Bi o ba yan lati ma kopa, aikopa re ko ni ki a ma se itoju re ninu ile iwosan yii.

Atubotan ipinnu olukopa fun kikuro ninu iwadi sise ati eto fun kikuro ninu iwadi patapata:

O le e yan lati kan fa seyin ninu iwadi yii ni igba ti o ba wu o. Jowo je ki o ye o wipe ati gba awon akosile kan nipa re tele ri ki o to yan lati kuro lati se jabo tabi se alaye. Eleyi ko lee se mu kuro mo. Mo se ileri lati sa ipa mi ninu igbagbo lati tele ife okan yin bi o ba se se e se si.

Ipese itoju ati igbese ti a ni lati tele nigba ti ijamba tabi ewu ba sele:

Ti o ba ni imolara kan ti o lodi nipase kikopa ninu iwadi yii o o gba itoju ninu awon ohun eto ibi ti o ti n kopa lai la owo lo. Emi ni yo san owo naa.

Ohun ti yoo sele si olukopa ati igbimo nigba ti iwadi ba dopin:

Abajade iwadii naa yoo di tite jade fun anfaani awujo lapapo.

Oro eni ti o gba lati kopa:

Mo ti se orin-kinni win alaye iwadi yii si……………………………………… mo si ti fun un ni idanileko to ye kooro paapaa julo lori ewu ati anfaani gbigba lati kopa.

DEETI ……………………………. IFOWOSI……………………………………

ORUKO……………………………………………………………………………

Oro eni ti ose tan lati kopa:

Mo ti ka alaye iwadii yii mo si ti tumo re si ede ti oye mi julo. Mo ti forojewo pelu onimo nipa eto ilera ago ara. O wa ye mi wipe ikopa mi yii kii se afipase. Mo ti mo nipa eredi, eto, ewu ati anfaani iwadi ijinle ti mo fe nipin ninu re. Mo mo wipe mo lee kuro ninu eto eko yii nigba ti o ba wu mi. Mo ti gba eda foomu idarapo yii ati ti alaye lori re fun itosona.

DEETI……………………………………IFOWOSI…………………………………

ORUKO………………………………………………………………………………

Idanimo: adiresi, ero ilewo ati e-mail oluwadi, institutional HREC ati Olorii eka ikeko (Head of department):

A ti bu owo lu iwadi lati odo Ethics Committee of University of Ibadan. A le kan si alaga igbimo yii ni Biode, Room 210, ni Institution for Advanced Medical Research and Training, College of Medicine, University of Ibadan, E-mail: uiuchirc@yahoo.com ati uiuchec@gmail.com

Ni afikun, ti o ba ni ibeere nipa kikopa ninu iwadi yii o lee kan si olori asewadi: NUDAMAJO Oluwasegun Sunday.

Department: Physiotherapy Phone: 08035261430/ 08055602316

E-mail: segun_nuda@yahoo.com

APPENDIX N

BACK CARE EDUCATION

1: Avoid prolonged sitting, bending, stooping and squatting.

2: Interrupt static posture every 30 minutes before development of any discomfort.

3: Maintain the hollow in the low back in sitting and other postures.

4: Use supportive roll/ cushion placed in the hollow of the back in sitting position at home.

5: Avoid sitting on low chairs, stools and soft couch with deep seat.

6: Use a firm, high chair with a good confortable back support.

7: Consciously control and maintain good upright posture when sitting on a seat without back rest.

8: Avoid lifting heavy loads as much as possible; when you have to lift, carry only a moderate load. Before lifting or carrying load, extend your back 5 times, and after lifting/ carrying the load extend your back 3 times.

9: Carry out your back exercises daily- bend backward 5 times daily with hands placed in the hollow of your back every hour.

