THE EFFECTS OF PROPRIOCEPTIVE NEUROMUSCULAR FACILITATION AND MCKENZIE METHOD IN NON-SPECIFIC LOW BACK PAIN AMONG UNIVERSITY POPULATION

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DEDICATION

I dedicate this piece of work to my LORD and Saviour Jesus Christ, the source of my all. “The fear of the LORD is the beginning of knowledge: but fools despise wisdom and instruction” *Proverbs 1: 7*.

To my father, Mr Ridwan Panjaitan and my mother, Mrs Purnama Tampubolon, My Sister, Irene M Panjaitan and my brother Rocky S Panjaitan. Thank you for every love, care, support to me to continue my study in Malaysia.

To my university, Christian University of Indonesia, especially Physiotherapy program, all of the lectures and staffs that support and sponsored me to continue study overseas.

ABSTRACT

University population consists of student and staff, where their daily activities predisposed them to prolonged sitting. Prolonged sitting has been identified as one of the factors leading to non-specific low back pain among university students and staffs. Exercise therapy is one of the mainstays in the management of non-specific low back pain. One of the most common exercise therapy for non-specific low back pain is the McKenzie method, whereas the Proprioceptive Neuromuscular Facilitation (PNF) exercise is seldom been used to treat non-specific low back pain cases. There were no studies being done to compare these two techniques on its effectiveness for PNF and McKenzie method on non-specific low back pain among university population. In this study, a quasi-experimental study involving 36 subjects (students and staffs) from the university population that participating based on the selection criteria set by the study protocols. The subjects were randomly assigned to three treatment groups: PNF group, McKenzie group and control group (hot pack and educational home exercise sheet) which underwent 12 treatment sessions distributed over three times in a week for four weeks duration. Subjects were measured on pain using visual analogue scale, lumbar range of motion by modified Schober method, functional ability by Oswestry disability index and health-related quality of life by SF-12. Measurement was performed at three points: pre-test, mid-test and post-test. Repeated measures ANOVA were used to analyse the study results. The within-between groups analysis performed to analyse the difference of the effect between of three treatments based on the measurement time. This study showed that there was significant mean difference between PNF and McKenzie method on pain score (p=0.037)and functional ability score (p=0.011) after 4 weeks. The study also showed no significant mean difference on lumbar flexion (p=0.100) and extension (p=0.127) ROM and Physical Component Summary (p=0.659) and Mental Component Summary (p=0.657) of SF-12 after 4 weeks. Subsequently, the study findings showed that the PNF exercise has more significant in reducing the pain and improving the functional disability than the McKenzie method among the university population. Furthermore, the PNF and McKenzie method showed no significant difference in improvement of lumbar ROM and health-related quality of life.

Keywords: Proprioceptive Neuromuscular Facilitation, McKenzie method, non-specific low back pain, student, staff

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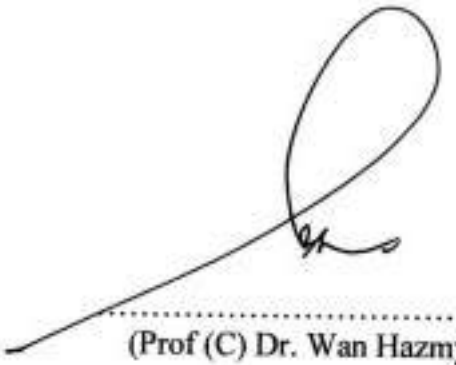
STATEMENT OF SUPERVISOR

"We declare that we have read this thesis and in our opinion, this thesis is sufficient in terms of scope and quality for the award of the degree of Master of Physiotherapy"

19 November 2018



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(Prof (C) Dr. Wan Hazmy Che Hon)

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STATEMENT OF STUDENT

"I, Lucky Anggiat, hereby declare that this thesis entitled The Effects of Proprioceptive Neuromuscular Facilitation and McKenzie Method in Non-specific Low Back Pain among University Population is based on my original work except for quotations and citations which have been duly acknowledged. I also declare that it has not been previously or concurrently submitted for any other degree at KPJ Healthcare University College or other institutions.

19 November 2018

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(Lucky Anggiat)

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LIST OF ABBREVIATIONS

LBP - Low Back Pain

PNF - Proprioceptive Neuromuscular Facilitation

RST - Rhythmical Stabilisation Training

COI - Combination of Isotonic

VAS - Visual Analogue Scale

ROM - Range of Motion

HRQoL - Health-related Quality of Life

SF-12 - Short Form 12

CHAPTER 1

INTRODUCTION

In this chapter, the background of the study, problem statement, objectives of the study, hypothesis and significance of the study have been discussed in detail one after the other.

1.1 BACKGROUND

Students usually attended the classroom session for the theories input and at the same time working in front of computer to browse through for resources, which involved prolonged sitting in most of their daily activities (AlShayhan and Saadeddin, 2017 ; Vincent-Onabajo et al., 2016). The study by Voon et al. (2013) have shown, the total of about 64.7% students who spent at least 90 minutes, sitting while attending the classroom theory session, and students sitting with working on computers for 45 minutes, 60 minutes and 90 minutes or more in a day were reported respectively by 10%, 18.4 % and 61.6 %. Another study by Nordin, Devinder, and Kanglun (2014) also revealed similar results, with which 31% of students usually sat in the classroom or working in front of the computers everyday between 6 to 8 hours. Similarly, majority of the support staffs working in the university, sit more than 4 hours daily with 90.8% prevalence while other staffs who sit in the same position working usually leave their office chair only for 10 minutes or less each day have scored about 65.8% prevalence (Damanhuri et al., 2014).

Study by Voon et al. (2013) also emphasized that students involved doing the educational activities weekly for more than 5 days for at least 90 minutes per session, have reported about 53.4% of the students suffered with LBP. Similar study in Taif University, Saudi Arabia found 30% of students suffered LBP (Issa et al., 2016). Whereas, a study at Mumbai, India, shown 352 per 1000 students of physiotherapy suffered from mechanical LBP. Majority of these students suffered from mild disability and the most affected activity was unable to stand (Patil et al. 2016). A study done by Nordin Devinder and Kanglun (2014) on the health sciences undergraduate students have demonstrated approximately 60% of younger population experience LBP due to their physical fitness and sitting for too long. A study by Arsh and Jan (2015), reported that 57.8% of student which spending time more than 3 hours in a day to prolonged sitting have experienced LBP while another 26.7% student with prolonged sitting less than three hours in a day also experienced LBP.

Damanhuri et al. (2014) also discovered the prevalence of LBP among office workers in University Putra Malaysia was 37%, with which is equivalence to about one-third of the office workers population, while Mozafari et al. (2014) reported, that office workers population that being affected by LBP is approximately 12.1% and that is the second prevalence finding on the office workers. Similarly with LBP that affect the students, some factors that contributed to the low back pain were sitting posture with the rounded back and crossed leg was 45% of the total population and another factor is the time spent on prolonged sitting, due to the routine of academic activities carried every day (Casas et al.,2016).

Initially the most common affected anatomical areas among office workers that were found to be high with musculoskeletal pain were the shoulders and low back, which significantly associated between individual factors, work ergonomics due to inappropriate posture and movements (Kaliniene et al., 2016). They also shared their finding by indicating that the work-related psychosocial factors have had a significant impact on experiencing pain as well with high quantitative demands, which was associated with musculoskeletal complaints in most of the anatomical

areas, and weak social support was a significant predictor for musculoskeletal complaints in the upper and low back areas.

Another study conducted in Australia by Safe Work Australia (2016) on musculoskeletal disorders for 5 years from 2009 to 2014 reported that LBP prevalence including lumbago was 6.4%, which showed that the results were higher than 6 other musculoskeletal disorders such as tendinitis (3.3%), disk displacement (3.1%), muscle or tendon tension (3.0%), excessive use syndrome (1.3%), bursitis (1.2%) and epicondylitis (1.0%). Whereas the study in Turkey on prevalence of work-related musculoskeletal discomforts have showed that the participants, which were the office workers, who have had reported with musculoskeletal symptoms, most commonly in the neck (67.85%), upper back (66.33%), lower back (59.49%), right shoulder (45.32%) and left shoulder (43.54%) (Ardahan and Simsek, 2016).

Several other studies have had concluded that students and supports staffs having similar habits with sitting for too long working or study and remain on a prolonged uncomfortable posture with high static muscle load (Casas et al., 2016; Voon et al., 2013 ; Mozafari et al., 2015). Prolonged sitting is one of the factors causing musculoskeletal pain specifically the office staffs who suffered from having low back pain (LBP) which commonly reported. A study done from one of the University in Columbia, found that 45% of the university population were having severe chronic pain specifically in the lower back region, which led several limitations during academic activities at the range of about 29.8% (Casas et al., 2016).

The low back pain consists of two types, which is specific and non-specific low back pain. Specific back pain can be divided into low back pain that related with vertebrae and non-vertebrae, but non-specific low back pain developed from the soft tissue, which is poorly localized. Low Back pain has two classifications; an acute stage, which pain lasts less than 12 weeks and chronic stage, which pain lasts more than 12 weeks (Husein et al., 2009). In addition, non-specific low back pain is classified into low back pain, which is not related to the neurological problem and degenerative syndrome (Taguchi, 2003). Some anatomical related factors can be

contributed to the incidence of low back pain. Prolonged sitting led to increased body discomfort in the neck, shoulder, upper back, low back, and buttock while prolonged slumped sitting may be related to internal oblique or transverse abdominis muscle fatigue, which compromise the stability of the spine, making it vulnerable to injury (Waongenngarm et al., 2015). Low back pain may develop by some factors such as increased lumbar lordosis, reduced abdominal muscle length and strength, together with decreased back extensor muscle endurance, back extensor muscle flexibility, length of iliopsoas, hamstring muscle flexibility, body composition and others (Koley et al., and Koley et al., 2010). A research by Mistry et al. (2014) also showed that there is a significant difference of hamstring tightness and tightness of gastrocnemius muscle between patient with low back pain and healthy individual. Mobility of the spine reduced causing disorders in muscle synergies and consequently increased the energy cost of maintaining postural ability (Gawda et al., 2015).

From all the above studies reported, both office workers and students are at risk of developing low back pain, which has been proven in some research studies that LBP have negative impact to their activities in the university. A study by Casas et al. (2016), found that the prevalence of limitation for academic activities was almost 30% and which affected both office workers and students, on their daily life activities and causing potential effect on both office workers and students quality of life. The limitation in academic activities due to pain was 29.8% and other research concluded moderate disability due to LBP among physiotherapy students in Mumbai (Patil, et al., 2016). The similar potential risk happened to office workers suffering from LBP. An employee with LBP usually takes a day off from their work for medical check-ups, which consequently, drop the company's productivity if it has a significant number of employees absent from work due to having LBP (Ramdan et al., 2014). A systematic review research discovered that 32% of the office workers were absent from work because of LBP and would be on long-term medical leave until recovered (Wynne-Jones et al., 2013). Previous study also indicated that the office worker will usually take a day offs for their work for the medical check-ups or having a moderate risk of low back pain which will affect the work productivity (Punnett et al., 2003). Moreover, the students suffering with LBP will be on medical

leaves and this may influence their academic activity, such as attendance to the class for theory input. Moderate LBP also showed a bad impact on the student (Patil et al., 2016).

There are several options and suggestions on the treatment to reduce LBP in the population (Castellini et al., 2016; Delitto et al., 2012; Koes et al., 2010). A study reported that the most common treatment used by most physiotherapist are the superficial heat, ultrasound, cold packs, massage and electrical stimulation; however, all these treatments are to relieve the symptoms only which provides analgesia and muscle relaxation (Arya, 2014). General exercise for low back pain also one of physiotherapy treatment that can promote the strengthening of muscle that supports the spine (Gordon and Bloxham, 2016). Exercise therapy was found to be the best choice to reduce low back pain and increase body functions in adult people who suffered from low back pain (Scharrer et al., 2012). Sihawong, Janwantanakul, and Jiamjarasrangsi (2014) emphasized that exercise program consisting of muscle stretching and endurance seems to be an effective intervention to reduce low back pain for office workers. A systematic review study on LBP also showed that exercise therapy has attracted most RCTs research interest (Castellini et al., 2016). A health care guidelines produced by Institute for Clinical System Improvement (ICSI) also recommended the use of self-management or educational exercise and heat as a first-line treatment of non-specific LBP (Goerzt et al., 2012).

The therapeutic exercise for LBP uncommonly performed by physiotherapist is Proprioceptive Neuromuscular Facilitation (PNF), despite this treatment is commonly used for neurological conditions (Westwater-Wood, Adams and Kerry, 2010). Proprioceptive Neuromuscular Facilitation has been recommended for sensory-motor control training, as well as for stimulating lumbar muscle proprioception (Lee, 2009). Combination of PNF patterns training for six weeks showed more effective comparing to performing ball exercise for low back pain (Young, Je, and Hwa, 2015; Lee, Hwangbo, and Lee, 2014). In other studies, in comparing modalities of exercises therapy, PNF was shown to have better result than manual therapy, core stability exercise and ball exercise for LBP and commonly used

for the trunk muscle, pelvic stability, and core muscle (Park and Wang, 2015; Lee, Hwangbo, Lee, 2014; Kumar et al., 2011; Johnson and Johnson, 2002).

A commonly used exercise therapy for LBP was developed by Brian McKenzie, which was recognised as McKenzie method. A systematic review study reported that McKenzie therapy is more effective than the comparison treatment at short-term follow up for spinal pain. The comparative treatments in these trials include NSAIDs, educational booklet, back massage with back care advice, strength training and spinal mobilization and general mobility exercises (Clare, Adam and Maher, 2004). At the same time other research performed with a comparative study of McKenzie and Back school treatment showed that McKenzie method have good results compared to Back School treatment (Garcia et al., 2011). McKenzie method can be a familiar treatment and is one of the common choices used by most physiotherapists for treating low back pain (Clare, Adam and Maher, 2004).

Based on several studies, LBP was found effect to the level of physical activities in every individual (Suzuki et al., 2016; Balakrishnan, Chellappan and Thenmozhi, 2016; Punnet et al., 2005). In order to determine the impact of LBP in physical activities, it is not only depend on the evaluation based on the pain, but also on some functional disability and range of motion, which is inter-related (Janwantanakul, Sihawong, Sitthipornvorakul and Paksaichol, 2015). The main assessment for LBP in some research is by using the pain scale assessment and this includes not only the original Visual Analogue Scale (VAS) but also the modified VAS. The VAS is a well-known assessment tools for pain and recommended as a means of rating the subjective intensity of pain, with scale ranging from “none” to “worst imaginable pain” (Casser, Seddigh and Rauschmann, 2016).

Pain in low back, can be one of contributing factors in reducing flexibility of lumbar spine (Lee et al., 2010). A study by Wong and Lee (2004) describe that there is a correlation between patient with LBP and the decreased lumbar ROM. The flexibility of lumbar spine is related with lumbar range of motion. They also conclude to evaluate the lumbar ROM into account of the effects of back pain after the treatment. In order to evaluate the flexibility of lumbar range of motion, some

researchers decided to use measuring tape (Park and Seo, 2014; Franklin et al., 2013). Tape measurements were the least expensive method to measure spinal movement and perhaps the easiest to use (Reese and Bandy, 2002). In order to measure flexion and extension of lumbar, modified Schober method was used (Sihawong et al., 2016), while lateral flexion is measured using fingertip-to-floor method (Reese and Bandy, 2002). However, flexion and extension were the most commonly used as the main evaluation of lumbar range of motion in low back pain cases (Park and Seo, 2014; Franklin et al., 2013, Kumar et al., 2011).

A study reported that the patients who have high pain score may also be at risk of developing disability (Melton et al., 2016). They also identified that to evaluate disability, should to use disability assessment along with pain measurement. Another study found that there is a correlation between pain and disability, which is the higher pain score in LBP, was correlated with the higher score of disability among working individuals (Davis et al., 2013). Some activity that affected with low back pain were indoor and outdoor mobility, climbing and descending stairs, walking, dressing, eating, using the toilet and using public transportation (Di Iorio et al., 2007). Several researchers suggested the use of the Oswestry Disability Index (ODI) for assessment of functional disability caused by LBP (Seif et al., 2015; Park et al., 2014; Vincent et al., 2014; Young et al., 2013). The Oswestry low-back pain disability index (ODI) was made for low back pain condition to assess the disability and it was known as the gold standard of functional outcomes of the lower back (Seif et al., 2015). A research by Fairbank and Pynsent (2000), concluded in their study that the ODI has been published in at least four formats in English and in nine other languages. The ODI has been approved with several evaluations. It has been used in a wide variety of applications with a specific outcome measure of spine-related or low back pain disability. Meta-analysis review found that the ODI scores from different spinal diseases and the changes after treatment were consistent with clinical experience. Questionnaires on the ODI comprised 10 items categorized from 0 to 5, with higher ratings indicating increased levels of disability. The sum of the scores was presented as a percentage, where 0% represented no disability and 100% maximal disability (Myhre et al., 2013).

Prolonged severe low back pain will also affect the quality of life of the patient or university population. The impact of low back pain on quality of life can be due to the severity of pain (Montgomery et al., 2016). They also conclude that the impact of LBP with severe pain on quality of life also related with physical functioning, mental health, worker productivity and daily activity. Another study by Tsuji et al. (2016) also reported that the higher pain score associated with lower health-related quality of life as well as the lower productivity among workers with LBP. They also suggested analysing the quality of life among LBP patient care as essential assessment. Study by Kabir-Mokamelkhah, Bahrami-Ahmadi and Aghili (2016) also found that the office worker that had a LBP also had lower quality of life. They also revealed that the lower quality of life related with higher work-related stress score. Kennedy et al. (2012) reported LBP also affected to psychosocial variables, which is feeling sad, overwhelmed and exhausted that related with quality of life among students.

Quality of life can be measured by some instruments and commonly referred to Health-related quality of life (HRQoL). The instruments are classified as generic, condition specific, or patient specific. To assess the HRQoL in low back pain population, condition-specific instrument of HRQoL can be used. The HRQoL is a multidimensional concept that refers to function and well-being on various dimensions of health, including physical, emotional, social and spiritual aspects of life (Younsi, 2015). One of the HRQoL instruments that can be used to assess the quality of life on low back pain patient is the Short Form 12-items Health Survey (SF-12) (Resnik and Dobrzykowsky, 2003). The SF-12 is a multipurpose short form generic measure of health status (Ware et al.,1995).

The SF-12 contains 12-items subset of the original 36 items in the SF-36 with the same eight domains which being examined, including physical function, physical role, bodily pain, general health, social functioning, vitality, emotional roles, and mental health. The SF-12 has been found to be reliable and sensitive in several different paradigms and conditions including longitudinal studies, stroke, pancreatitis, fibromyalgia, and low back pain (Johnson et al.,2011).

From all studies above founds that exercise therapy is one of the mainstay of treatment for LBP. Some of study have been revealed the good effect of PNF and McKenzie method on non-specific LBP (Clare, Adam and Maher, 2004 ; Garcia et al., 2011; Park and Wang, 2015 ; Kumar et al., 2011). However, there is no comparison between the PNF and McKenzie method in those treatment effects on LBP.

1.2 PROBLEM STATEMENT

Based on the review study, it can be concluded that doing exercises will help individuals with back pain because it will not increase the risk of future back pain or injuries and prolong medical leaves (Rainville et al., 2003). The researchers also found the substantial evidence that support on the use of therapeutic exercise as a tool to improve impairments in low back flexibility and help reduce disability. A systematic review, which was published on the randomized control trials (RCTs) which focuses on the intervention for LBP showed that exercise therapy had the most research interest, even though the limitation of the studies was the absent of the specific exercise therapy (Castellini et al., 2016).