ILLUSTRATION PAMPHLET FOR YOUR BACK CARE

Please follow the instructions below carefully:

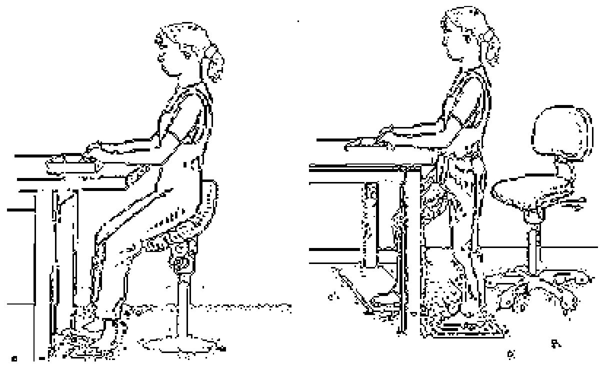
1. Avoid prolong sitting

2. Avoid bending

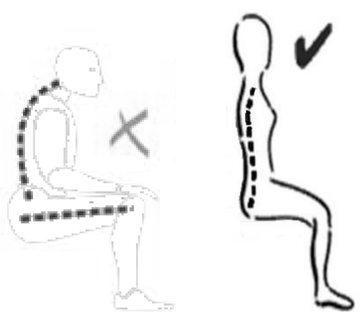
3. Avoid stooping

4. Avoid squatting

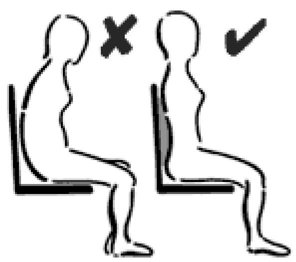
5. Interrupt static posture every thirty minutes before developing any discomfort



6. Maintain lumbar lordosis (hollow in the low back) in sitting and other postures.

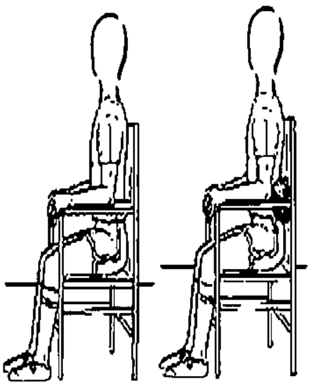


7. Use supportive roll/cushion placed in the hollow of the back in sitting position

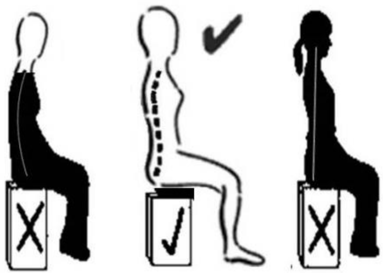


8. Avoid sitting on low chairs, stool and soft couch with deep seat as much as possible.

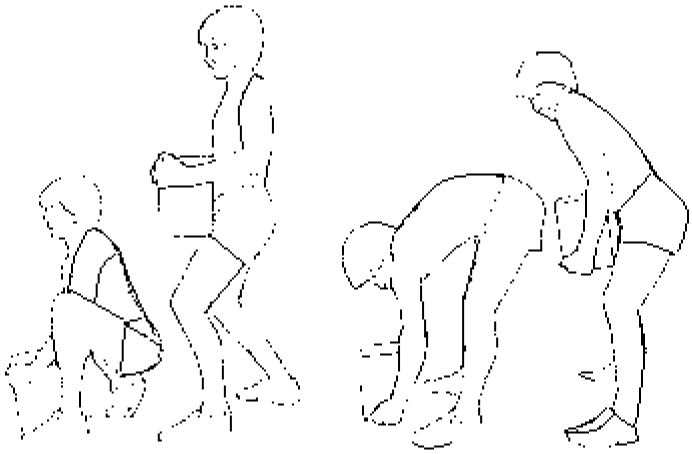
9. Use a firm, high chair with a good comfortable back support;



10. Consciously control and maintain good upright posture when sitting on a seat without back rest or support



11. Avoid lifting a heavy load as much as possible - when you have to lift, carry only a moderate load.



12. Carry out your back exercises daily - bend backward five (5) times with hand placed in the hollow of your back every two hour

N.B: **Regularly look through the postal illustrations to remind yourself of what you need**

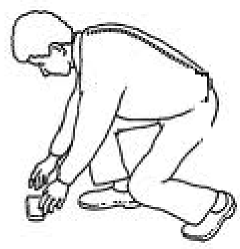
APPENDIX O

FÚN IGBÀÁDÙN ÈYÌN ÀTI ÀLÁÁFÍÀ RE, TẸ̀LE ÀWON ÌLÀNÀ TÓ WÀ NÍSÀLẸ̀ YÌÍ

1. Yera fún ìjókòó pípé,

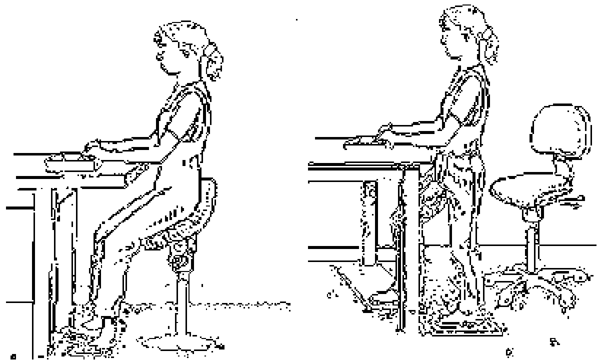
2. Yera fún bíbèrè mólè

3. Yera fún ìlósòó

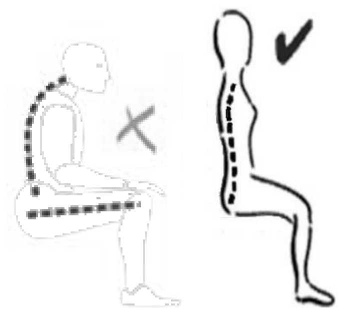


4. Yera fún títiro

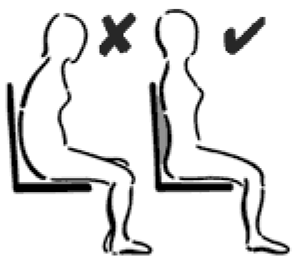
5. Máa pàrò ipò ara léhìn ogbòn ìséjú tí o bá jókòó, kú ara tó ni ó.



6. Jé kí eegun ìbàdìí re nàró tí o bá jókòó.

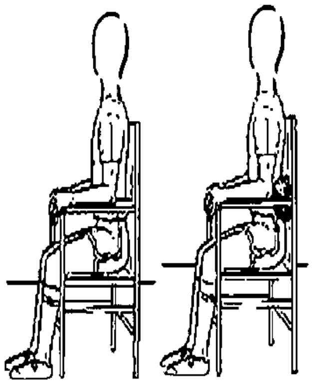


7. Fi nnkan to fuye ti ehin re ti o ba jókòó



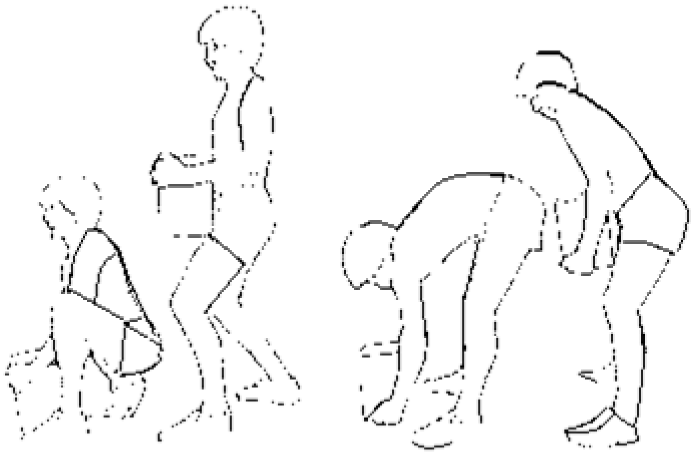
8. Yera fún jijókò lóri àga tí kò ga, àpóti àti ijókò tó rọ ti ò niho

9. Lo àga tó lágbára, tí ó ga, tí ó sí nì ìfèhìntì.



10. Mòómò jókòó dáadáa nígbàkugbà tí o kò bá lo ohun ìtì èhìn.

11. Sóra fún gbígbé erù wúwo-nígbà tí ó bá pon dandan, gbé ìwònba.



12. Máa se eré amárale fún èyìn l’ójojúmó, tè s’èhìn léémáàrún-wò, nípa fífi ọwó te ìbàráàdí s’íwájú ní wákàátí méjì

Àkíyèsí pàtàkì: Máa wo àwòrán asàpèjúwe ní gbogbo ìgbà láti rán ara rèe létí àwon ohun tí o ní láti se.