There were several studies performed the specific exercises to treat LBP, such as McKenzie method, PNF, ball exercise, yoga, spinal stabilization exercise, Mat based Pilates and ordinary exercise like aerobic exercise with good result for LBP condition (Gracia, 2016; Kumar et al., 2011; Park, 2015; Young et al., 2015 ; Lee, 2014; Clare et al., 2004; Johnson et al., 2002). A review study concluded that PNF has been used for many different types of impairments as a comprehensive exercise for rehabilitation, including the LBP condition (Smedes et al., 2016). The PNF was more focus on sensory-motor control training and stimulating the lumbar muscle proprioception and also as an endurance exercise for the muscle to reduce the LBP (Lee, 2009 ; Kofotolis and Kellis, 2006). Initially, McKenzie method designed as exercise therapy only for LBP condition (McKenzie, 2011). The purpose of the McKenzie method was postural correction, maintenance of the correct posture and restore the flexibility of the back muscles to reduce the LBP (Garcia et al. 2016; Clare, Adam and Maher, 2004). Comparison between these two treatments is

important for physiotherapist to choose which exercise approach can give more improvement in reducing the LBP. However, from all previous studies did not do any comparison between PNF exercise and McKenzie method to verify the effectiveness of each treatment for non-specific LBP.

Hence, the strength of this study is its ability to explore more on PNF exercise and the McKenzie method, to identify which one is more effective to treat the non-specific LBP in the university population, which consist of both students and staffs. Thus, the present study will focus more, to compare on both interventions and to evaluate the low back pain, lumbar ROM, functional disability and health-related quality of life. The use of PNF among physiotherapist most commonly for neurological condition, despite there was some research also showed the effect of PNF on musculoskeletal condition (Westwater-Wood, Adams and Kerry, 2010 ; Smedes et al., 2016). However, the PNF was not common than the McKenzie method on LBP condition in physiotherapy practice (Delitto et al., 2012). At the beginning, the McKenzie method was developed only for LBP condition while the concepts of PNF also can be applied in every condition including LBP (Delitto et al., 2012 ; Smedes et al., 2016). This comparison will determine the effect of PNF in LBP condition compare with the common McKenzie method and introduce the use of PNF in wider rehabilitation condition rather than for neurological condition.

1.3 RESEARCH OBJECTIVES

1.3.1 General Objective

To determine the effect of intervention between PNF and McKenzie method in non-specific low back pain among university population.

1.3.2 Specific Objectives

1. To compare the effect of PNF exercise and McKenzie method on pain in non-specific low back pain among university population.

2. To compare the effect of PNF exercise and McKenzie on lumbar range of motion in non-specific low back pain among university population.
3. To compare the effect of PNF exercise and McKenzie on functional ability for low back in non-specific low back pain among university populations.
4. To compare the effect of PNF exercise and McKenzie on health-related quality of life in non-specific low back pain among university population.

1.4 RESEARCH HYPOTHESES

This study had the following null hypotheses:

1.4.1 There is no significant difference between PNF and McKenzie method in Non-Specific Low Back Pain among university population.

1.4.2 There is no significant difference between PNF Exercise and McKenzie method on pain in non-specific low back pain among university population.

1.4.3 There is no significant difference between PNF Exercise and McKenzie method on lumbar range of motion in non-specific low back pain among university population.

1.4.4 There is no significant difference between PNF Exercise and McKenzie method on functional ability for low back in non-specific low back pain among university population.

1.4.5 There is no significant difference between PNF Exercise and McKenzie method on health-related quality of life for low back in non-specific low back pain among university population.

The alternate hypotheses are:

1.4.6 There is significant difference between PNF and McKenzie method in Non-Specific Low Back Pain among university population.

1.4.7 There is significant difference between PNF Exercise and McKenzie method on pain in non-specific low back pain among university population.

1.4.8 There is a significant difference between PNF Exercise and McKenzie method on lumbar range of motion in non-specific low back pain among university population.

1.4.9 There is a significant difference between PNF Exercise and McKenzie method on functional ability for low back in non-specific low back pain among university population.

1.4.10 There is significant difference between PNF Exercise and McKenzie method on health-related quality of life for low back in non-specific low back pain among university population.

1.5 SIGNIFICANCE OF STUDY

Subsequently, the previous studies suggested that exercise therapy to treat the LBP with both PNF and McKenzie have given good result in measuring the level of pain, lumbar ROM, functional ability or disability and quality of life (Clare, Adam and Maher, 2004 ; Garcia et al., 2011; Park and Wang, 2015 ; Kumar et al., 2011). However, there is no research done to compare PNF exercise and McKenzie method for the treatment of non-specific LBP. From previous studies PNF showed good result, compare with other exercise therapy, such as general exercise and core stabilisation exercise (Dhaliwal et. al., 2014 ; Mavromoustakos, et al.,2015; Jadeja et al., 2015). In the other research, McKenzie method also have good result then other exercise therapy (Islam, Haque, Irin, 2015; Anies and Al-Azab, 2017). The

comparison between PNF and McKenzie method was chosen because these two therapeutic exercises had good result than the other general exercise for low back pain. Hence, this study will introduce the PNF for the treatment of LBP compare to the most common treatment for LBP, which is the McKenzie Method.

Therefore, this study will specifically be carried out to compare the PNF exercise and McKenzie method for the treatment of LBP, which have affected the students and the office workers in the university population specifically to assess the level of pain, lumbar ROM, disability score and quality of life. In the future, the result of the study will benefit to guide the physiotherapist in choosing a better approach for the treatment of non-specific low back pain with the purpose to reduce pain, increase range of motions of the back, and improve the functional ability and quality of life.

1.6 DELIMITATION

This study is more concern on the methodology on the assessment tool, which is the basic pain assessment and range of motion for low back pain. The latest technology for the assessment tools could not be used because of the limitation of the tools that owned by the university. The subjects in this study were limited to the university population in KPJ Healthcare University College, which have Rehabilitation centre. This centre is open to staff and student to get physiotherapy treatment. This study is designed as preliminary study to determine the effects of PNF and McKenzie method on nonspecific low back pain

1.7 DEFINITIONS OF TERMS

For the purpose of this research, the following terms were defined operationally:

Non-specific Low Back Pain (NLBP) is pain in the back from the level of the lowest rib down to the gluteal fold without radiation with no clear causal relationship between the symptoms, physical findings, and imaging findings (Casser, Seddigh, Rauschmann, 2006).

Proprioceptive Neuromuscular Facilitation (PNF) is an exercise based on neuromuscular control by stimulation of muscle and joint proprioceptors as well as sensory inputs from peripheral organs to influence motor outputs of the central nervous system and promote functional activity of daily living (Adler, Beckers and Buck, 2014).

McKenzie method is exercise program consists of seven exercises: the first four exercises are extension exercises, the last three are flexion exercises. Extension means bending backward and flexion means bending forward with purpose to abolish pain and, where appropriate, to restore normal function-that is, to regain full mobility in the low back or as much movement as possible under the given circumstances (McKenzie and Kubey, 2000).

Visual Analogue Scale is a subjective measure of pain. It consists of a 10 cm line with two end-points representing ‘no pain’ and ‘worst imaginable pain’. Patients are asked to rate their pain by placing a mark on the line corresponding to their current level of pain (Huskisson, 1974).

Lumbar Range of Motion (Lumbar ROM) is a measurement of the range of lumbar motion consists move anteriorly and posteriorly around the medial-lateral axis (flexion and extension) (Reese and Bandy, 2002).

Oswestry Disability Index (ODI) (also known as the Oswestry Low Back Pain Disability Questionnaire) is a tool that used to measure a patient's permanent functional disability on LBP. The test is considered the ‘gold standard’ of low back functional outcome tools (Fairbank and Pynsent, 2000).

Health-related Quality of Life (HRQoL) is a multidimensional concept that includes physical, psychological, and social domains of health and is broadly accepted as an important outcome measure of health care (Younsi, 2015).

Short Form 12-item Health Survey (SF-12) is a multipurpose short form generic measure of health status. The SF-12 is containing 12-item subset of the original 36 items in the SF-36 with the same eight domains being examined including physical function, physical role, bodily pain, general health, social functioning, vitality, emotional roles, and mental health (Ware et al., 1995).

CHAPTER 2

LITERATURE REVIEW

2.1 INTRODUCTION

In this chapter, some of important and recent literature on non-specific low back pain in university population, PNF exercise, McKenzie method and measurements to assess the non-specific low back pain were discussed. There are several definitions of the concepts of non-specific low back pain in university population and latest study about the PNF exercise and McKenzie method for non-specific low back pain. The measurement on this research such as visual analogue scale, lumbar range of motion, disability index and health related quality of life also discussed in this chapter.

2.2 APPLIED ANATOMY OF LOW BACK

This section focuses on the lumbar spine anatomy, which is associated with the low back pain. The lumbar vertebra is larger than the other vertebra. They are comparatively large for bearing the weight of the trunk and are mobile but not nearly as mobile as the cervical spine (Hansen and Koepen, 2010). The spine is designed to be strong, since it has to protect the spinal cord and spinal nerve roots. At the same time, it is highly flexible, providing for mobility in many different planes (Alegri et al., 2016).

The vertebrae and intervertebral discs are stabilised by robust spinal ligaments, which function to restrict movements and to minimize the need for continual muscular contraction (Rawls and Fisher, 2010).

The lumbar spine contains three regular movements, which is flexion or extension, side bending, rotation. Flexion and extension motion is performed in the sagittal plane. Flexion motion is when the anterior portion of the body approximate and spinous processes separate while extension is when the anterior portion of the body separate and the processes spinous approximate. Side bending motion is performed in the frontal plane with the motion to the right or left. When performing side bending, the lateral edges of vertebral bodies approximate toward to the side, which is spine bending, and the other side of the bodies is separate. Rotation motion is performed in the transverse plane. Rotation motion to the right performing rotation movement of the body to the right and the spinous processes to the left and so does the opposite rotation motion (Kisner and Colby, 2012). The flexion and extension movement are the main segmental movement of the lumbar spine, while side bending and rotation movement are combination of thoracal and lumbar movement (Key and Chaitow, 2010)

The muscles in the trunk act as prime movers and stabilizer of the spine. The stabilizing activity is performed by the superficial (global) and deep (segmental) muscles of the spine (Cael, 2010). The global muscles of lower back are rectus abdominis, external and internal obliques, quadratus lumborum (lateral portion), erector spine, Iliopsoas. The characteristics of the global muscles are farther from the axis of motion, cross multiple vertebrae segments, produce motion and compressive loading with strong contractions (Key and Chaitow, 2010). The segmental muscles of the lower back are transversus abdominis, multifidus, quardatus lumborum (deep portion) and deep rotators. The characteristic of the segmental muscles are closer to the axis of motion, attach to each vertebral segment, control segmental motion and greater percentage of type I muscle fibres of muscular endurance (Kisner and Colby, 2012).

Despite two different characteristic of the muscle, every single motion of the lumbar muscles is performed together. Lumbar flexion motion is performed by rectus abdominis, external and internal oblique. For extension motion is performed by illiocostalis, longissimus, semi spinalis, multifidus. For lateral flexion motion, performed by quardatus lumborum and also assisted by illiocostalis, longissimus, spinalis. For rotation motion, the prime mover is tranversus abdominis, and multifidus work contralateral for every rotation motion (Cael, 2010). Some muscles of the back that related with the low back pain are tranverse abdominis, internal obliques, erector spinae and multifidus. Those muscles will indicate low back pain problem if the muscle has poor muscular endurance, which is related with, prolonged posture activity (Kisner and Colby, 2012). Currently, multifidus dysfunction is being implicated as a contributory factor in the development or recurrence of sub-acute and chronic mechanical back complaints (Danneels, Dickx and Cagnie, 2010). A study found that sitting in extreme postures, such as excessive kyphotic posture with flexion of the lumbar spine or excessive lordotic posture with extension of the lumbar spine in some people correlated with findings of low back pain (Dankaerts et al., 2006).

2.3 THE UNIVERSITY POPULATION

University is the higher education level mainly for young aged people. Population in university consists of the student studying undergraduate or postgraduate program, academic staff, and non-academic staff that also known as office worker in university (Issa et al., 2016 and Damahuri et al., 2014). University student were commonly aged between 19-25 years old (Issa et al, 2016 ; Nordin, Devinder, and Kanglun, 2014). Office workers or supporting staff were commonly started working in 20 years old, which is working after graduated from high school or in Malaysia, they were started after completed their Sijil Pelajaran Malaysia (SPM) (Waongenngarm et al., 2015; Damahuri et al., 2014; Myhre et al., 2013). Thus, the started ages of staff were commonly similar with the student in university. However, a study reported the age range of the staffs in university was 20-59 years old (Damahuri et al., 2014).

During the study period, the students usually sit in the classroom more than three hours in a day. Prolonged sitting is the most common posture of students when they are receiving the theory input from the lecturers besides doing the practical modules in the skill laboratory or during the presentation sessions. Nordin, Devinder, and Kanglun (2014) in their study also indicated similar result among other university students that there were 31% of the students sitting between six to eight hours per day and at times exceed to more than nine hours per day. Thus, the aims of their study were to determine the incidence of low back pain and at the same time to rule out the associated factors experienced by the students in university. The study was only conducted to investigate more about the prevalence and to ensure the management for the students suffered with having low back pain. Consequently, they only assessed the full-time undergraduate students for Health Sciences Program using self-administrated questionnaire, which is similar with the current study that using the self-administrated questionnaire for university students.

Damahuri et al. (2014) described the similarity habits of the office workers with the students in the university from one of their research, with which most of the office workers sat more than four hours per day at work, with prevalence about 90.8%. This previous study was conducted in one of a public university to determine the predisposing factors of low back pain and the incidence of low back pain among office workers in the university. From the prevalence, the study concluded that there were 37% from 155 respondents, was having low back pain. The study also used self-administrated questionnaires, which was distributed to the office workers or support staff only that working in the university for at least one year.

In the current study, the university population is defined the students in undergraduate programs and office workers or support staffs which experience prolonged sitting for more than three hour a day and has been working or studying at least 1 year. Prolonged sitting is one of the factors that will increase the body discomfort around the neck, both shoulders, upper back and the most severity is the lower back. Furthermore, this problem is mainly caused by the exhaustion of the lower back muscle after sitting more than 3 hour in a day (Waongenngarm et al., 2015). Thus, comparing both from the previous study and from the current study,

prolonged sitting is the main contributing factor that either students or office worker have low back pain.

2.4 CONTRIBUTING FACTORS OF NON-SPECIFIC LOW BACK PAIN

Impairments in the joints, muscles, or connective tissues may lead to faulty postures, or, conversely, faulty postures may lead to impairments in the joints, muscles, and connective tissues as well as symptoms of discomfort and pain. Many musculoskeletal complaints can be attributed to stresses that occur from repetitive or sustained activities when in a habitually faulty postural alignment. Postural pain syndrome refers to the pain that results from mechanical stress when a person maintains a faulty posture for a prolonged period; the pain is usually relieved with activity. There are no impairments in functional strength or flexibility, but if the faulty posture continues, strength and flexibility imbalances eventually develop (Kisner and Colby, 2012).

Low back pain is called non-specific when there is no clear causal relationship between the symptoms, physical findings, and imaging findings. According to a study by Taguchi (2003), chronic non-specific low back pain is due to physiological structural fragility in lumbar region, and often caused by improper posture, which can be called a living functioning impairment. Non-specific low back pain mainly related with posture or poor body mechanic. There are several other factors caused the low back pain with anatomical problem. Prolonged sitting is one of risk of postural pain and related to non-specific low back pain, hence sitting activity at least 2 hour in a day defined as a prolonged sitting and led to increased body discomfort (Casser, Seddigh and Rauschmann, 2016 ; Waongenngarm et al., 2016). Initially prolonged slumped sitting may relate to internal oblique or transverse abdominis muscle fatigue, which may compromise the stability of the spine, making it susceptible to injury and has been reported that there was atrophy in the multifidus and para-spinal muscles in chronic non-specific low back pain among office worker (Waongenngarm, Rajaratnam and Janwantanakul, 2016).

Researchers from Japan have reported that 22% of population aged 20-85 years old experienced non-specific low back pain (Suzuki et al., 2016). Similarly, the student and office worker was reported experience LBP because habitual position with prolonged sitting (Nordin, Devinder, and Kanglun, 2014). The non-specific low back pain suffered by both the students and office workers is responsible for causing physiological and psychological stress and sometimes increases the risk of interconnected secondary impairment and reduces quality of life (Aziz, et al., 2016 and Taguchi, 2013). Non-specific low back pain has also increased in general community, which have affected the adolescents and middle-aged staffs and have a major impact to functional and educational activities, which is related to university population (Aziz, et al., 2016). Nordin, Devinder, and Kanglun (2014) revealed in their study that the incidence of non-specific low back pain among undergraduate student in Health Sciences Programs was 40.3%, the incidence was associated with the age, years of study, physical fitness, and hours they spent sitting in the classroom.

2.5 EVALUATION METHOD OF LOW BACK PAIN

In order to assess the effect of low back pain to an individual life, physiotherapist will carry out several assessments to evaluate both the students and office workers low back pain and its impact. Some researcher commonly assesses the pain, range of motion (ROM), functional ability and quality of life (Waqqar, Rehman and Ahmad, 2016; Dhaliwal et al., 2014; Park and Seo, 2014; Longo et al., 2010).

2.5.1 Pain measurement

The common procedure carried out by physiotherapist to assess the pain perception is by using the Visual Analogue Scale (VAS) (Waqqar, Rehman, Ahmad, 2016; Dhaliwal et al., 2014; Hosseinifar et al., 2013). Visual Analogue Scale is a subjective measure of pain. It consists of a 10 cm line with two end-points representing ‘no pain’ and ‘worst imaginable pain’. Patients are asked to rate their pain by placing a mark on the line corresponding to their current level of pain (Huskisson, 1974). The VAS is a well-known assessment tools for pain and recommended as a means of rating the subjective pain (Casser, Seddigh and Rauschmann, 2016). The scale is

anchored by “no pain” or “none” (score of 0) and “pain as bad as it could be” or “worst imaginable pain” (score of 100 [100-mm scale]). Hawker et al. (2011) describe that the VAS is self-completed by the respondent. They also mentioned that the VAS is widely used due to simplicity and adaptability to a broad range of population and settings.

2.5.2 Lumbar Range of Motion

Lee et al. (2010) describe that pain in low back, can be one of contributing factors in reducing flexibility of lumbar spine. Lumbar Range of Motion (Lumbar ROM) is a measurement of the range of lumbar motion consists move anteriorly and posteriorly around the medial-lateral axis (flexion and extension) (Reese and Bandy, 2002). They also describe the aim of lumbar ROM assessment is to evaluate the flexibility of lumbar spine. Flexion and extension movement of lumbar ROM were the common assessed movement in lumbar ROM regarding to flexibility (Park and Seo, 2014; Franklin et al., 2013, Kumar et al., 2011). The flexion and extension movement are the main segmental movement of the lumbar spine (Key and Chaitow, 2010). The Schober method was also reported as one of the good methods to assess the lumbar flexibility (Sihawong et al., 2016; Chhaya, Renuka, Vijaya, Amol, 2015; Franklin et al., 2013). The details about how to use the modified Schober method described in chapter three.

2.5.3 Functional ability

Melton et al. (2016) reported that the patients who have high pain score may also be at risk of developing disability. They also identified that to evaluate disability, should to use disability assessment along with pain measurement. Functional ability on patient with low back pain is mainly assessed by using Oswestry Disability Index for low back pain. Oswestry Disability Index (ODI) (also known as the Oswestry Low Back Pain Disability Questionnaire) is a tool that used to measure a patient's permanent functional disability on LBP (Fairbank and Pynsent, 2000).This measurement is known as the gold standard of functional outcomes of the lower back (Seif et al., 2015). The ODI has been published in at least four formats in English and

in nine other languages. The ODI has stood the test of time and many reviews. It is usable in a wide variety of applications as a condition-specific outcome measure of spine-related or low back pain disability (Fairbank and Pynsent, 2000). ODI comprised of 10 items, which categorized from 0 to 5, with higher ratings indicating increased levels of disability (Myhre et al., 2013).

2.5.4 Health-related Quality of life

The low back pain also affected patients' quality of life. The impact of low back pain on quality of life can be due to the severity of pain (Montgomery et al., 2016). Quality of life referred to Health-related Quality of Life (HRQoL) instrument. Health-related quality of life (HRQoL) is a multidimensional concept that includes physical, psychological, and social domains of health and is broadly accepted as an important outcome measure of health care (Younsi, 2015). A study reported that higher pain score can be associated with lower HRQoL, which means that the quality of life would be worst due to increasing pain. The HRQoL instruments are classified as generic, condition specific, or patient specific (Resnik and Dobrzykowsky, 2003). In order to assess the HRQoL of low back pain patient, Short Form 12-items Health Survey (SF-12) was used in this research.

The SF-12 and its longer version, the SF-36, are widely used and accepted tools to assess self-reported aspects of health-related quality of life. The SF-12, has been developed for use in studies requiring greater efficiency (Litwin, 2006). The SF-12 is a 12-item subset of the original 36 items in the SF-36 with the same eight domains being examined including physical function, physical role, bodily pain, general health, social functioning, vitality, emotional roles, and mental health (Johnson et al., 2011). The details about how to score the HRQoL with SF-12 will be described in chapter three. Permission to use and reproduce the SF-12 is granted by the Medical Outcomes Trust (MOT) without charge. Permission to reproduce SF-12 items and scoring algorithm has also been granted to commercial survey and data processing based on standard SF-12 scoring algorithm and interpretation guidelines (Ware et al., 1995).

2.6 PHYSIOTHERAPY MANAGEMENT FOR NON-SPECIFIC LOW BACK PAIN

2.6.1 Proprioceptive Neuromuscular Facilitation (PNF)

Proprioceptive Neuromuscular Facilitation (PNF) is an exercise based on neuromuscular control by stimulation of muscle and joint proprioceptors as well as sensory inputs from peripheral organs to influence motor outputs of the central nervous system and promote functional activity of daily living (Adler, Beckers and Buck, 2014). In order to treat the patient, PNF have some therapeutic goals. The basic facilitation procedure provides tools for the therapist to help the patient gain efficient motor function and increased motor control (Westwater-Wood, Adams and Kerry, 2010). The effectiveness of PNF does not depend on having the conscious cooperation of the patient. These basic procedures were used to: increase the patient's ability to move or remain stable, guide the motion by proper grips and appropriate resistance, help the patient achieve coordinated motion through timing and increase the patient's stamina and avoid fatigue (Smedes et al., 2016).

Adler, Beckers and Buck (2008) described that PNF have some basic procedures that were used to treat the patient, the basic procedures will guide the therapist to perform maximal response from patient. The basic procedures consist of ten elements. First is resistance, which is use to aid muscle contraction and motor control, to increase strength and aid motor learning. Second, Irradiation and reinforcement, that is spreading of the response to stimulation. Third is manual contact, which is used to increase power and guide motion with grip and pressure. Forth, body position and body mechanics, as guidance and control of motion or stability. Fifth, verbal or commands, use of words and the appropriate vocal volume to direct the patient. Sixth, vision, which is use of vision to guide motion and increase force. Seventh, traction or approximation is the elongation or compression of the limbs and trunk to facilitate motion and stability. Eight, stretch, that is the use of muscle elongation and the stretch reflex to facilitate contraction and decrease muscle fatigue. Ninth, timing, that is to promote normal timing and increase muscle

contraction through “timing for emphasis”. Tenth, pattern, that are the synergistic mass movements, components of functional normal motion.

There are some PNF patterns can be applied to treat the patient. The pattern is based on normal function motion that composed of mass movement pattern of the limb and synergistic trunk muscles. Based on the diagonal movement, the PNF pattern combines of three planes those are sagittal plane for flexion and extension, frontal lane for abduction and adduction of limbs or lateral flexion of the spine, and transverse plane for rotation (Smedes et al., 2016).

In general, when preparing to treat the patient, the right techniques should be chosen depending on the type of treatment the patients require (Smedes et al., 2016; Johnson and Johnson, 2002). There are ten techniques of PNF that can be used to treat the patient. The techniques are rhythmical initiation, combination of isotonic, dynamic reversal, stabilizing reversal, rhythmical stabilization training, repeated stretch from beginning of range, repeated stretch through range, contract-relax, hold-relax and replications. In order, choose the techniques, combination of two or more techniques to be used (Adler, Beckers and Buck, 2014). The PNF exercise should be combine the basic procedure and the techniques when applied to the patient (Smedes et al., 2016).

The common PNF techniques used in the previous study for low back pain was one that been developed by Kofotolis and Kellis (2006). Kofotolis and Kellis (2006) were comparing rhythmical stabilization training (RST) and Combination of Isotonic (COI). Both techniques used in sitting position, which facilitate the flexion and extension of trunk movement. The RST consisted of alternating (trunk flexion or extension) isometric contraction against resistance, with no motion intended for ten seconds. The COI consisted of alternating concentric muscle contration for five seconds and eccentric contraction of agonist without relaxation for five seconds and resisted eccentric contraction and resisted maintained contraction for five seconds. Both RST and COI were applied for three sets of fifteen repetitions. The rest interval of 30 second was provided in each sets and 60 seconds in each repetition. The treatment regime was done for four weeks with five times in a week. Their study

findings reported that the RST and COI of PNF techniques defined as static and dynamic training that appropriate for improving muscle endurance and trunk mobility in people with LBP. Many other researchers used Kofotolis and Kellis (2006), techniques in their research. Dhaliwal et al. (2014), Jadeja et al. (2015), Chitra and Das (2015) also used the same techniques similar to Kofotolis and Kellis, (2006) with some additional conventional back treatment before applying the PNF techniques.

A study by Kumar et al. (2011) use only the COI technique in their research. The exercises were given five times a week for four weeks, with details in providing the resistance by placement of therapist hand on the scapular-shoulder region. They also added some conventional treatment for low back pain before the PNF technique. This study also followed by Franklin et al. (2013) with added Shortwave Diathermy and George et al. (2013) along with conventional strengthening exercise. Since, there were some researchers supported the use of RST and COI, this present study also followed by previous research procedure with modification in frequency set of exercise in three times a week for four weeks. The modified exercise frequency in this present study is based on a systematic review study by Rodrigues et al. (2014). They were reported that exercise therapy could reduce the work-related musculoskeletal disorder with a minimum of twenty minutes and as low as three times in a week.

Rhythmical stabilisation training (RST) goals were used to increase the active and passive range of motion, increase strength, improve stability and decrease the pain. The goals of combination of isotonic (COI) are to activate control of motion, improve coordination, increase active range of motion, strengthen the muscles and functional training in eccentric control of movement (Adler, Becker and Buck, 2014). In some studies, PNF have good result than the other exercise like ball exercise, core stability exercise and manual therapy on low back pain subjects (Park and Wang, 2015 ; Lee, Hwangbo, Lee, 2014; Kumar, et al, 2011; Johnson and Johnson, 2002).

Some other studies reported that PNF contribute to strengthening of the trunk muscles while research by Tanvi et al. (2013) reported that there was a significant improvement of trunk flexor and extensor muscle compared with lumbo-pelvic stabilisation group for low back pain patients. The PNF exercise also designed for four weeks. They also assess the functional performance that can be implied and the muscle strength will improve the functional performance. The core muscle strength also reported significantly improvement after PNF exercise from a study performed by Chitra and Das (2015).

Besides the muscle strength, some studies also reported that PNF improve the trunk muscles endurance (Areeudomwong et al., 2016 ; Kumar et al.,2011 ; Jadeja et al., 2015). Kofotolis and Kellis (2006), in their study reported that PNF significantly improve the muscle endurances, where they defined that the RST exercise provided the trunk static endurance and COI provided dynamic muscle endurance. However, they also reported that COI program more significant on both static and dynamic muscle endurance.

Another study performed by Areeudomwong et al (2016), reported that the PNF exercise showed significantly improvement in lumbar erector spine muscles activity. The study designed was randomised control trial with the aims to determine the long-term effect of PNF on pain-related outcomes and back muscle activity in patients with chronic low back pain. However, the study conducted among forty-two participant, with the age range about 18 to 50 years. The PNF exercise was conducted for four weeks and they made some modification from the former study by Kofotolis and Kellis. However, the techniques were same with RST and COI. They added upper limb pattern as a modification at week 3 and 4. The control group were designed to receive the LBP educational booklet and the subjects asked to record they compliance in a logbook to monitor the improvement of the treatment. The study aimed to know the long-term effect of the treatment, in which, after the treatment, the subject will be evaluated after twelve weeks. The study revealed that the effect of four weeks treatment of low back pain still presents until twelve weeks observation and evaluation. The improvement still lasted in pain intensity, functional disability, patient satisfaction and the quality of life besides the improvement on

lumbar erector spinae muscle. Therefore, this study can be as an example to the present study to conduct the PNF exercise for four weeks.

Improvement in trunk muscle endurance could be correlated with reducing the pain, improve functional ability and increase the lumbar range of motion. A study by Jadeja et al. (2015) emphasised that performing the four weeks PNF exercise program help to reduce the pain score along with the improvement of trunk muscle stabilisation endurance. Study by Kumar et al. (2011) also showed there was significant in decreasing the pain score, improve the functional ability and increase lumbar flexion and extension, while, they also reported improvement of trunk muscle endurance after four weeks intensive PNF exercise program. The PNF exercises for four weeks, also contributed in increasing the quality of life among low back pain patients' (Areeudomwong et al., 2016 and Jadeja et al., 2015). As previous studies stated that 4 weeks treatment of PNF resulted improvement in reducing pain, improve the lumbar range of motion, functional ability and quality of life, the current study also followed the protocols with four weeks treatment of PNF for nonspecific low back pain.

2.6.2 McKenzie Method

McKenzie method is exercise program consists of seven exercises: the first four exercises are extension exercises, the last three are flexion exercises (Hosseinifar et al., 2013 ; McKenzie, 20110. Extension means bending backward and flexion means bending forward with purpose to abolish pain and, where appropriate, to restore normal function, to regain full mobility in the low back or as much movement as possible under the given circumstances (McKenzie and Kubey, 2000). McKenzie method is one of popular treatment for low back pain among physiotherapist (Aziz et al., 2016).

McKenzie (2011) introduced the extension exercise of McKenzie method, which is divided it into four stages. The first stage is lying face down at the beginning of the exercise and the purpose is to relax the back muscle. Second is lying face down in extension. Patient position is lying face down with elbow support the

trunk to flexion. The purpose of the second position is to make relaxation in back muscle. The first and the second stages were combined with deep breathing to promote relaxation. The third stage is extension on lying; the purpose of this position is to treat stiffness of lower back muscle. Patient position is the same with the second stage but with extension of elbow joint and the trunk supported by the palm. The previous three steps were in prone lying position. The fourth stage is extension in standing which is standing with both hands in the small of the back with finger pointing backward then performing extension of the trunk.

The next is flexion exercise; it is divided in three stages. The first stage is flexion on lying with patient lying in prone position with both knees folded up toward to the chest. The purpose of this stage is to restore the flexibility of the back muscle. The second stage is flexion on sitting. Patient is in sitting position and then asked to do trunk flexion with holding the hands onto the ankle. The last stage of flexion exercise is the patient in standing position while performing flexion of the trunk as far as the patient can comfortably reach. All the flexion exercise has the purpose to restore the flexibility of the back muscles (Garcia et al. 2016; Clare, Adam and Maher, 2004).

Postural correction and maintenance of the correct posture are the aims of the McKenzie method (Clare, Adam and Maher, 2004). The intention is to correct any distortion or bulging that may have developed in the joints of the low back. However, the purpose of the exercise is to identify any movement or posture that is likely to increase distortion in the joints and delay recovery (McKenzie, 2011). A study performed by Islam, Haque and Irin (2015) concluded that the McKenzie method were used as postural correction exercise, by which the postural correction would be affected to improve the functional ability and reducing the pain. Some studies had discovered the effectiveness of McKenzie in reducing pain among low back pain patient. Ibrahimaj et al. (2015) in their study have reported that McKenzie method significantly reduced the pain in sub-acute and chronic low back pain. They also assess the lumbar range of motion with improvement after 15 times treatment. Aziz et al. (2016) also reported similar result that McKenzie method reduce the pain score followed with disability score within three weeks.

A research reported by Garcia et al. (2016) used the complete stages of McKenzie method. However, the treatment only last for four times with one-hour session in one month, once a week. The McKenzie method was compared with back school training for the subjects. The study was conducted as a secondary analysis from a previous trial study. The study was using randomised control trial design, with the back school as the control group. Participant in this study was 54 years old as the mean number of the age. There are 140 subjects, which divided into two groups. Although, the treatment of McKenzie method only carried out once a week for four weeks, the study result using the McKenzie method has better improvement in reducing the low back pain than the control group with back school program. However, this previous study only assessed the pain and pain location but did not assessed the disability or the quality of life. Furthermore, based on this previous study, the present study should follow the four weeks duration of the treatment.

A study conducted by Hossenifar et al. (2013) modified the techniques for their research with only six stages of McKenzie method. The modifications are the four extensions in prone lying, two flexion in supine lying and sitting position. Each session, the position was maintained for ten second and the total exercise was repeated 80 and 100 times. The exercises were conducted three times a week for six weeks. Aziz et al. (2016) in their research also made modification on McKenzie method. The protocols were divided into five stages, which was single knee to chest, both knee to chest, standing lumbar flexion, prone lying on elbows and standing extension. These exercises were done every day within three weeks.

Other study by Waqqar, Rehman and Ahmad (2016) have decided to use only extension stages of McKenzie method with additional hot pack and TENS before applying the exercise. The study also compared the McKenzie extension program with Mulligan manual therapy. A total 37 patient have participated this study with 20 patients in Mulligan manual therapy group and 17 patients in McKenzie method group. The subject means age were 50.25 in group A and 49.12 in group B. Both treatments were conducted in 4 weeks with 2 sessions per week and single session in a day. The measurement point was designed in three-point, before, after 2 weeks and at the last of the 4-week treatment. The result of this study revealed that McKenzie

method is more effective in reducing pain and improvement of functional ability than Mulligan manual therapy. However, the subjects in this study considered too old, albeit, the low back pain in this study was diagnosed with the mechanical low back pain. Similarly, study by Tarek et al. (2017) only used extension stages, treated three times a week for one month. The McKenzie method was done combined with traditional electrotherapy and the results revealed that McKenzie decrease pain and improve lumbar ROM. Based on this study, the duration of the treatment can be one of reference for the current study to treat the subjects within three times in a week for four weeks with three-time measurement.

El-Bandrawi and Ghareeb (2016) chose to modify the exercise protocol in their study, with only using extension stage of McKenzie method. The exercise was done with two sessions per week in five weeks. They have added five minutes warm-up and active stretching before the McKenzie method exercise. Another modified steps of McKenzie method also done by Anies and Al-Azab (2017), they modified the extension in lying with added overpressure and the flexion exercise was not applied. The exercise was done in three sets per session with 10 times repetitions and each repetition has one-minute rest. The protocols in their study were three times a week for six week. However, for the current study, the McKenzie method was conducted with four stages of extension exercise and three flexion exercise. McKenzie will be done in two sets for each stage. Furthermore, the treatment on this present study will be held on three times a week within for weeks. The detailed procedures is explained in chapter three.

The McKenzie method was reported having better result compared to the other exercise or therapy for low back pain such as aerobic exercise, traction and massage (Casazza, 2012). A review study also concluded that McKenzie method would be a beneficial treatment for low back pain on reducing the pain, physical disability and beside that it also preventing recurrence of the low back pain (de Sousa, Moura and da Cunha, 2016; Kupussamy, Narayanasamy and Christopher, 2013). The effectiveness of McKenzie method for the treatment of low back pain also have proof better improvement in increasing the health-related quality of life (Mazloum et al., 2017; Mbada et al., 2014).

2.6.3 Regular treatment for non-specific low back pain

As a regular treatment for non-specific low back pain, some study recommended general exercise to reduce the impairment of non-specific low back pain (Gordon and Bloxham, 2016 ; Scharrer et al., 2012). The type of general exercise for low back pain mainly is an active stretching, which easily performed by the patient (Sihawong, Janwantanakul, and Jiamjarasrangsi, 2014). A study by Gawda et al. (2015) revealed that the stretching therapy that done by the low back pain patients could be effective to reduce the low back pain. In their study, the physiotherapist gives some example to do the stretching until the patients can do the stretch by themselves. Some guidelines, also reported some educational exercise that can be done by the low back pain patient to manage the low back pain (Goerzt et al., 2012 ; Hussein et al., 2009). In 2016, National Institute for Health and Care Excellence (NICE) produce an assessment and management guideline for the low back pain. In that guidelines, described that the self-management was the first management for low back pain. The second recommendation treatment for low back pain, recommended using exercise for the patient.

A review study by Bardin, King and Maher (2017) also recommended self-management exercise along with hot-pack as the first line care for non-specific low back pain. The use of hot packs considered as a pain relief that provides analgesia effect and muscle relaxation (Arya, 2014 ; Bardin, King and Maher, 2017). Self-management exercise or educational home exercise program with hot packs also recommended by a health care guidelines as a management of low back pain patient (Goerzt et al., 2012). A research by Taguchi (2013) stated that the therapeutic heating is often conducted by physiotherapy for the chronic non-specific low back pain, despite the effectiveness in not clear, however, from the viewpoint of relaxation, the purpose of therapeutic heating is reducing the pain. Some previous study also use the home exercise and hot packs as a control group that compared with experimental groups (Areeudomwong et al., 2016 ; Tarek et al., 2017 ; Dogan et al., 2008). Based on those previous studies, the two experimental group will compared with the control group, which is receive the home exercise that consist of active stretching using educational exercise sheet and hot packs.

In this present study, the control group receive the hot packs for 15 minutes in the clinic and continue with self-management exercise that using the educational exercise sheet. The physiotherapist explains and teaches the patient to do the exercise that described in the sheet and following the same steps with previous study (Sihawong, Janwantanakul, and Jiamjarasrangsi, 2014; Gawda et al., 2015). The subject in control group can perform the exercise from the educational sheet at the clinic, their office or home. In some study, to control the subjects to do their exercise, the principal investigator and physiotherapist will remind the subjects to do the exercise if they decide to do the exercise in their home or office with message or phone call (Sihawong, Janwantanakul, and Jiamjarasrangsi, 2014 ; Dogan et al., 2008). In this present study, the subject will receive message or phone call to remind them to get the treatment and do the home exercise. Anar (2016) also revealed that the home-based exercise that explained by physiotherapy and done by the patient in their home, effective to reduce pain, disability, abdominal muscle endurance and flexibility of lumbar ROM. However, in their research recommended that the home exercise should be followed up and the patient should receive consultation after shorter period in order to increase adherence the subject to do the exercise. Based on that study, in this present study, the control group also receive mid intervention assessment after 2 week as an evaluation or consultation to make sure the subject doing their exercise. The home exercise with educational sheet and hot packs in this study will held on three times in a week within four weeks.

2.7 STUDY FRAMEWORK

A study framework produced to guide the structure on this study. As the figure shows, the dependent variables in this study that is the university population with non-specific low back pain that recruited in this study will be assessed for the pain intensity, lumbar ROM, functional disability and health-related quality of life. From the assessment, subjects divided into three treatments group, those are PNF, McKenzie and control group who received regular physiotherapy treatment for non-specific low back pain. After the treatment, the subjects evaluated with same measurement to determine the effect of the treatment in non-specific low back pain. The changes after those three treatments will be compared to determine which the better among those treatments. The figure of study framework presented in figure 2.1.

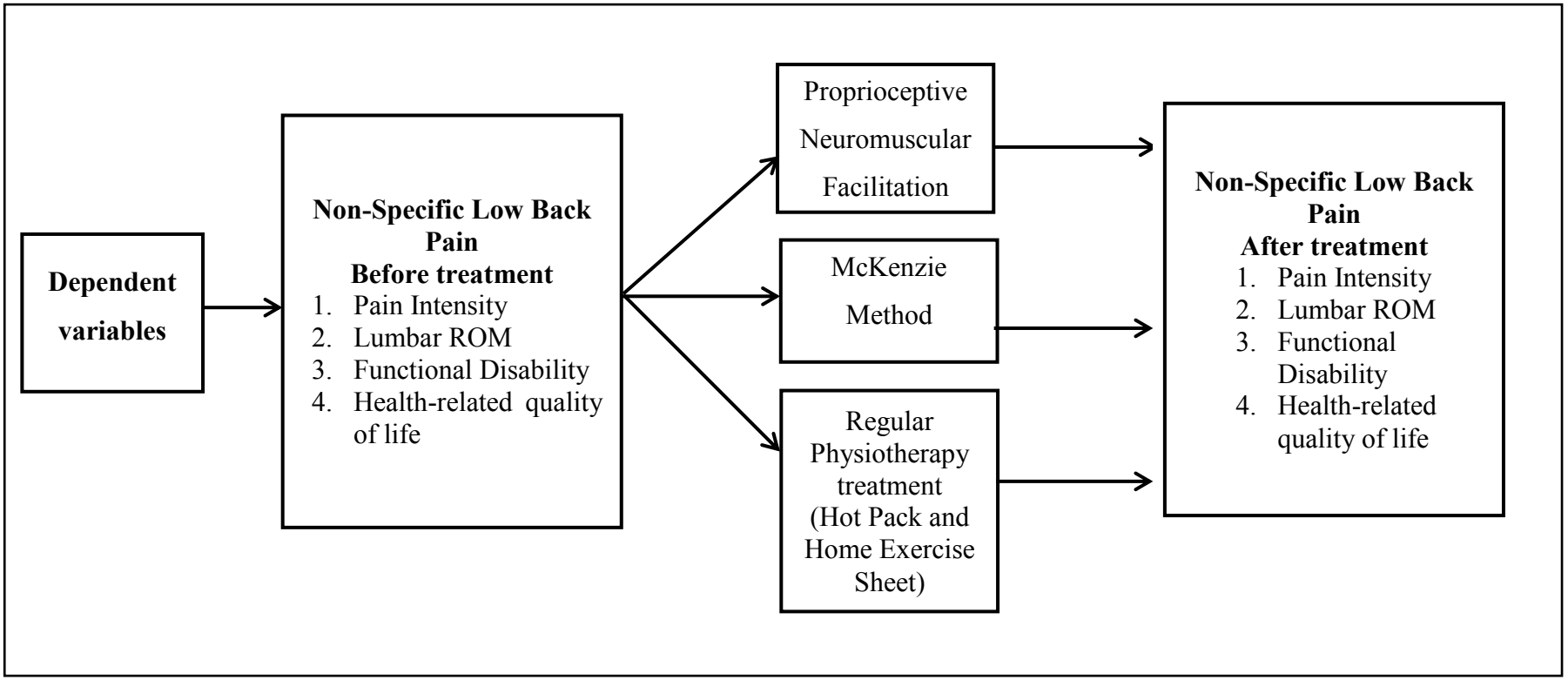

Figure 2.1 Study Framework

2.8 SUMMARY

The literature review presented in this chapter supported that the non-specific low back pain affected to the university population (Issa et al., 2016; Damahuri et al., 2014). The similar habit of the student and staff with prolonged sitting were revealed the main contributing factor lead to non-specific low back pain (Nordin, Devinder, and Kanglun, 2014). The non-specific low back pain also revealed to be one of the factors that make physiological and psychological stress and sometimes increases the risk of interconnected secondary impairment and reduces the quality of life (Aziz, et al., 2016 and Taguchi, 2013). The evaluation of low back pain using VAS for perceived pain, lumbar ROM for lumbar flexibility, Oswestry disability index for functional ability level for low back pain and SF-12 for health-related quality of life are also known to be reliable assessment tools to predict the impairments from non-specific low back pain (Sihawong et al., 2016 ; Seif et al., 2015 ; Hawker et al., 2011; Johnson et al., 2011).

Hence, the PNF and McKenzie can be considered as the best choice of the rehabilitation program for reducing the non-specific low back pain. The review also supported that both the PNF and McKenzie method showed good improvement in pain, functional ability, lumbar flexibility and health-related quality of life (Areeudomwong et al., 2016 ; de Sousa, Moura and da Cunha, 2016; Jadeja et al., 2015 and Kupussamy, Narayanasamy and Christopher, 2013). The PNF using sensory-motor control training and stimulating the lumbar muscle proprioception and endurance exercise to muscle for reducing the LBP impairment (Lee, 2009 ; Kofotolis and Kellis, 2006). While, the McKenzie using postural correction, maintenance of the correct posture and restore the flexibility of the back muscles to reduce the LBP (McKenzie, 2011; Garcia et al. 2016; Clare, Adam and Maher, 2004). Hence, the different mechanism of PNF and McKenzie in reducing the non-specific LBP might be one of the gaps that the physiotherapy did not compare these techniques.

The application of PNF by the physiotherapist on the patient need to use resistance using the manual contact, body position and body mechanic, stretch and timing to facilitate the exercise movement based on the impairment of LBP (Adler, Beckers and Buck, 2008 ; Smedes et al., 2016 ; Kofotolis and Kellis, 2006). On the other hand, McKenzie method uses seven steps to treat the patient with LBP and can be done only by the patient (McKenzie, 2011 ; Paatelma et al., 2008). Patients should be commanded by the physiotherapist to make sure the McKenzie method's steps done appropriately (Paatelma et al., 2008 ; Aziz et al., 2016). The practical application of PNF seems much complex than the McKenzie, thus, this problem might be one of causes the physiotherapist commonly use the McKenzie method to treat the LBP patient.

However, there is no previous study comparing these two exercises in order to know the best treatment for the non-specific low back pain. Therefore, the finding of this study may give introduce a knowledge for physiotherapist on the treatment for non-specific low back pain.

Table 2.1 Table of Evidence

Authors	Objectives	Methods	Results
Kofotolis and Kellis (2006)	To examine the effects of 2 PNF programs on trunk muscle endurance, flexibility, and functional performance in subjects with chronic low back pain.	Experimental study with factorial design.	Static and dynamic PNF programs may be appropriate for improving short-term trunk muscle endurance and trunk mobility in people with CLBP.
Jadeja et al. (2015)	To determine the effect of PNF on back muscle strength, pain and QOL in subjects with Chronic Low Back Pain.	Randomized controlled trial study	PNF exercises on back increases back muscle strength, reduces pain, but there is no significant change in quality of life in subjects with Chronic Low Back Pain.
Chitra and Das (2015)	To find the effect of PNF technique on core strength on patient with type two-diabetes.	Quasi-experimental study	PNF exercises which involve significant muscle work results in muscle strength and endurance improvement
Franklin et al. (2013)	This study compared the effect of PNF versus core stabilization exercises for decreasing pain, improving flexibility and functional ability of the patients with chronic low back pain	Quasi-experimental study	PNF group is statistically significant than Core Stabilization Exercise group

Authors	Objectives	Methods	Results
George et al. (2013)	To compare the effectiveness of combination of trunk PNF training and conventional strengthening exercises with conventional strengthening exercises alone in the management of mechanical low back pain.	Quasi-experimental study	The result of the study proves that Trunk PNF along with conventional strengthening exercises is more effective than conventional strengthening.
Kumar et al. (2011)	The purpose of this study was to examine the PNF programs on trunk muscle endurance, flexibility, and functional performance in subjects with chronic low back pain	Quasi-experimental study	The results of the study reported that the PNF programs are appropriate for improving trunk muscle endurance, trunk mobility, pain and functional ability in people with CLBP
Areeudomwong et al. (2016)	To investigate the persistence of the effects of PNF training on pain intensity, functional disability, patient satisfaction, health-related quality of life (HRQOL) and lower back muscle activity in patients with CLBP	Randomised control trial study	The study found that 4-week PNF training has positive long-term effects on pain-related outcomes, and increases lower back muscle activity in patients with CLBP

Authors	Objectives	Methods	Results
Garcia et al. (2016)	To investigate whether baseline characteristics of patients with chronic LBP, already classified as derangement syndrome, can identify those who respond better to MDT compared with Back School.	Randomised clinical trial	The results of the study suggest older age may be an important factor that can be considered as a treatment effect modifier for patients with chronic LBP receiving MDT.
Aziz et al. (2016)	To determine the effectiveness of McKenzie exercises in reducing neck and back pain among madrassa students.	Experimental study	McKenzie exercises had significantly reduced the neck and back pain among madrassa students
Hosseinifar et al. (2013)	To compare the effects stabilization and McKenzie's exercises on pain intensity, disability and lumbo pelvic stability in non-specific CLBP subjects	Randomized controlled trial study	The present study supported that stabilization exercises can reduce pain and disability in non-specific CLBP patients.
Waqqar et al. (2016)	To compare the effects of McKenzie versus Mulligan Sustained Natural Apophyseal Glides for chronic mechanical low back pain (CMLBP).	Randomized control trial.	McKenzie more effective in the management of pain and disability compared with Mulligan SNAGs, while Mulligan SNAGs are more effective in the improvement of lumbar ROM.

Authors	Objectives	Methods	Results
El-Bandrawy and Ghareeb (2016)	The purpose of this study is to determine the efficacy of McKenzie method on low back pain in postmenopausal women	Randomised controlled trial.	The study demonstrates the superiority of the efficacy of the McKenzie method in addition to interferential current, compared with interferential only on low back pain in postmenopausal women
Anies and Al-Azab (2017)	to assess the impact of McKenzie extension exercise approach on patients with chronic low back pain with radiculopathy.	Randomised controlled trial.	McKenzie extension exercise approach is a more effective treatment than conventional physical therapy for patients with chronic LBP with radiculopathy who demonstrating centralization with lumbar extension.
Islam et al. (2015)	To find out efficacy of McKenzie approach and conventional physiotherapy protocol in reducing pain and disability in subjects with postural low back pain was aim of this study.	Quasi-experimental study	McKenzie approach is very effective in treating patient with postural low back pain and it results in significant improvement of functional activities and relieving pain

CHAPTER 3

RESEARCH METHODOLOGY

3.1 INTRODUCTION

This chapter presents the research methodology used in this study. It provides a details explanation of the study design, including an in depth description of the research subjects, together with the inclusion and exclusion criteria used to determine the eligibility for the study. The chapter also describes the evaluation and treatments considered to test the study hypotheses. As a final point, a detailed account of the statistical methods and techniques considered to test the hypotheses is provided. The content of this chapter will be very useful for future research and development in physiotherapy research.

3.2 STUDY DESIGN

This is an experimental study using quasi-experimental. Quasi-experimental study is defined as study comparing the effect and value of intervention in between three groups at their pre-test and post-test design in which subjects are equally differentiated on the treatment given. It is aims at determine therapeutic effects between Proprioceptive Neuromuscular Facilitation (PNF) and McKenzie method in non-specific low back pain among university population specifically in reducing pain, increasing lumbar range of motion (Lumbar ROM), improving lumbar

functional ability with Oswestry disability index (ODI) and increase the quality of life and compared with control group.

All subjects that included in this study were assigned randomly to three groups. The therapeutic outcomes for each group determined comparatively in which to answer research questions of this study.

3.3 TIME AND RESEARCH FIELDWORK

This research was conducted in KPJ Healthcare University College (KPJUC), Nilai, Kota Seriemas, Malaysia. The subjects in this research were underwent a specified treatment for the non-specific low back pain in KPJUC Rehabilitation Centre. The timing for the implementation of data collection and testing of the research subjects was from August 2017 - December 2017.

3.4 SAMPLE SIZE

The determination of the sample size was done using G*power 3. Three group, using F test, the effect size f is 0.25. Statistically significant defined as α err prob 0.05. Power 1-β err prob 0.8. Number of groups are 3, with the measurement repetitions are 3. Corr among rep measures 0.5 and nonsphericity correction € 1. Based on the above data, the calculated total sample size is thirty and as additional subject is 20% from total sample size, which is six, then total sample size is thirty-six with twelve subjects for each group (Hasanpour-Dehkordi, Dehghani and Solati, 2017).

3.5 RESEARCH SUBJECTS

The study population were selected from students and staff of KPJ Healthcare University College (KPJUC) who met the inclusion criteria. In order to determine the subjects, questionnaire based on inclusion criteria was given to all students and staffs in KPJUC. Upon selection, subjects were given written and verbal study information and informed consent that states that they are willing to be the subject of this

research. All subjects were explained on aims, procedure, and the risk of study and participate in this study as a volunteer. The subjects who are willing to participate in this study invited to come to the rehabilitation centre. Then, the subject selection was determined by the time that they come to the rehabilitation centre.

Once the written consent has been obtained from the subjects, qualified physiotherapists interviewed the selected subjects and at the same time performed clinical examination to confirm the diagnosis and further measuring the VAS, Lumbar ROM, ODI and SF-12 as a pre-test baseline measurement of this study.

3.5.1 Inclusion criteria

All subjects who have been recruited by questionnaire, they were selected randomly and included to the study following the inclusion criteria. The inclusion criteria of this study are

1. Subject with non-specific low back pain (Casser, Seddigh, Rauschmann, 2016).
2. Subjects with age ≥ 18 to 45 years old (Damanhuri et al., 2016).
3. Study or work in prolonged sitting position ≥ 3 hours a day (Issa et al., 2016).

3.5.2 Exclusion criteria

Non-specific low back pain classified into low back pain, which is not related to the neurological problem and degenerative syndrome. Subjects who had low back pain with neurological problem, degenerative syndrome and other related disease should be excluded from this study by following the exclusion criteria (Taguchi, 2003). The exclusion criteria in this study are

1. Subjects with any history of pathological conditions or diagnosed with disk herniation, spinal stenosis, spondylolysthesis, spondylitis, radiculopathy, vertebral fracture and surgery to lumbar spine (Casser, Seddigh, Rauschmann, 2016).
2. Subject with reported pregnancy (Sihawong, Janwantanakul, and Jiamjarasrangsi, 2014).
3. Subject with other medical illnesses such as tumor, kidney disease, and visceral disease that can be related with low back pain (Maher, Underwood, Butchbinner, 2017).

3.6 RESEARCH INSTRUMENTS

3.6.1 Visual analogue scale (VAS)

Perceived level of pain was measured using VAS. The scale is anchored by “no pain” or “none” (score of 0) and “pain as bad as it could be” or “worst imaginable pain” (score of 100 [100-mm scale]) as presented in figure 3.1. The pain VAS is self-completed by the subject. The respondent asked to place a line perpendicular to the VAS line at the point that represents their pain intensity. The VAS took one minute to complete (Hawker, Mian, Kendzerska, French, 2011).

A higher score indicates greater pain intensity. The following score interpretation points on the pain VAS have been recommended: no pain (0–4 mm), mild pain (5–44) mm), moderate pain (45–74 mm), and severe pain (75–100 mm) (Buckhardt and Jones, 2003).

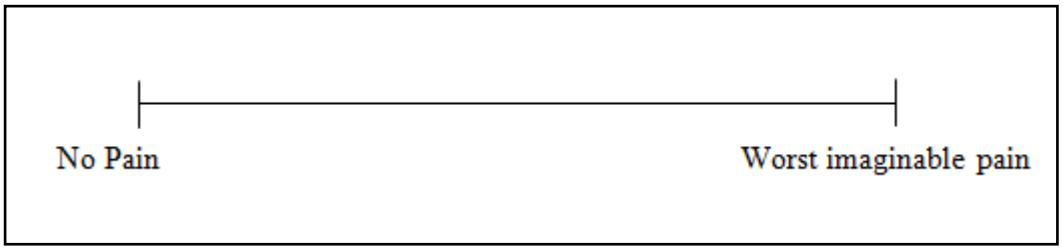

Figure 3.1 Visual Analogue Scale

The visual analogue scale for pain is one-dimensional single-item scale that provides an estimate of patients' pain intensity. The VAS is easy to administer, complete, and score by the subjects. The VAS also widely used in research and has been tested for validity and reliability (Hawker et al., 2011; Buckhardt and Jones, 2003).

3.6.2 Lumbar Range of Motion

The flexibility of the lumbar spine was assessed by flexion and extension range of motion. Some researchers decided to use tape measure to assess the flexibility of lumbar spine. Tape measurer was used to measure spinal movement and easy to use (Reese and Bandy, 2002).

The lumbar flexion and extension range of motion were assessed by using the modified Schober method (Sihawong, Janwantanakul, and Jiamjarasrangsi, 2014). Examiner will palpate the lumbosacral junction, which is the between the posterior superior iliac spine (PSIS), and make a line as a reference point. After that, another point is 10 cm superior from the line. For lumbar flexion, the subject was instructed to bend forward as much as possible while keeping the knee straight. Once the bend

forward had completed, the increase distance between the line and the point was measure and recorded. For lumbar extension, the subject instructed to do hyperextension from the normal position and the distance between two points were measured and recorded (Chhaya et al., 2015).

This measurement method was valid and reliable to assess the lumbar flexion and extension ROM and widely used in research (Chhaya et al., 2015; Norkin and White, 2003). The normal range of motion with schober method for lumbar flexion is 5.8 to 6.7 cm and lumbar extension 1 to 4 cm (Reese and Bandy, 2002).

3.6.3 Oswestry Disability Index (ODI)

The Oswestry Disability Index (ODI) was used to assess the subject's disability that caused by the non-specific low back pain. The questionnaire contains 10 sections, with six statements for each section (Appendix D). The questionnaire can be self-administered by the patient or assessed by the physiotherapist; it is usually completed in less than five minutes and scored in less than one minute (Longo et al., 2010).

The subject selects one statement in each section of the questionnaire which best represents their perceived ability to perform a function and or the quantity of pain experienced on the day of assessment. Each statement is scored on a 6-point scale (0-5), where a score of "0" is awarded if the client selects the first statement of the section and a score of "5" is awarded if the client selects the last statement. The section scores are tallied to produce a total raw score (Sihawong, Janwantanakul, and Jiamjarasrangsi, 2014). Total raw scores can vary from 0 to 50. The classification of total raw score are minimal disability for score 5 to 10, moderate disability for score 11 to 20, severe disability for score 21 to 30, crippled for score 31 to 40 and completed disability for score 41 to 50 (Longo et al., 2010). In this research, the number of collected score is the total score.

3.6.4 Health Related Quality of Life

As an examination of health-related quality of life, subjects were assessed using the SF – 12 health survey (Appendix F). This is a multipurpose short form generic measure of HRQoL status. Two summary scores calculated from this measure were used the physical component summary (PCS) as an index of overall physical functioning, and the mental component summary (MCS) scores, which is an index of mental and emotional health (Ueberall, Eberhardt and Mueler-Schwefe, 2016). The SF- 12 have 12 items that measure the health concepts of physical functioning, role limitations due to physical health problems, body pain, general health, vitality, social function, role limitations due to emotional problems, and mental health (Ware et al., 1995). The SF-12 was developed to lessen administration time (5 minutes or less), while maintaining acceptable variance explanation. The SF-12 questions consist of two questions concerning physical functioning, two questions on role limitations because of physical health problems, one question on bodily pain, one question on general health perceptions, one question on vitality (energy or fatigue), one question on social functioning, two questions on role limitations because of emotional problems, and two questions on general mental health (psychological distress and psychological well-being) (Marosszeky, 2005).

The domains are summarised in a physical and a mental component summary. Physical and Mental Health Composite Summary (PCS and MCS) are using the scores of for each section. The highest score for PCS is 20 and 27 for the highest score of MCS. The lowest score indicates the lowest level of health-related quality of life and the highest score for each section indicates the highest level of health-related quality of life (Ueberall, Eberhardt and Mueler-Schwefe, 2016).

3.7 RESEARCH PROCEDURE

3.7.1 Subjects preparation

The preparation of the subjects includes several stages stated as follow; the first stage is to provide a questionnaire to KPJUC students and staffs. The questionnaire provided to determine the subjects who were experienced low back pain. After the questionnaire completed by the subjects, the selection of subjects was performed according to the inclusion criteria. All subjects who met the inclusion criteria invited to come to the Rehabilitation Centre. The physiotherapist and principal investigator counted the subjects until the subject thirty-six subjects by the time that they come to the rehabilitation centre. Then the subjects were randomly divided into three groups. All subjects picked a number in an envelope with number one entered in group one (group I), with number two entered into group two (group II) and number three to group three (group III) until all subject fulfil the three groups. Another subject that not included in this study was given advice by the physiotherapist to do the home exercise. Every subject was given an explanation by verbal and written about the purpose and benefits of the study prior to signing the inform consent to certify their willingness to participate in this research.

The principal investigator also explained to every subject if they are not able to comply with the treatment for more than two weeks, they are excluded from this study. Physiotherapist and researcher informed the subjects that they should avoid any activities that can worsen their condition. Hence, subjects also informed to report any complaints or worsening condition during participation in this study to get referral to medical doctor. Subjects also advised by physiotherapist and researcher not to take any painkiller or any kind of medications to reduce the pain during the treatment session. However, any use of medication during study period should be informed the researcher. The subject's profile consisted of socio-demographic information including age, gender, occupation, and years of study or working.

Subsequently, the researcher and physiotherapist assessed the subject based on pain score, lumbar ROM, disability score and health-related quality of life. In addition, the mean and standard deviation of age, VAS score, lumbar ROM, ODI score, PCS and MCS score were collected and presented as baseline descriptive data of the subjects.

3.7.2 Interventions procedures

Three physiotherapists that participating in this study had on average, about three to five years of professional experience in the area of orthopedic, sports and exercise therapy. All physiotherapists participating in this study were trained by the principal physiotherapist to perform the specific PNF exercise and McKenzie method used as experimental treatment in this study. Training included visual demonstrations, hands-on experience and technique evaluation. Each physiotherapist was not considered suitable to perform these two exercises until they could perform each one correctly in two attempts or less.

Training continued until all physiotherapists had successfully mastered each technique. Physiotherapists performing the PNF exercise and McKenzie method reached training criteria within one week period. All physiotherapists are not assigned to a particular group of subjects, in which the physiotherapists randomly provide intervention to all patients in each group. In addition, these three physiotherapists were closely supervised by the principal physiotherapist in charge in KPJUC Rehabilitation Center to assure proper performance of PNF exercise and McKenzie method. The subjects were undergoing 12 sessions of the treatment regime, 3 sessions in a week for 4 weeks (Dhaliwal et al, 2014; Rodrigues et al, 2014).

Subjects in the group I received the PNF exercise intervention (Appendix G). The PNF technique performed on the trunk movement. The patient is in sitting position. First, physiotherapist conducted Rhythmic Stabilisation Training (RST). The RST exercise consisted of alternating (trunk flexion-extension) isometric contractions against resistance for 10 seconds, with no motion intended. Subjects

performed three sets of 10 repetitions at maximal resistance provided by the same physiotherapist. The resting intervals of 30 seconds and 60 seconds provided after the completion of 10 repetitions for each pattern and between sets, respectively. Secondly, physiotherapist conducted combination of isotonic technique with flexion or extension for lumbar, depending on the patient condition. The combination isotonic (COI) technique consists of alternating concentric and eccentric contractions of agonists without relaxation. The sequence of COI are resisted active concentric contraction for 5 seconds, resisted eccentric contraction for 5 seconds, and resisted maintained during contraction for 5 seconds (trunk flexion-extension). The combination of isotonic performed three set of 10 repetitions with resting intervals of 30 second and 60 second were provided after completion of 10 repetitions for each pattern and between sets, respectively. In total, all PNF exercise will be held for 30-45 minutes (Jadeja, Vyas and Sheth, 2015; Dhaliwal et al, 2014; Kumar et al, 2011; Kofotolis and Kellis, 2006).

The subjects in the group II received the McKenzie method (Appendix H). The physiotherapist guided the subject to conduct four extension exercises and three flexion exercises. The extension exercise started with; first, lying face down for one until two minutes. Second, lying face down with extension, the subject was asked to start with lying face down position and followed with the extension of the trunk on the elbow and hold on for five seconds and back to first position as a relaxation. Third, extension on lying, subject instructed to start in lying face down position, and then followed with the extension of the trunk with elbow extension (push-up position) for ten seconds, then the subject asked to relaxation with back to first position. Forth, extension on standing, subject instructed to standing and then asked to do the extension of the trunk and hold for five seconds with hands of the back and the fingers pointing backwards and then followed with relaxation with back to standing position. All extension exercise repeated for ten repetitions for two sets.

The flexion exercise started with; first, flexion on lying, subject was instructed on lying position then flexes the trunk with both knees to the chest and hold with both hands. Subjects instructed to hold that position for five second and relaxation to the first lying position. Second, flexion on sitting, the subject asked to sit on the edge

of a chair, and then instructed to bend the trunk forward and grasp the ankle or touch the floor with both hands. This position maintained for five seconds and followed with relaxation to the first position. Third, flexion on standing, the subject was asked to be in standing position, and then was instructed to bend forward or flexion the trunk with fingers down to the legs as far as they can. Subject asked to hold the last position for five seconds and back to standing position as a relaxation. All flexion exercises were also repeated for ten repetitions for two sets. There are three minutes for resting intervals in every set. The McKenzie treatment lasted for 20-40 minutes (Aziz et al, 2016 ; McKenzie, 2011).

Subjects in the group III was treated with hot pack for 15 minutes as a basic treatment for non-specific low back pain and physiotherapist gave home exercise guided by educational exercise sheet (Appendix I) and teach the subjects how to use it as a regular physiotherapy treatment (Bardin, King and Maher, 2017; Paatelma et al., 2008). A narrative review by Bardin, King and Maher (2017), revealed that hot pack consider as a first line care for non-specific low back pain along with self-management with home exercise. The subjects were instructed to exercise with eight repetitions for two sets. The exercise based on the educational exercise sheet lasted for 7-10 minutes that can be done at the home or the office (Sihawong, Janwantanakul, and Jiamjarasrangsi, 2014).

All subjects in PNF, McKenzie and control group treatment were monitored three times a week to get the treatment. Physiotherapists and principal investigator was using short message service or phone call to remind the subject to get the treatment in Rehabilitation Centre.

3.7.3 Assessment of outcomes

Those three physiotherapists who doing the interventions are also performed the assessment outcome measurements. In addition, all physiotherapists also trained by the principal physiotherapist to perform all assessment of outcome measurements. The principal physiotherapists in charge in KPJUC Rehabilitation Centre closely control and supervise those physiotherapists, to assure proper measurements. All

subjects were assessed pain score with VAS, Lumbar ROM, functional ability with ODI and health-related quality of life. Currently, these outcome instruments are the standard for measuring LBP treatment effectiveness in all settings. The assessment point was performed at three points; pre-test as the baseline measurement, mid-test which is two weeks after treatment and post-test as the last measurement after four weeks treatment.

3.8 DATA ANALYSIS

All data analyses were performed with the Statistical Package for the Social Science (SPSS) statistic software version 22. The data from thirty-six subjects were analysed in this study for socio-demographic data, which included the mean distribution percentage of age categories, gender, occupation, and years of study or working. Descriptive analyses of study population were presented based on the demographic details. Continuous variable showed as mean and standard deviation and frequency.

Repeated measures ANOVA analysis was used to determine the result of differences before and after treatment in every group. There are three steps when applying the repeated measure ANOVA analysis to answer the objectives. Assumption of normality, homogeneity of variance and compound symmetry were checked and were fulfilled before the repeated measure ANOVA analysis was applied. The level of statistical significance was set at $p<0.05$.

Firstly, in order to analyse of the effect of each treatment groups for every outcome measures based on time measurement, repeated measure ANOVA within group analysis were used. Bonferroni adjustment for multiple comparison were applied. Secondly, in order to analyse the between the treatment group regardless of time, repeated measure ANOVA between group analysis were applied. Post-hoc multiple comparison for between group analysis followed by using the Tukey HSD. Lastly, repeated measure ANOVA within-between groups analyses were applied to determine the effect between three treatment groups based on time measurement. Bonferroni adjustment were applied for multiple comparison.

3.9 SUMMARY OF INTERVENTION PROCEDURES

Table 3.1 Summary of Intervention Procedures

Intervention	Techniques	Repetition and sets	Duration
Proprioceptive Neuromuscular Facilitation (PNF)	Rhythmic Stabilisation Training (RST) and combination isotonic (COI).	Ten repetitions with three set each technique. Resting interval between repetition 30 second and between sets 60 seconds.	Total duration of PNF exercise is 30-45 minutes (Jadeja, Vyas and Sheth, 2015; Dhaliwal et al, 2014; Kumar et al, 2011; Kofotolis and Kellis, 2006).
McKenzie Method	Four extension exercise and three flexion exercise.	Ten repetitions for two set each stage. Three minutes rest intervals between sets.	The McKenzie method duration lasted for 20-40 minutes (Aziz et al, 2016 ; McKenzie, 2011)
Regular physiotherapy treatment	Hot packs placed on the lower back region and home exercise with educational exercise sheet	15 minutes hot pack one set and home exercise eight repetitions for two sets.	Total duration of hot packs and home exercise is 20-30 minutes (Sihawong, Janwantanakul, and Jiamjarasrangsi, 2014)

3.10 METHODOLOGICAL FLOW

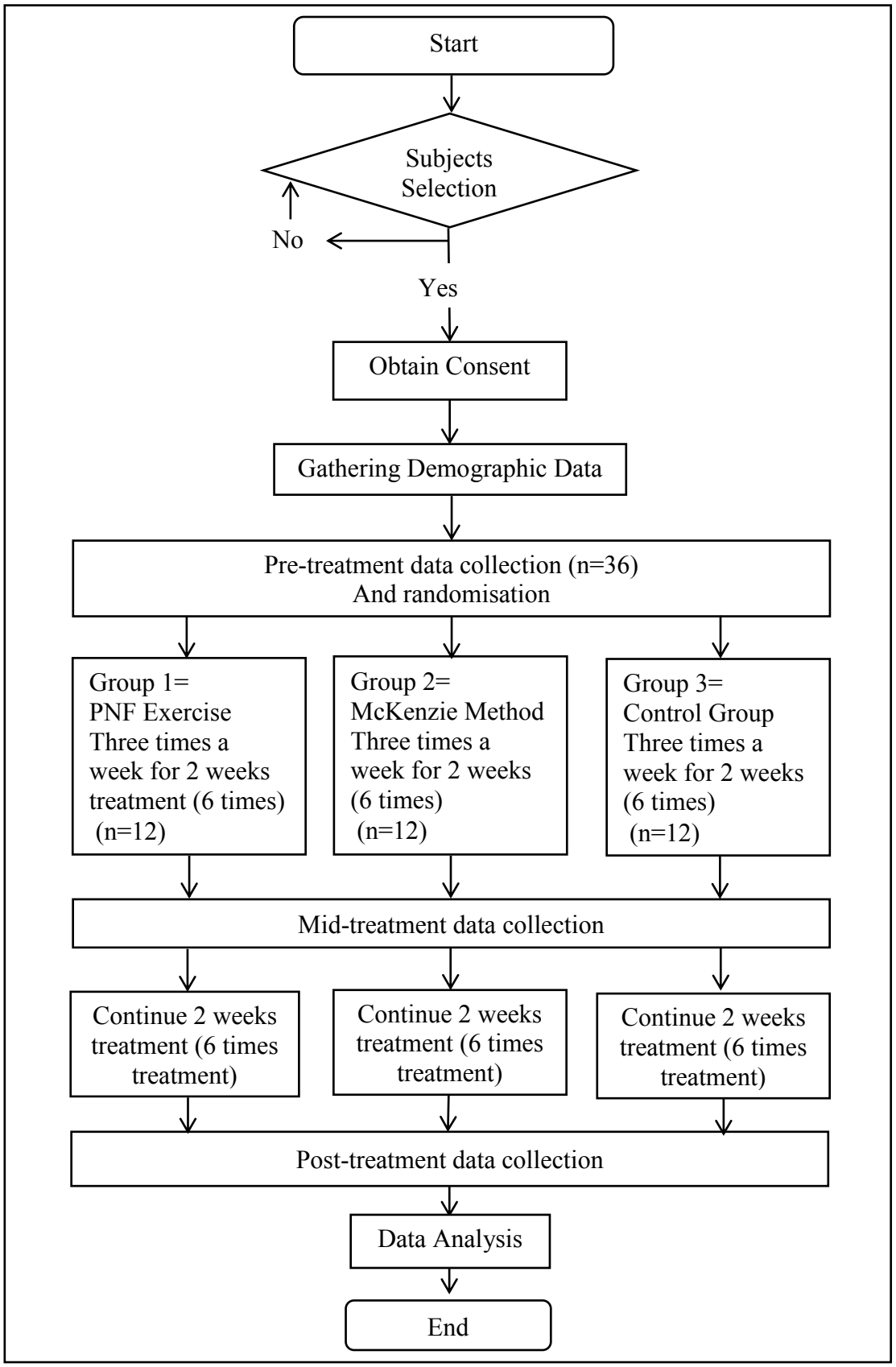

Figure 3.2: Methodological Flow

3.11 RESEARCH GRANT

This study was funded by KPJ Healthcare University College research grant, which covered in all circumstances regarding the research processes.

3.12 ETHICAL CONSIDERATION

This study conducted in a private academic institute and the ethical approval has be obtained from School of Health Sciences, KPJ Healthcare University College, in Nilai, Negeri Sembilan, Malaysia with reference number KPJUC/RMC/MPT/EC/2017/89 (Appendix A), and before the commencement of the data collection process, for which the researcher must comply with the guidelines and requirements. The personal information received from the subject treated as highly confidential and used by the researcher for the sole purpose of this study only. The researcher maintained professional etiquette in dealing with the subjects to ensure they do not feel vulnerable or threatened by their participation in the study. Upon completion of the data collection, the filled copies of questionnaires coded by the researcher and sealed to maintain confidentially of information.

CHAPTER 4

RESULTS

4.1 INTRODUCTION

The data analysis and the results are presented in this chapter. The results of the finding include the frequency analysis on demographic variables of the subject's data profile and the analysis measurement to determine the benefits and effects on the PNF and McKenzie method for the student and staffs that experienced non-specific low back pain due to prolonged sitting in the classroom or working. The results provide a description of the study subjects, and variables considered throughout the study. The results from repeated measure ANOVA within groups and between group analysis of PNF exercise, McKenzie method and control group treatment on pain, lumbar ROM, functional disability and quality of life in non-specific low back pain were presented.

4.2 SUBJECT'S PROFILE

4.2.1 Socio-demographic data of subjects

A total of 36 subject with non-specific low back pain who were participate in this study was randomly divided into three groups, those are PNF exercise, McKenzie method and control group. Subject who showed willingness to participate in this

study were given written consent form and verbal explanations of the study and it was obtained by the researcher and the data was collected.

Table 4.1 showed total number of subjects from three treatment groups, and each consisted of 12 subjects. The data concerning the age range was divided into 3 groups the highest number of subject with age range 18-25 years old was in control group with 11 subjects. The age range between 26 to 33 years old were 2 subjects in PNF exercise group, 2 subjects in McKenzie method group and 1 subject in the control group. The most subjects in the age range between 34 to 41 years old were 3 subjects involved in PNF exercise group.

The data regarding the gender showed that the most male subjects was 5 subjects in PNF exercise group with total of male subject is 13 subjects. The female subject is more than the male subjects with total is 23 subjects and most of female subjects were in McKenzie method and control group with 8 subjects.

The occupation category participated in this study showed that the number of students were more than the number of staffs. The total number of students were 22 which the most subjects were eight subjects joining the control group. Whereas, the total numbers of staffs were 14, in which the most subjects were in PNF and McKenzie method group with five subjects each.

Regarding the occupations, the years of working or studying are categorised in four categories. The most categories are student or staffs who has been working or studying for 1-3 years with the most were 11 subjects in control group treatment. For 4-6 years category, the McKenzie method group has the most subjects with 3 subjects. For 7-9 years category, there are one subject in PNF and McKenzie group and none in control treatment group. For subject with working years equal or more than 10 years, there is only one subject in PNF group, whereas for McKenzie and control group had none subject. The socio-demographic details such as age, gender and occupation are tabulated in Table 4.1.

Table 4.1 Socio-demographic distribution of the subjects (n=36)

Parameter	Treatment Group, n (%)		
	PNF	McKenzie	Control
Age (Years)			
18 – 25	7 (58.3)	9 (75)	11 (91.7)
26 – 33	2 (16.7)	2 (16.5)	1 (8.3)
34 - 41	3 (25)	1 (8.3)	0 (0)
Gender			
Male	5 (41.7)	4 (33.3)	4 (33.3)
Female	7 (58.3)	8 (66.7)	8 (66.7)
Occupation			
Student	7 (58.3)	7 (58.3)	8 (66.7)
Staff	5 (41.7)	5 (41.7)	4 (33.3)
Years of Study/Working			
1-3 years	8 (66.7)	8 (66.7)	11 (91.7)
4-6 years	2 (16.7)	3 (25)	1 (8.3)
7-9 years	1 (8.3)	1 (8.3)	0 (0)
≥ 10 years	1 (8.3)	0 (0)	0(0)

Overall age categories of the subjects were 75% are 18-25 years old, 13.89% 26-33 years old and 34-41 years with 11.11%. For the gender categories, most of the subjects are female with 63.89% and 36.11% are male. The occupation categories of all subjects are 61.11% student and 38.89 % office worker. The year of working or study of overall subjects, were 75% for 1-3 years, 16.7% for 4-6 years, and 5.6% for 7-9 years and more than or equal to 10 years are 2.8 %.

4.2.2 Baseline descriptive analysis of study population

Baseline descriptive analysis was presented as mean, standard deviation and frequency and *p*-value. The details includes the subjects' profile based on variables such as VAS score, ODI score, Lumbar flexion and extension ROM, Physical Component Summary (PCS) score and Mental Component Summary (MCS) score. The descriptive analysis data is presented in Table 4.2. There were no significant differences between treatment groups in terms of VAS score, ODI, Lumbar flexion and extension ROM, PCS and MCS score with $p>0.05$.

Table 4.2 Baseline descriptive analysis of the subjects (n=36)

Parameter	Treatment group (Mean ± SD)			*p*-value*
	PNF	McKenzie	Control	
VAS (mm)	30.75 ±13.92	41.58 ± 16.46	35.92 ± 9.90	0.159
Lumbar Flexion ROM (cm)	4.00 ± 1.20	4.17 ± 1.58	4.17 ± 0.71	0.929
Lumbar Extension ROM (cm)	2.33 ± 0.77	2.75 ± 1.13	2.67 ± 0.77	0.505
ODI	9.67 ± 3.05	12.33 ± 4.18	10 ± 2.76	0.126
PCS	14.42 ± 1.67	14.25 ± 2.45	14.67 ± 2.6	0.904
MCS	20.75 ± 2.52	18.42 ± 3.26	19.25 ± 3.44	0.190

Note. VAS (Visual Analogue Scale); ODI (Oswestry Disability Index); ROM (Range of Motion); PCS (Physical Component Summary); (MCS) Mental Component Summary. *Comparison between the treatment groups based on one-way ANOVA with significant value $p<0.05$

4.3 EFFECT OF PNF EXERCISE AND MCKENZIE METHOD ON PAIN SCORE (VISUAL ANALOGUE SCALE) IN NON-SPECIFIC LOW BACK PAIN (MEASURED)

Repeated measures ANOVA was conducted to determine the effect of treatment on pain score (VAS) between PNF, McKenzie method and control group. Firstly, within group analysis used to know the effect of PNF exercise, McKenzie method and control group treatment on VAS in each group. Secondly, between group analyses used to compare the effect of PNF exercise, McKenzie method and control group treatment on VAS (regardless of time). Lastly, the analysis continued to within-between groups to compare the treatment effect among three treatments based on the time.

The following result is describing the findings of the effect of PNF exercise and McKenzie method and control group on VAS in non-specific low back pain using repeated measure ANOVA within groups (based on time).

Table 4.3 described the within group result of PNF exercise, McKenzie and Control group in VAS score in terms of Mean Difference (MD) and Confidence Interval (CI). Mauchly's test of Sphericity indicated that the assumption of sphericity had been violated, χ^2 (2)=15.90, p=0.001, and therefore, a Greenhouse-geisser correction was used. There was a significant effect of time on VAS score, F=79.90, p=0.001. Bonferroni pairwise comparison test was proceeded which allowed us to discover which specific means differed. The result showed that there was significant mean difference in each measurement time comparison for each group. The result presented in the Table 4.3.

Table 4.3 Comparison of VAS within each treatment group based on time (n=36)

Comparison	PNF		McKenzie		Control group	
VAS	MD (95% CI)	*p*-value	MD (95% CI)	*p*-value	MD (95% CI)	*p*-value
0 week – 2 week	15.00 (8.58, 21.41)	<0.001	16.00 (3.70, 28.29)	0.011	6.83 (3.59, 10.06)	<0.001
0 week - 4 week	26.50 (16.20, 36.79)	<0.001	28.16 (15.80, 40.53)	<0.001	13.00 (9.24, 16.75)	0.001
2 week-4 week	11.50 (4.79, 18.20)	0.002	12.16 (5.53, 18.79)	0.001	6.16 (2.78, 9.54)	0.001

Repeated measure ANOVA within group analyses were applied followed by multiple comparison; MD = Mean Difference, CI = Confidence Interval. Bonferroni correction applied by correction level of significance. Significant value at $p<0.05$

The following analysis is describing the comparison of the effect of PNF exercise and McKenzie method and control group on VAS in non-specific low back pain using repeated measure ANOVA between group analysis (regardless of time).

Table 4.4 describes the between group result of PNF exercise, McKenzie and Control group in Visual Analogue Scale (VAS) in terms of Mean Difference (MD) and Confidence Interval (CI). There was significant difference of VAS score between the group (F= 5.49, p=0.009). The analysis is followed with multiple comparisons with post hoc using Tukey HSD to discover which specific group means differed. The result showed that there was significant mean difference between PNF exercise group with McKenzie method group treatment as p=0.044 and PNF exercise with Control group as p=0.010. However, there was no significant mean difference between McKenzie group with control group. The results presented in the Table 4.4 below.

Table 4.4 Overall mean difference of VAS among three treatment group based on treatment effect (n=36)

Comparison	VAS score MD (95% CI)	p-value	F-stat (df)
PNF – McKenzie	-9.94 (-19.66, 0.23)	0.044	5.49 (2)
PNF – Control	-12.39 (-22.10, -2.68)	0.010	
McKenzie – Control	-2.44 (-12.16, 7.27)	0.812	

Repeated measure ANOVA between group analysis was applied followed by post-hoc multiple comparison using Tukey HSD. Significant value at $p<0.05$.

The following is describing the findings from the comparison of the effect of PNF exercise and McKenzie method on pain (VAS) in non-specific low back pain using repeated measure ANOVA within-between groups analysis (based on time). The result presented in the Table 4.5.

Table 4.5 describes the comparison between PNF exercise, McKenzie method and control group treatment on VAS in terms of Mean difference and p-value for every comparison group. The Multivariate test for VAS-treatment interaction result based on *F*-test showed the $p < 0.05$. The analysis is followed by producing means (estimated marginal means) with its confidence interval.

A multiple comparisons using Bonferroni revealed that there was no statistically significant difference in VAS during 0 week between PNF and McKenzie ($p=0.171$), PNF and Control group ($p=1.00$) also McKenzie and Control group treatment ($p=0.929$) as the baseline measurement. During 2 weeks of treatment, there is no statistically significant mean difference between PNF with McKenzie as $p=0.117$, and McKenzie with Control group as $p=1.00$. However, there is statistically significant mean difference between PNF with control group as $p=0.019$. At 4 week period, the value of p decrease and showed statistically significant mean difference between PNF and McKenzie as $p=0.037$, PNF with control group as $p=0.001$ and McKenzie with Control group as $p=0.029$.

Therefore, it can be conclude, that the PNF exercise have significant improvement to reduce the VAS score with statistically significant ($p<0.05$) than McKenzie Method at 4 weeks after treatment. Thus, it was significant and has the power to reject the null hypothesis.

Table 4.5 Comparison of mean VAS Score among three treatment group based on time (n=36)

Variable VAS	Comparison	Mean Difference (95% CI)	*p*-value
Pre-treatment	PNF-McKenzie	-10.83 (-24.69, 3.02)	0.171
	PNF-Control	-5.16 (-19.02, 8.69)	1.000
	McKenzie-Control	-5.66 (-8.19, 19.52)	0.929
2 weeks treatment	PNF-McKenzie	-9.83 (-21.37, -1.71)	0.117
	PNF-Control	-13.33 (-24.87, -1.78)	0.019
	McKenzie-Control	-3.50 (-15.04, 8.04)	1.000
4 weeks treatment	PNF-McKenzie	-9.16 (-17.89, -0.43)	0.037
	PNF-Control	-18.66 (-2739, -9.93)	0.001
	McKenzie-Control	-9.50 (-18.23, 0.77)	0.029

Repeated measure ANOVA within-between group analyses with based on time was applied. Assumption of normality, homogeneity of variances and compound symmetry were checked and were fulfilled. Adjustment for multiple comparisons using Bonferroni. Significant value at $p<0.05$.

4.4 EFFECT OF PNF EXERCISE AND MCKENZIE METHOD ON LUMBAR RANGE OF MOTION (FLEXION) IN NON-SPECIFIC LOW BACK PAIN (MEASURED)

Repeated measures ANOVA were conducted to determine the effect of treatment on Lumbar flexion ROM between PNF, McKenzie method control group. Firstly, within group analysis was used to determine the effect of PNF exercise, McKenzie method and control group treatment on lumbar flexion ROM in each group. Secondly, between group analyses used to compare the effect of PNF exercise, McKenzie method and control group treatment on lumbar flexion ROM (regardless of time). Lastly, the analysis continued to within-between groups to compare the treatment effect among three treatments based on the time.

The following result is describing the findings of the effect of PNF exercise and McKenzie method and control group on lumbar flexion ROM in non-specific low back pain using repeated measure ANOVA within groups (based on time).

Table 4.6 described the within group result of PNF exercise, McKenzie and Control group in lumbar flexion ROM in terms of Mean Difference (MD) and Confidence Interval (CI). Mauchly's test of Sphericity indicated that the assumption of sphericity had been violated, χ^2 (2) = 13.46, p=0.001, and therefore, a Greenhouse-geisser correction was used. There was a significant effect of time on lumbar flexion ROM, F=30.33, p=0.001. Bonferroni pairwise comparison test was proceeded which allowed us to discover which specific means differed. The result showed that McKenzie method had significant result in 0 week to 2 weeks as p= 0.005, while in the other group were not significant. In 0 week to 4 weeks, all three groups have significant mean difference as p<0.05. However, in 2 week to 4 week only PNF exercise group showed significant result as p = 0.009, while the others treatment has no significant difference. The results presented in the Table 4.6.

Table 4.6 Comparison of Lumbar Flexion ROM for each treatment group based on time (n=36)

Comparison	PNF		McKenzie		Control group	
Lumbar Flexion ROM	MD (95% CI)	*p*-value	MD (95% CI)	*p*-value	MD (95% CI)	*p*-value
0 week – 2 week	-0.83 (-1.67, 0.05)	0.052	-0.75 (-1.25, -0.24)	0.005	-0.25 (-0.75, 0.25)	0.573
0 week - 4 week	-1.91 (-3.23, -0.59)	0.005	-1.16 (-1.93, -0.40)	0.004	-0.75 (-1.36, -0.13)	0.016
2 week - 4 week	-1.08 (-1.89, -0.27)	0.009	-0.41 (-1.06, 0.22)	0.288	-0.50 (-1.04, 0.04)	0.078

Repeated measure ANOVA within group analyses were applied followed by multiple comparison; MD = Mean Difference, CI = Confidence Interval. Bonferroni correction applied by correction level of significance. Significant value at $p<0.05$

In order to analyse the lumbar flexion ROM between group interaction, there was no significant mean difference of lumbar flexion ROM between the group (F= 0.542, p=0.587). Multiple comparisons were not conducted, as the overall F-test was not significant.

For time-treatment interaction result in repeated measure ANOVA within-between group analysis, founded that there was no significant mean difference of lumbar flexion ROM based on time (p=0.100). It is indicated that the mean of lumbar flexion ROM for each treatment were similar based on time. Multiple comparisons were not conducted as the global test was not significant. Assumption of normality, homogeneity of variances and compound symmetry were checked and were fulfilled. Thus, it was not significant and we have to accept the null hypothesis.

4.5 EFFECT OF PNF EXERCISE AND MCKENZIE METHOD ON LUMBAR RANGE OF MOTION (EXTENSION) IN NON-SPECIFIC LOW BACK PAIN (MEASURED)

Repeated measures ANOVA were conducted to determine the effect of treatment on lumbar extension ROM between PNF, McKenzie method and control group. Firstly, within group analysis was used to determine the effect of PNF exercise, McKenzie method and control group treatment on lumbar extension ROM in each group. Secondly, between group analyses used to compare the effect of PNF exercise, McKenzie method and Control group treatment on lumbar extension ROM (regardless of time). Lastly, the analysis continued to within-between groups to compare the treatment effect among three treatments based on the time.

The following result describing the findings of the effect of PNF exercise and McKenzie method and control group on Lumbar extension ROM in non-specific low back pain using repeated measure ANOVA within groups (based on time).

Table 4.7 described the within group result of PNF exercise, McKenzie and control group in Lumbar extension ROM in terms of Mean Difference (MD) and Confidence Interval (CI). Mauchly's test of Sphericity indicated that the assumption of sphericity had not been violated, χ^2 (2) = 2.09, p= 0.35. Bonferroni pairwise comparison test was proceeded which allowed us to discover which specific means differed. The result showed that each group had no significant mean difference in 0 Week to 2 week treatment as p>0.05. In 0 week to 4 week, all groups have significant mean difference as p< 0.05. However, in 2 week to 4 week only PNF exercise group showed significant result as p = 0.001, while the others treatment has no significant mean difference. The results presented in the Table 4.7.

Table 4.7 Comparison of Lumbar extension ROM for each treatment group based on time (n=36)

Comparison	PNF		McKenzie		Control group	
Lumbar Extension ROM	MD (95% CI)	*p*-value	MD (95% CI)	*p*-value	MD (95% CI)	*p*-value
0 week – 2 week	-0.16 (-0.63, 0.30)	>0.95	-0.41 (-0.96, 0.12)	0.161	-0.25 (-0.75, 0.25)	0.573
0 week - 4 week	-1.16 (-1.63, -0.69)	0.001	-0.83 (-1.51, -0.15)	0.016	-0.66 (-1.30, -0.03)	0.038
2 week - 4 week	-1.00 (-1.49, -0.50)	0.001	-0.41 (-0.836, 0.003)	0.052	-0.41 (-0.96, 0.12)	0.161

Repeated measure ANOVA within group analyses were applied followed by multiple comparison; MD = Mean Difference, CI = Confidence Interval. Bonferroni correction applied by correction level of significance. Significant value at $p<0.05$

In order to analyse the lumbar extension ROM between group interaction, there was no significant mean difference of lumbar extension ROM between the group (F= 0.872, p=0.428). Multiple comparisons were not conducted, as the overall F-test was not significant.

For time-treatment interaction result in repeated measure ANOVA analysis, founded that there was no significant mean difference of lumbar extension ROM based on time (p=0.127). It is indicated that the mean of lumbar flexion ROM for each treatment were similar based on time. Multiple comparisons were not conducted, as the global test was not significant. Assumption of normality, homogeneity of variances and compound symmetry were checked and were fulfilled. Thus, it was not significant and we have to accept the null hypothesis.

4.6 EFFECT OF PNF EXERCISE AND MCKENZIE METHOD ON FUNCTIONAL DISABILITY (OSWESTRY DISABILITY INDEX) IN NON-SPECIFIC LOW BACK PAIN (MEASURED)

Repeated measures ANOVA were conducted to determine the effect of treatment on functional disability with Oswestry Disability Index (ODI) between PNF, McKenzie method and control group. Firstly, within group analysis was used to determine the effect of PNF exercise, McKenzie method and control group treatment on ODI in each group. Secondly, between group analyses used to compare the effect of PNF exercise, McKenzie method and control group treatment on lumbar ODI (regardless of time). Lastly, the analysis continued to within-between groups to compare the treatment effect among three treatments based on the time.

The following result described the findings of the effect of PNF exercise, McKenzie method and control group on ODI in non-specific low back pain using repeated measure ANOVA within groups (based on time).

Table 4.8 described the within group result of PNF exercise, McKenzie and Control group in Oswestry disability index (ODI) in terms of Mean Difference (MD) and Confidence Interval (CI). Mauchly's test of Sphericity indicated that the assumption of sphericity had been violated, χ^2 (2) = 14.94, p=0.001, and therefore, a Greenhouse-geisser correction was used. There was a significant effect of time on ODI score, F=65.32, p=0.001. Bonferroni pairwise comparison test was proceeded which allowed us to discover which specific means differed. The result showed that there was significant mean difference in each measurement time comparison for each group. In 0 week to 2 week after treatment, each group had significant within group as p>0.05 with PNF exercise group was the most significant (p=0.001) than the others. In 0 Week to 4 week, each group have significant mean difference as $p < 0.05$ with same significant p-value. In 2 week to 4 week all groups had significant result as p<0.05 with McKenzie group was the most significant (p=0.004). The result were presented in the Table 4.8.

Table 4.8 Comparison of Oswestry Disability Index (ODI) for each treatment group based on time (n=36)

Comparison	PNF		McKenzie		Control group	
ODI	MD (95% CI)	*p*-value	MD (95% CI)	*p*-value	MD (95% CI)	*p*-value
0 week – 2 week	5.66 (4.22, 7.11)	0.001	5.50 (1.08, 9.91)	0.014	1.33 (0.39, 2.27)	0.006
0 week - 4 week	8.83 (7.24, 10.41)	0.001	8.16 (4.41, 11.91)	0.001	2.58 (1.57, 3.59)	0.001
2 week - 4 week	3.16 (0.89, 5.43)	0.007	2.66 (0.92, 4.41)	0.004	1.25 (0.39, 2.10)	0.005

Repeated measure ANOVA within group analyses were applied followed by multiple comparison; MD = Mean Difference, CI = Confidence Interval. Bonferroni correction applied by correction level of significance. Significant value at $p<0.05$

The following described the comparison of the effect of PNF exercise and McKenzie method and control group on ODI in non-specific low back pain using repeated measure ANOVA between group analysis (regardless of time). Table 4.9 below describe the between group result of PNF exercise, McKenzie and Control group in Oswestry disability index (ODI) in terms of Mean Difference (MD) and Confidence Interval (CI). There was significant mean difference of ODI score between the group (F= 6.14, p=0.005). The analysis is followed with multiple comparisons with post hoc using Tukey HSD to discover which specific group means differed. The result showed that there was significant difference mean between PNF exercise group with McKenzie group treatment as p=0.040 and PNF exercise with Control group as p=0.006. However, there was no significant difference between McKenzie group with control group.

Table 4.9 Overall mean difference of ODI among three treatment group based on treatment effect (n=36)

Comparison	ODI MD (95% CI)	p-value	F-stat (df)
PNF – McKenzie	-2.94 (-5.77, 0.12)	0.040	6.14 (2)
PNF – Control	-3.86 (-6.69, -1.04)	0.006	
McKenzie – Control	-0.92 (-3.74, 1.91)	0.708	

Repeated measure ANOVA between group analysis was applied followed by post-hoc multiple comparison using Tukey HSD. *Significant value at p<0.05.

The following result described the findings from the comparison of the effect of PNF exercise and McKenzie method on (ODI) in non-specific low back pain using repeated measure ANOVA within-between groups analysis (based on time).

Table 4.9 describe the comparison between PNF exercise with control group, McKenzie method and control group treatment on ODI in terms of Mean difference and p-value for every comparison group. The Multivariate test for ODI-treatment

interaction result based on *F*-test showed the $p < 0.005$. The analysis is followed by producing means (estimated marginal means) with its confidence interval.

A pairwise comparisons using Bonferroni revealed that there was no statistically significant mean difference in ODI during 0 week between PNF and McKenzie ($p=0.18$), PNF and Control group ($p=1.00$) also McKenzie and control group treatment ($p=0.30$) as the baseline measurement.

During 2 weeks of treatment, there is no statistically significant mean difference between PNF with McKenzie as $p=0.211$ and McKenzie with control group as $p = 0.70$. However, there is a statistically significant between PNF with Control group as $p=0.012$. At 4 weeks period, the value of p decrease some more statistically significant between PNF and McKenzie as $p=0.011$, PNF with control group as $p=0.0001$ and McKenzie with Control group as $p=0.013$. The results presented in the Table 4.10.

Therefore, it can be concluded, that the PNF exercise more significant improvement to reduce the ODI score with statistically significant ($p<0.05$) than McKenzie Method at 4 weeks after treatment. Thus, it was significant and has the power to reject the null hypothesis.

Table 4.10 Comparison of ODI among three-treatment group based on time

Variable ODI	Comparison	Mean Difference (95% CI)	*p*-value
Pre-treatment	PNF-McKenzie	-2.66 (-6.15, 0.82)	0.188
	PNF-Control	-0.33 (-3.82, 3.15)	1.000
	McKenzie-Control	2.33 (-1.15, 5.82)	0.304
2 weeks treatment	PNF-McKenzie	-2.83 (-6.65, 0.98)	0.211
	PNF-Control	-4.66 (-8.48, -0.84)	0.012
	McKenzie-Control	-1.83 (-5.65, 1.98)	0.704
4 weeks treatment	PNF-McKenzie	-3.33 (-6.01, -1.16)	0.011
	PNF-Control	-6.58 (-9.26, -3.89)	<0.001
	McKenzie-Control	-3.25 (-5.93, -0.56)	0.013

Repeated measure ANOVA within-between group analyses with based on time was applied. Assumption of normality, homogeneity of variances and compound symmetry were checked and were fulfilled. Adjustment for multiple comparisons using Bonferroni. Significant value at $p<0.05$.

4.7 EFFECTS OF PNF EXERCISE AND MCKENZIE METHOD ON HEALTH-RELATED QUALITY OF LIFE (PHYSICAL COMPONENT SUMMARY) IN NON-SPECIFIC LOW BACK PAIN (MEASURED)

Repeated measures ANOVA were conducted to determine the effect of treatment on Physical component summary (PCS) between PNF, McKenzie method and control group. Firstly, within group analysis used to know the effect of PNF exercise, McKenzie method and control group treatment on PCS in each group. Secondly, between group analyses used to compare the effect of PNF exercise, McKenzie method and control group treatment on PCS (regardless of time). Lastly, the analysis continued to within-between groups to compare the treatment effect among three treatments based on the time.

The following result described the findings of the effect of PNF exercise and McKenzie method and control group on PCS in non-specific low back pain using repeated measure ANOVA within groups (based on time). Table 4.10 describe the within group result of PNF exercise, McKenzie and control group in Physical Component Summary (PCS) in terms of Mean Difference (MD) and Confidence Interval (CI). Mauchly's test of Sphericity indicated that the assumption of sphericity had not been violated, χ^2 (2) = 4.91, p=0.086. Bonferroni pairwise comparison test was proceeded which allowed us to discover which specific means differed. The result showed that PNF exercise and Control group have significant result in 0 week to 2 week as p<0.05, while in McKenzie group was not significant. In 0 Week to 4 week, each group have significant mean difference as p < 0.05 with the most significant was PNF exercise as p=0.001. In 2 week to 4 week each group have significant mean difference as p<0.05 with the most significant was PNF exercise as p=0.006. The results presented in the Table 4.11.

Table 4.11 Comparison of Physical Component Summary for each treatment group based on time (n=36)

Comparison	PNF		McKenzie		Control group	
PCS	MD (95% CI)	*p*-value	MD (95% CI)	*p*-value	MD (95% CI)	*p*-value
0 week – 2 week	-1.41 (-2.82, -0.008)	0.049	-1.00 (-2.66, 0.66)	0.355	-1.08 (-2.09, -0.07)	0.035
0 week – 4 week	-3.25 (-5.05, -1.44)	0.001	-2.58(-4.19, -0.97)	0.003	-2.16 (-3.45, -0.87)	0.002
2 week - 4 week	-1.83 (-3.12, -0.54)	0.006	-1.58 (-2.85, -0.31)	0.015	-1.08 (-1.89, -0.27)	0.009

Repeated measure ANOVA within group analyses were applied followed by multiple comparison; MD = Mean Difference, CI = Confidence Interval. Bonferroni correction applied by correction level of significance. Significant value at $p<0.05$.

In order to analyse the physical component summary (PCS) between group interaction, there was no significant difference of PCS between the groups (F= 0.243, p=0.785). Multiple comparisons were not conducted as the overall F-test was not significant.

For time-treatment interaction result in repeated measure ANOVA analysis, founded that there was no significant mean difference of PCS based on time *(p*=0.659). It is indicated that the mean of PCS for each treatment were similar based on time. Multiple comparisons were not conducted, as the global test was not significant. Assumption of normality, homogeneity of variances and compound symmetry were checked and were fulfilled. Thus, it was not significant and we have to accept the null hypothesis.

4.8 EFFECTS OF PNF EXERCISE AND MCKENZIE METHOD ON HEALTH-RELATED QUALITY OF LIFE (MENTAL COMPONENT SUMMARY) IN NON-SPECIFIC LOW BACK PAIN (MEASURED)

Repeated measures ANOVA were conducted to determine the effect of treatment on mental component summary (MCS) between PNF, McKenzie method and control group. Firstly, within group analysis used to know the effect of PNF exercise, McKenzie method and control group treatment on MCS in each group. Secondly, between group analyses used to compare the effect of PNF exercise, McKenzie method and control group treatment on lumbar MCS (regardless of time). Lastly, the analysis continued to within-between groups to compare the treatment effect among three treatments based on the time.

The following result described the findings of the effect of PNF exercise and McKenzie method and control group on MCS in non-specific low back pain using repeated measure ANOVA within groups (based on time).

Table 4.11 describe the within group result of PNF exercise, McKenzie and Control group in Mental Component Summary (MCS) in terms of Mean Difference (MD) and Confidence Interval (CI). Mauchly's test of Sphericity indicated that the

assumption of sphericity had been violated, χ^2 (2) =6.03, p=0.049, and therefore, a Greenhouse-geisser correction was used. There was a significant effect of time on MCS F=49.07, p=0.001. Bonferroni pairwise comparison test was proceeded which allowed us to discover which specific means differed. The result showed that there was significant mean difference in each measurement time comparison for each group. In 0 Week to 2 week after treatment, each group had significant within group as p>0.05 with PNF exercise group and Control group were the most significant (p=0.025). In 0 week to 4 week, each group have significant mean difference as p<0.05 with same significant p-value. In 2 week to 4 week PNF, there was no significant difference in PNF group as p=0.089. However, McKenzie group had significant result as p=0.032 and Control group was the most significant as p=0.023. The results presented in the Table 4.12.

Table 4.12 Comparison of Mental Component Summary for each treatment group based on time (n=36)

Comparison	PNF		McKenzie		Control group	
MCS	MD (95% CI)	*p*-value	MD (95% CI)	*p*-value	MD (95% CI)	*p*-value
0 week – 2 week	-1.50 (-2.82, -0.17)	0.025	-1.50 (-2.95, 0.04)	0.042	-1.91 (-3.59, -0.23)	0.025
0 week – 4 week	-3.16 (-4.75, -1.58)	0.001	-4.50 (-6.99, -2.00)	0.001	-3.66 (-5.37, -1.94)	0.001
2 week - 4 week	-1.66 (-3.54, -0.21)	0.089	-3.00 (-5.75, -0.24)	0.032	-1.75 (-3.26, -0.23)	0.023

Repeated measure ANOVA within group analyses were applied followed by multiple comparison; MD = Mean Difference, CI = Confidence Interval. Bonferroni correction applied by correction level of significance. Significant value at $p<0.05$

In order to analyse the mental component summary (MCS) between group interaction, there was no significant difference of MCS between the groups (F= 1.69, p=0.200). Multiple comparisons were not proceeded as the overall F-test was not significant.

For time-treatment interaction result in repeated measure ANOVA analysis, we founded that there was no significant mean difference of MCS based on time (p=0.657). It is indicated that the mean of MCS for each treatment were similar based on time. Multiple comparisons were not proceeded as the global test was not significant. Assumption of normality, homogeneity of variances and compound symmetry were checked and were fulfilled. Thus, it was not significant and we have to accept the null hypothesis.

4.9 SUMMARY

The aim of the current study was to determine the effect of PNF, McKenzie in non-specific low back pain as well as comparison between PNF and McKenzie method on pain score, lumbar ROM, functional disability and health-related quality of life. Firstly, according to the statistical results, all treatments have significant mean difference in within group analysis after four weeks on pain, lumbar ROM, functional disability and health-related quality of life. Secondly, in comparison between group analyses, statistical test showed PNF have significant mean difference between McKenzie method and control group in pain score and functional disability score. While, there is no significant mean difference between PNF, McKenzie and control group in lumbar ROM and health-related quality of life.

Thirdly, the comparison within-between group analyses, statistical test showed that PNF have significant mean difference than control group after two weeks between control group in pain score and functional disability; However there is no significant mean difference between PNF and McKenzie with McKenzie and control group. Subsequently, after four weeks the statistical test showed that PNF have significant mean difference than McKenzie and control group in pain score and disability score. However, the McKenzie method also showed significant mean

difference than the control groups after four weeks in pain score and functional disability score. From the statistical test also showed there is no significant mean difference between PNF, McKenzie and control group in lumbar ROM and health-related quality of life.

CHAPTER 5

DISCUSSION

5.1 INTRODUCTION

This chapter explained the finding of the results based on the factors analysis conducted through the entire study. This study was designed to find the research objectives and hypotheses following the study protocol. It focuses on the significance and benefits of the study findings. The findings of the research were then discussed based on the knowledge acquired from study results and with an updated knowledge. The discussion emphasized on the contributions of the additional knowledge from existing study finding which were limited to the present study including strength and weakness of the research. The general objective of this study was to compare the effect of intervention between PNF and McKenzie method in non-specific low back pain among university population.

The subjects' participation was volunteer participation, selected by the principal investigator and randomised to three groups. Calculation of sample size in this research is 30 subjects and 20% added subjects to prevent the type two errors, type two errors depend on the power of the test that can be prevented with adequate sample size. Total subjects who were joining this study are 36 subjects. These total participants were the same number of samples on previous study, which was carried out to investigate the effect three treatments on low back pain (Hasanpour-Dehkordi, Dehghani and Solati, 2017). Subjects in the current study consist of 22 students and

14 staff who have at least one year of study or work in university. All subjects participated in this study were committed until the end of study without any drop out.

5.2 THE EFFECT OF PNF EXERCISE AND MCKENZIE METHOD ON PAIN (VISUAL ANALOGUE SCALE)

The result of the current study indicated that there were positive effects of those three treatments on pain by visual analogue scale (VAS) in within group analysis. Each group showed significant result for both 2 weeks and 4 weeks after the treatment. In the within-between group analysis showed that PNF have significant mean difference result than control group treatment, while no significant difference between PNF and McKenzie after 2 weeks. After 4^{th} week treatment, PNF showed significant mean difference result between McKenzie and control group. All treatments in this present study were conducted for three times a week, as proposed by the previous systematic review study with exercise therapy for three times a week with minimum of 20 minutes to promote the reduction of the pain in work-related musculoskeletal disorders in lumbar spine (Rodrigues et al, 2014).

Similar to the result of PNF that have significant difference than the control group, a previous study also reported that PNF, with same procedure in the present study, showed statistically significant in pain reduction than the control groups treated with educational booklet after 4 weeks (Areeudomwong et al, 2016). The result of comparison between PNF and McKenzie group can be related with study performed by George, Kumar and Nikhil (2013) which identify the PNF for low back pain compare with the conventional back exercise training. They also found the PNF exercise produce a significant result on pain score reduction than the conventional exercise training for low back pain after three weeks. This can also be related with the result of the present study that showed the PNF have significant improvement after 2 weeks treatment before the completion of the 4 weeks compared with the control group.

Similarly, the result of the present study was supported by a study by Mavromoustakos et al. (2015) that conducted comparison study between PNF and general exercise for low back pain, which the general exercise is similar with McKenzie method. They also reported that after 12 sessions of treatment, the PNF group showed a significant difference in pain score than the general exercise, then, it showed the consistency result when compared with the present study indirectly.

According to a study by Jadeja et al. (2015) that explain the result in their study when the back-muscle strengthen with PNF compared with the conventional back exercise showed that the PNF, which consisted of RST and COI, have significant in reducing the pain and strengthen the core muscle. Thus, the previous study concluded that the PNF also provided strengthening exercise for the core muscles, which involved the core muscle strength. In the present study, we used the same procedure, which were RST and COI for the PNF exercise. The RST involves isometric contractions of agonist and antagonist and COI used all muscle action types (eccentric, concentric, and isometric), that was not provided by the McKenzie method. The improvement of core muscle strength was also reported in a study performed by Chitra and Das (2015). In their assessments, the deep abdominal muscle strength assessed using sphygmomanometer and a stopwatch. From those previous studies result showed that the PNF was significant to improve the core muscle strength after 4 weeks treatment and related with reducing the pain score which consistent with the present study.

A study by Tanna, Thiyagarajan and Gounder, (2016) comparing the effectiveness of motor control exercise versus McKenzie method for mechanical back pain showed that the motor control exercise (MCE) gave significant improvement in reducing pain than the McKenzie. The MCE was defined as specific stabilisation exercise and focuses on regaining control of trunk muscles (multifidus and tranversus abdominis), which can be assume similar with the purpose of the PNF exercise in the present study. While, the study by Dhaliwal et. al. (2014), reported that the PNF exercise had significant difference result in reducing the pain for low back pain than the core stabilisation exercise. It can be concluded that those previous studies supported the superiority of PNF in strengthening the core muscle and related

to reducing the pain of low back pain compared to the core stabilisation exercise (Chitra and Das, 2015 ; Dhaliwal et. al., 2014). On the other hand, the previous study also showed the McKenzie method was not significant compare with the core stabilisation exercise (Tanna, Thiyagarajan and Gounder, 2016). Thus, it can be related that the reduction of pain by PNF exercise was more significant than the McKenzie method because of the core muscle strengthening that provided by PNF exercise while the McKenzie method not provide the core muscle strengthening.

Despite of the superiority of PNF results, the McKenzie group also showed a better result than the control group treatment in the present study after the 4 weeks. Anies and Al-Azab (2017) also stated in their study that the McKenzie extension exercise was shown more significant at reducing pain than the control group, which contains TENS and strengthening exercise for low back pain. Consequently, the previous study could be related to the present study in comparing the McKenzie and control group. However, this study was conducted among low back pain with radiculopathy subject. Similarly, with the study done by El-Bandrawy and Ghareeb (2016) about the influence of McKenzie among postmenopausal low back pain, showed that the McKenzie have a significant result in reducing the pain compared with conventional therapy (interference current therapy). However, the study was conducted for five weeks, which is longer than the present study.

Islam, Haque and Irin (2015) found that the McKenzie have had significant difference result in decreasing pain compare with the conventional physiotherapy protocols on low back pain. The previous study compared the McKenzie method with conventional physiotherapy (ultrasound and strengthening exercise for the back) after 4 weeks, which consist of three days a week. The result was similar with present study that supported the effect of McKenzie in decrease the pain score compare with the control group. However, the comparison treatment was not the same with the PNF exercise, in which focused on strengthening the core muscle, and the McKenzie group was combined with strengthening exercise, yet, consistent with the result in McKenzie compare with the control group in the present study.

The result of this present study revealed that the PNF exercise, with RST and COI reduce the pain more significant than the McKenzie and control group because of the core muscle strengthening that reported by previous studies (Chitra and Das, 2015 ; Dhaliwal et. al., 2014). The mechanism of PNF also involved sensory-motor control training, stimulating the lumbar muscle proprioception and endurance exercise for the muscle to reduce the LBP (Lee, 2009 ; Kofotolis and Kellis, 2006). On the other hand, the McKenzie only provides postural correction and flexibility training for low back muscle without strengthening the muscles (Garcia et al. 2016; Clare, Adam and Maher, 2004).

5.3 THE EFFECT OF PNF EXERCISE AND MCKENZIE METHOD ON LUMBAR ROM

According to the statistical result of the present study, three treatment groups have significant effects on lumbar flexion ROM after 4 weeks treatment for each group. However, only the control group treatment has no significant result after 2nd week treatment. Similarly, the result of the three treatments on lumbar extension ROM, those three treatments showed statistically significant after 4 weeks treatment for each group. However, after 2 weeks of treatment, those three treatments showed no significant difference in each group. In the between-group interaction and time-treatment interaction, there is no statistical difference of increasing lumbar ROM in both flexion and extension. Hence, it could be said that those three treatments increased the lumbar ROM for both flexion and extension after the 4 weeks treatments equally.

Subsequently the findings of the study done by Franklin et al., (2013) showed that the PNF training have significant results of lumbar flexion and extension ROM among patients with low back pain in within group results. The study used the Schober method to assess the lumbar ROM and same PNF techniques used in the present study. The study compared the PNF training for trunk with strengthening exercise for 4 weeks treatment. The result showed the PNF training had significantly difference result of lumbar ROM, for both flexion and extension, compared with the conventional exercises on low back pain. Even though, the result contradicted with

present study, yet, this was also supported the findings of present study that the PNF training improved the lumbar ROM in within group analysis.

A study by Park and Seo (2014) explained about the effects of PNF compared with strengthening exercise on low back pain patient showed that in the within group result showed significantly increased lumbar ROM of both flexion and extension after the 4 weeks treatments. However, the result of between groups analyses showed that there was no significant difference of increasing lumbar flexion ROM than the strengthening exercise, on the other hand, the lumbar ROM extension showed the significant difference as compared with the strengthening exercise. The PNF techniques in their study were using scapular and pelvic pattern, which more focuses on extension of the trunk. Although, the PNF techniques were different with the present study, this study similarly supported the findings of the present study that no significant difference between three treatment groups in increasing lumbar flexion ROM.

Previous study by Kumar et al. (2011) which is the study only use the COI for PNF exercise and compare with conventional back exercise with no strengthening exercise showed that PNF exercise has significant difference result of increasing lumbar flexion ROM than the conventional back exercise. However, there was no significant difference result of increasing lumbar extension ROM between PNF and conventional back exercise. Although, only flexion ROM has significant difference, both treatments in this previous study demonstrated significant result of increasing lumbar flexion and extension ROM in within group result. Thus, this study also supported the result of the present study findings that there is no significant difference between three treatment groups in lumbar extension ROM.

Another study by El-Bandrawy and Ghareeb (2016) investigated the McKenzie method in postmenopausal low back pain patients, showed that the result in increasing lumbar flexion and extension ROM was statistically significant compared to the control group. The study underwent for five weeks treatment, for two days in a week. However, the control group only received Interference Current Therapy (IFT), which was a passive treatment. Therefore, even though this previous study showed

the McKenzie has significant result than the control group, the comparison of the treatments was not the same as the present study, while this study compared three active exercises.

Another study by Tarek et al. (2017) that the McKenzie compared with low-level laser treatment (LLLT), showed the McKenzie have significant difference result in increasing lumbar flexion ROM than the LLLT, and has no significant difference in increasing lumbar extension ROM compared to the LLLT. The treatment in this study underwent three days a week for 4 weeks similar with the present study procedure. However, the comparison is not the same with the present study, which the previous study, compared McKenzie with passive treatment. Therefore, this previous study supported the present study with no significant difference in increasing lumbar extension ROM between three treatment groups.

The result of this present study on lumbar flexion ROM was related with the previous study by Garcia et al. (2011) this studied comparing with the McKenzie and Back School for low back pain, which was found to be not much of a difference in lumbar flexion ROM between both treatments, even though in within-group analysis showed a significant result. Both treatments underwent once a week for 4 weeks.

Another comparative study done between Mat Based Pilates and McKenzie were conducted by Kupussamy, Narayanasamy and Christopher (2013), showed that both Mat based Pilates and McKenzie method in within-group analysis have significant result of increasing lumbar ROM for both flexion and extension. However, the comparison between both groups analysis reported no significant difference in increasing lumbar flexion and extension ROM. Both treatments in this study underwent twice a week for 6 weeks that was longer than the present study. The result of the previous study was similar with the present study indirectly, which compared the two active exercise treatments that implied and supported the result in the present study. Since there was no previous study directly compared the PNF and McKenzie, the previous study can be related with the present study when the comparison was comparing between active exercises.

The present study noticed the improvement of lumbar ROM in each group and the previous study that also supported the result that the PNF, McKenzie and control group as active exercises gave an improvement on lumbar ROM. Then, it concluded that the difference in increasing lumbar ROM in those three treatments was one of the expected outcomes even though no differences between the three treatment groups.

5.4 THE EFFECT OF PNF EXERCISE AND MCKENZIE METHOD ON FUNCTIONAL DISABILITY (OSWESTRY DISABILITY INDEX)

The findings of the present study showed that there was improvement in functional disability by using Oswestry disability index (ODI) in within group analysis. Those three treatments showed significant result in reducing the ODI score after both after 2 weeks and after 4 weeks. In between groups and time-treatment interaction, showed there was significant difference result in increasing ODI score by PNF than control group treatment after 2 weeks of treatment, however, comparison between PNF and McKenzie showed no significant difference also McKenzie and control group comparison. After 4 weeks treatment, PNF showed more statistically significant difference in reducing the ODI score than the McKenzie group and the control group.

The result of this present study was similar with the findings of the study by Kumar, Zutshi and Narang (2011) reported that PNF showed significant improvement in ODI score compared with conventional exercise for low back pain that consist of knee to chest, pelvic bridging, pelvic rolling and alternate arm leg extension after 4 weeks. This previous study was using the same PNF exercise and reported showed the better result in muscle endurance compare with conventional exercise, which can be concluded the improvement in muscle endurance related with reducing ODI score result after the PNF exercise. Sawant and Ghodey (2017) also studied about PNF functional ability and trunk muscle endurance, the study stated that PNF has shown significant improvement in trunk muscle endurance and functional ability with ODI on chronic mechanical low back pain patient.

The results of previous studies revealed that PNF also provides trunk muscle endurance, which related to a reduction in ODI scores. The mechanism of PNF that increases the endurance of the lumbar muscles is correct to improve decreased muscle resistance due to long sitting activities (Waongenngarm et al., 2015 ; Sawant and Ghodey, 2017 ; Kumar, Zutshi and Narang, 2011).

The study on the effectiveness of PNF for low back pain done by Franklin et al. (2013) reported that the PNF showed significant difference to improve the ODI score compared with core stability exercise. The PNF group in this previous study underwent 4 weeks session at the same period with core stabilisation exercise. Similar study by Dhaliwal et al. (2014) regarding PNF exercise versus core stabilisation exercise for decreasing pain and improving function on patient with low back pain, reported that the PNF showed significant in decrease the ODI score among low back pain patient. Thus, the result those previous studies can be assumed the PNF is better in strengthening of core muscle than the core stability exercise, in which related to improve the functional ability outcomes of low back pain.

A study comparing the PNF with conventional strengthening exercise, which consist of exercise for transvesus abdominis muscle and multifidus showed that PNF with only combination of isotonic has better improvement than the conventional exercise in ODI score (George, Kumar and Nikhil, 2013). The exercise period in the study was only conducted for 3 weeks, which can be implied the PNF could be improving the ODI score before 4 weeks. Kofotolis and Kellis (2008) in their study also found that the PNF with RST and COI technique improved the muscle endurance and reduced the ODI score after 4 weeks treatment. The PNF exercise was divided into three groups; those are RST, COI, and control group. Even though the COI showed dominant improvement on the muscle endurance, the study concluded that RST was appropriate in static muscle endurance, while the COI, particularly for dynamic muscle endurance of the low back muscle.

The results from previous studies also implied that the PNF, compared with core stabilisation exercise, were better at reducing the ODI score and supported the present study result (Kofotolis and Kellis, 2008; George, Kumar and Nikhil, 2013;

Dhaliwal et al., 2014). The mechanism of PNF that provide the strengthening of core muscle also with endurance training for lumbar muscle can be related with a decrease of ODI score. The McKenzie more focused on postural correction to reduce the pain, improve flexibility that related with improving the functional ability (Garcia et al. 2016; Clare, Adam and Maher, 2004). However, the McKenzie not provided the core strength training and muscle endurance training, hence, it can be concluded that the PNF better in reducing the ODI score with improving the trunk muscle strength and endurance.

In this present study the McKenzie method also showed better result to improve the ODI score better than the control group after 4 weeks treatment. This result Supported by a study of Waqqar, Rehman & Ahmad (2016), the McKenzie was significant than the Mulligan sustained natural apophyseal glides for chronic low back pain after 4 weeks intervention. Even though, both treatments showed significant in within group analysis. This previous study can support the present study that McKenzie has better improvement in ODI score than the control group, despite; the Mulligan is one of manual therapy and considers as a one of passive treatment. Another approached based on the study by Islam, Haque, Irin (2015) emphasized on the efficacy of McKenzie method and conventional physiotherapy protocols in low back pain. This previous study showed that the McKenzie method approach demonstrated significant improvement after 4 weeks treatment than the conventional physiotherapy protocols. However, the conventional physiotherapy consists of ultrasound treatment and back strengthening exercise while the McKenzie method combined with strengthening exercise, which is not stand-alone McKenzie method.

Findings from study by Hosseinifar et al. (2013) about comparison between stabilisation exercise and McKenzie showed that both stabilisation exercise and McKenzie have better result in reducing the ODI score. However, in between group comparison, no significant differences in reducing the ODI score. This previous study findings may contradict the result of the present study, but the PNF exercise provided stabilisation exercise and compared to the core stabilisation exercise in the another previous studies resulted the PNF was better than stabilisation exercise

(Franklin et al., 2013 ; Dhaliwal et al., 2014). This can be concluded the PNF still better than the McKenzie method because the core stabilisation exercise that provided by the PNF.

Similarly, a study done by Kupussamy, Narayanasamy and Christopher (2013) concluded that the effectiveness of McKenzie compared with Mat Based Pilates, showed no statistical difference between both groups in reducing the disability score. This study compared the two active exercises, which similar with the present study and both exercises showed significant results in within group analysis. However, the functional ability was measured with Rolland-Morris disability questionnaire, which is not same with the present study. Even though the result in this previous study was contradicted, the Mat Based Pilates was described mainly consist of stretching then the core stability, hence it is not same with the PNF exercise in this present study.

5.5 THE EFFECT OF PNF EXERCISE AND MCKENZIE METHOD ON HEALTH-RELATED QUALITY OF LIFE (SF-12)

The results for this study showed significant effect on health-related quality of life in each treatment among non-specific low back pain subjects. The subjects were assessed with Short-Form 12 (SF-12), which was divided into two score summaries. The physical component summary was measured, and all treatments showed good result in increasing the score of physical component summary (PCS) after 4 weeks of treatment. However, there only the McKenzie method did not show any significant result after 2 weeks of treatment. The second component was the mental component summary. Those three treatments also showed good improvement in mental component summary (MCS) score after 2 weeks and 4 weeks of treatment. However, the only not significant result is in PNF group were assessed the MCS in 2^{nd} week to 4^{th} week.

In order to compare the between-groups differences, it was found that the result showed no significant difference in increasing the PCS and same goes to the time-treatment interaction that revealed no significant difference between three treatment group based on the time. Similarly, same results were found with no significant

difference in increasing MCS between group analysis and in the time-treatment interaction between group analyses. Although the result between-group analyses were not significant in both components, the three treatments were equally improved on the PCS and MCS score in SF-12.

There was lack of study using health-related quality of life to measure the quality of life among low back pain patient. The SF-12, as the abbreviation of SF-36, was found to be reliable and valid although it has not widely studied by researcher (Rensik and Dobrzykowski, 2003). However, there were still some studies using the SF-36 to measure the quality of life among low back pain that can be discussed in this present study.

There were similarities between the results concluded in the present study and with those described by Jadeja et al. (2015) in which they established that the PNF exercise has no significant difference to improve the PCS and MCS scoring using SF-36 health survey tools which have had the same summary with SF-12. In their study, they only compared the PNF and conventional back exercise without another control group. In the within group analysis, the PNF showed significant result both in PCS and MCS scoring, whereas, the conventional back exercise was not significant. However, the comparison between group analyses showed, there were no significant difference between PNF and conventional back exercise. They also suggested having more than 4 weeks assessment to get better improvement in quality of life assessment.

Another study by Areeudomwong et al. (2016) showed certain disagreement with the present study. They found that PNF showed significant improvement of PCS score both in within group and between groups, which compared with educational booklet only. However, the PNF showed no significant difference in the MCS score compare to educational booklet. They also carried out the assessment for 12 weeks, follow-up with the same result after 4 weeks treatment. Although, the result of the previous study was contradicted, however, the comparison between the PNF and educational booklet was not same with the present study that comparing three active exercise.

Mbada et al. (2014) also stated that the comparison of McKenzie method alone or between McKenzie combined with static back exercise and McKenzie protocol combined with dynamic back exercise have reported that, the McKenzie combined with dynamic back exercise was found to be superior in improving the health-related quality of life as measured with SF-36. However, each exercise group has significant result in improve the SF-36 score after 4 and 8 weeks of treatment. These previous studies have not reported the SF-36 score on PCS and MCS separately, however, it can be implied that McKenzie alone will not be superior to the McKenzie combined with dynamic back exercises.

In the latest study by Mazloum et al. (2017) the researchers strongly emphasized on the comparison between Pilates and McKenzie, which was found that both exercises were equally significant in improving the quality of life among low back pain subjects. The study was comparing Pilates, McKenzie, and the control group, which was similar with the present study that compared the two active exercises and a control group. This previous study underwent for 6 weeks intervention and follow-up was made after 4 weeks. However, the quality of life score was measured by World Health Organization Quality of Life questionnaires, which differed with SF-12 that was used in the present study. Furthermore, this previous study can be implied consistent with the present study since the previous study compared two active exercise and a control group which is same with the present study comparison.

In addition, previous studies also stated that the quality of life can be improved in long-term assessment while, this study was only measure in immediate effect after 2^{nd} week and 4^{th} week treatment (Mazloum et al, 2017; Jadeja et al, 2015). A study by Jadeja et al. (2015) also stated that the health-related quality of life of the patients with non-specific low back pain depending on the functional status and physiological factors which will be more than simple physical impairment and suggested to add with behavioural programs to get better results to improve the quality of life. However, in this present study, each treatment groups have shown better improvement in the quality of life,thus it can be implied as expected outcomes from this present study which is improve the quality of life on non-specific low back pain

subject. Hence, those three treatments contribute to improving the quality of life which is related to students' academic activity such as attending to the class and productivity of the office worker (Patil et al., 2016 ; Casas et al., 2016 ; Ramdan et al., 2014).

5.6 STRENGTH OF STUDY

The strength of the study is that there was a high adherence rate of 100% from the subjects. This showed that all subjects that consist of students and staffs were willing to contribute to the study and complete the treatment session. The participation of the subjects was voluntary and free of charge. It also showed that there was no subject dropped out because all subject was reminded by the physiotherapist and principal investigator to get the treatment three times in a week. Thus, this study has prevented the type two errors. Since this study conducted with three treatments arms and the subject get better improvement after the treatments, it can be said that the study also contributed to reduce the non-specific low back pain and avoid the ethical issues.

Since the present study concluded the PNF exercise showed better outcome on non-specific low back pain and is uncommon in physiotherapy treatment for non-specific low back in Malaysia, then, this study can be one of the new protocols for of non-specific low back pain patients. The PNF treatment also can replace the common treatment for low back pain, which is the McKenzie method, because the PNF showed better result than the McKenzie method.

Since previously the researchers have not develop a study comparing PNF exercise and McKenzie method on non-specific low back pain, therefore, this study becomes the first study in comparing PNF and McKenzie treatment. Moreover, the outcomes and the results of this study will benefit all physiotherapists to apply better approach of treatments on non-specific low back pain patient and will encourage the physiotherapist to introduce the use of PNF in musculoskeletal cases both in treatment and in research.

In this study, the assessment was carried out for three times, which cater before the treatment, the middle test that was after second weeks and the post-test which was after the forth weeks treatment. The middle test was done to determine which treatment gives the faster recovery on the subjects. Furthermore, the middle test used as a follow up assessment and remind the subjects from the previous assessment.

5.7 LIMITATION OF STUDY

In this study students and staffs also have their own activity besides their activity in the university, which we could not control on the day and time pertaining their participation in the treatment session. Some activities like sports or lifting heavy objects will make the subjects' condition worse so much, so they will take medications to reduce the pain. However, before joining the study, the subjects have been informed to avoid all activities that can cause their condition worse and advised them not to take any painkiller or any kind of medications to reduce the pain during the treatment session. Moreover, if they cannot resist the pain, they are informed to report any medication that they used. In addition, the same goes on the commitment of the subjects to come on the schedule time could not be controlled due to the different time scheduling of their lectures or workload in their departments. However, all subjects still participate the study and finish the treatment even though the treatment was conducted in different time schedule. Furthermore, the different time schedule of the treatment did not affect to the outcome of the treatment.

Another limitation is the fact that the subjects may not have accurately reported their LBP history, pain perception, functional disability and quality of life in this study. Inaccurate reporting would yield variable results, although it is the assumption that the subjects accurately reported these variables. In addition, in this study the physiotherapists were not blinded to treatment groups' allocation, which may have caused bias during the measurement and treatments. However, the principal physiotherapist in KPJUC Rehabilitation centre was closely control and supervised all physiotherapists to perform all measurements and treatments. Furthermore, the study design is quasi-experimental that not compulsory to do the blinding.

Other confounding factors could affect non-specific LBP and the treatments such as workload, physical activity and stress. Therefore, the inability to control for these factors likely leads to some variability, as controlling for these variables is very difficult and the researcher is required to trust the subjects' report.

Since, this study was conducted to determine the direct impact of the treatment, it could not be guaranteed for the treatment to produce better effects if the follow-up sessions are extended, in which, the present study does not assess on the long-term effects. The assessment form of SF-12 was constructed in English, with some terms were unfamiliar to the participants. Consequently, causing inconvenience to the participants, in which took a longer time to fill up the form thus, the assistance of the physiotherapist and the researcher is required to assist wherever is necessary.

CHAPTER 6

CONCLUSION

6.1 INTRODUCTION

This chapter presents the summary and conclusion of the study. The basic findings are outlined and finalised. At the end of the chapter, recommendations to physiotherapy to improve the treatment for low back pain among students and staffs are made based on the findings of the study.

6.2 SUMMARY

In this study, it has been proven that the non-specific low back pain has affected both the students and the staffs in the university. The similar habit of students and staffs with prolonged sitting more than 3 hour in a day become the main cause of non-specific low back pain even though the number of years working or studying in the university was only 1 year. In this study, the three treatments have statistically significant improvement for patient pain score, ODI score, lumbar range of motion and health-related quality of life in within group analysis.

Thus, when comparing between PNF exercise and McKenzie method, PNF exercise have better improvement in the low back pain with significant mean difference found in pain score and functional disability score than McKenzie method.

However, there were no differences between PNF exercise and McKenzie methods to improve the lumbar range of motion in both flexion and extension and in health-related quality of life in both physical component summary and mental component summary. Hence, it can be proposed to the physiotherapist to choose the PNF exercise to get more improvements in decreasing the pain and increasing the functional ability in non-specific low back pain patient rather than the McKenzie method. Despite, both treatments have no difference in improvement of the lumbar range of motion and health-related quality of life in non-specific low back pain.

6.3 RECOMMENDATIONS

The recommendation for the university population, based on the demographic data, the students and staffs in the university had non-specific low back pain. Thus, the university management should be aware of the consequences of the university population habits with prolonged sitting in both students and staffs. University also should introduce preventive steps and resolve the non-specific low back pain with a self-management exercise with educational exercise sheet or poster in information board.

For the physiotherapist, we can give some suggestions to the clinical settings to choose the PNF exercise to get the better outcome for non-specific low back pain patient. Furthermore, the PNF exercise in this study was applied in sitting position, which easier to apply to the subjects, while the McKenzie should be applied in lying, sitting and standing which need more space for the patient to get the treatment. Moreover, as prevention and self-management for the patient who has habits with prolonged sitting, the physiotherapist can educate the patients to do the exercise based on an educational exercise sheet beside their regular treatment with the physiotherapist.

Since all treatments have good result in within group, physiotherapist also can make a priority with PNF exercise and McKenzie method to replace electro physical agents or other passive treatment to manage the non-specific low back pain patient and that make the treatment cost-effectively. Furthermore, the present study revealed

that there was lack of study of PNF exercise used for low back pain condition in South-east Asia, the physiotherapist was recommended to use the PNF exercise on low back pain as a treatment protocol or research. The use PNF exercise will contribute to development of evidence-based practice on PNF exercise for low back pain. This present study using quasi-experimental design thus the development of study design for future study also suggested improving the level of study.

Since this study is not using the whole population to identify the prevalence of non-specific low back pain found in university population; further research needs to be conducted using more larger sample size of populations to obtain the prevalence data before selecting the subject for the study. The age difference in this study was large thus; future research needs to be conducted with differentiating in age group.

The research instrument in lumbar ROM in this study was the very basic instrument to assess the lumbar ROM therefore it is also recommended for the physiotherapy department to own a more sophisticated instrument for getting results that are more reliable with specific detail in increasing of lumbar ROM. This sophisticated instrument can be used in the future study to collect data that are more relevant.

The SF-12 questionnaire only available in English where the terms were not familiar then it suggested translating the questionnaire in to the local language for better understanding and easier to complete. The long-term effect of the treatment also not investigated in this study, while this research only assesses the immediate effect of the treatment. In the future study, it is also suggested to develop a long-term assessment after the treatment to determine the length of the treatment effect.

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APPENDIX A

ETHICAL CLEARANCE

KPJ HEALTHCARE UNIVERSITY COLLEGE
(A Member of KPJ Healthcare Berhad Group)
PUTERI NURSING COLLEGE SDN BHD (253703-V)

Reference No. KPJUC/RMC/MPT/EC/2017/89
Date: 2nd August 2017

LUCKY ANGGIAT
Postgraduate Candidate
Master of Physiotherapy
School of Health Sciences,
KPJ Healthcare University College

Dear Lucky,

SUB: ETHICAL CLEARANCE APPROVAL (CLINICAL)

This is to certify that your research proposal entitled "The Effectiveness of Proprioceptive Neuromuscular Facilitation And Mc. Kenzie Method On Non-Specific Low Back Pain Among University Population" under the supervision of Prof. (C) Dr. Wan Hazmy Che Hon (KPJ Seremban Specialist Hospital) and Mdm Siti Nur Baait Binti Mohd Sokran (KPJ Healthcare University College) for Master of Physiotherapy was presented before in the Institutional Research and Ethics Committee of KPJ Healthcare University College on 28th July 2017. After the review and discussion of the proposal, the committee has approved the project to be conducted in the present form.

The study is approved for the duration of 2 years from August 2017 until August 2019.
The ethical committee expects to be informed about progress of your study time to time.

Wishing you all the best.

Yours sincerely,

Prof. (C) Dr. Wan Hazmy Che Hon
Chairman, Research & Ethics Committee
KPJ Healthcare University College, Nilai

C.C:
Dr Faizah Safina Mohd Bakrin, Director, Research Management Centre, KPJUC
Haji Mohd Izham Bin Haji Mohd Zain, Dean, School of Health Sciences, KPJUC
Nabilah Ahmad, Research Coordinator, Dept. of Physiotherapy, School of Health Sciences, KPJUC
Mdm Siti Nur Baait Binti Mohd Sokran, Co-Supervisor

PUTERI NURSING COLLEGE SDN. BHD.
Lot PT 17010, Persiaran Seriemas,
Kota Seriemas, 71800 Nilai,
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APPENDIX B

KPJ HEALTHCARE UNIVERSITY COLLEGE
(A Member of KPJ Healthcare Berhad Group)

INFORMED CONSENT FORM FOR POSTGRADUATE STUDIES (RESEARCH)

You are hereby invited to participate in the research study carried out by Lucky Anggiat (42721172003) as part of postgraduate studies at **KPJ HEATLHCARE UNIVERSITY COLLEGE** for the award of Master of Physiotherapy

TITLE OF THE RESEARCH:

THE EFFECTIVENESS OF PROPRIOCEPTIVE NEUROMUSCULAR FACILITATION AND MCKENZIE METHOD ON NON-SPECIFIC LOW BACK PAIN AMONG UNIVERSITY POPULATION

BRIEF DESCRIPTION OF THE RESEARCH STUDY:

This is experimental research. First step is selection of research subject using questionnaire. After subjects selected, they will divided into three groups and inform consent will be given to each subject. Group I will be treated with Proprioceptive Neuromuscular Facilitation (PNF), group II will be treated with McKenzie Method and Group III will be treated with hot-pack and educational booklet. Second step, physiotherapist will do initial assessment and measurement. Third, Physiotherapist will treat the subject following the group for 2 weeks. After that, physiotherapists will do the middle assessment and measurement. Then, Physiotherapists will continue the treatment for next 2 week. Once the treatment completed, the physiotherapist will precede the end assessment and measurement.

OBJECTIVE(S) OF THE STUDY:

To compare the effect of treatment between PNF and McKenzie on non-specific low back pain in pain, lumbar range of motion and disability index among university population

POTENTIAL BENEFITS OF THE STUDY:

The importance of this study is finding the effective treatment, hence enhancing the recovery time for the affected subject. Faster recovery time for the staff and student meant better-anticipated cost of their lost workdays. Further, this study might be able to guide the physiotherapist in selecting the better approach in the treatment of non-specific low back pain.

RISKS OF THE STUDY:

The subject might be experiencing numbness sensation over the treated area. There is also potential for fatigue muscles or muscles cramps due to excessive exercise. The symptoms are most likely to be transient and resolve spontaneously. In case the symptoms persist or deteriorate, the treatment will be stopped and the subjects will be referred for further medical assessment and treatment.

ENSURE THE PROTECTION OF CONFIDENTIALITY:

The data will be stored in researcher's computer and locked by password and the paper will be stored in locked cupboard throughout the study and will be destroyed one year after study completed.

PARTICIPATION IS VOLUNTARY:

Full participation in all aspect of the study is well appreciated. However, the participants have the liberty in answering the questions and they may skip any question based on their personal reasons.

ANSWER THE QUERIES:

In case if the subject requires any information or complains due to the treatment, subject may contact the physiotherapist or researcher, through following contact:

KPJUC Rehabilitation Centre : 06-798 4450
Lucky Anggiat : 0182569765
Madam Siti Nur Baait Binti Mohd Sokran : 0123565325

TITLE OF RESEARCH:

THE EFFECTIVENESS OF PROPRIOCEPTIVE NEUROMUSCULAR FACILITATION AND MCKENZIE METHOD ON NON-SPECIFIC LOW BACK PAIN AMONG UNIVERSITY POPULATION

STATEMENT OF CONSENT

I_____I/C_____ have read (or explained by the researcher) and fully understood the purpose of the study and voluntarily willing to participate in the study

I expect no financial or other benefits from my participation in the study

I understand that the information can be disclosed in case of legal requirement.

I agreed to be interviewed and my response may be recorded either in written or in tape/video form.

I understand that I have choice to respond to the questions asked

Signature with date:_____

Contact details (include address, phone no. email ID)

_____

Researcher

Lucky Anggiat
42721172003

Centre for Post Graduate Studies (CPGS)
KPJ HEALTHCARE UNIVERSITY COLLEGE
Lot PT 17010, Persiaran Seriemas, Kota Seriemas,
71800 Nilai, Negeri Sembilan Darul Khusus,
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Fax: 606-794 2662
Web Site: http://www.kpjuc.edu.my

APPENDIX C

Low Back Pain Questionnaire

This Questionnaire is provided to determine the prevalence of low back pain among university population

***Required**

1. Name *

_____

2. No. Phone/ Email *

_____

3 Gender *

- ☐ Male
- ☐ Female

3. Age (Mark one) *

- ☐ 18 – 25 years old
- ☐ 26 – 33 years old
- ☐ 34 – 41 years old
- ☐ 42 – 49 years old
- ☐ > 47 years old

4. Year of Working/Study *

- ☐ 1 – 3 years
- ☐ 4 – 6 years
- ☐ 7 – 9 years
- ☐ ≥ 10 years

5.	Do you study / work in prolonged sitting > 3 hours a day? * ☐ Yes ☐ No
	The Lower Back Pain 
6.	Do you have pain in your lower back in last 3 weeks? * ☐ Yes ☐ No
7.	Regarding low back pain, do you have any other medical illness/ previous surgery to lumbar spine? * ☐ Yes ☐ No
	Thank you to participate in my research Further information: Lucky Anggiat Student of Master Physiotherapy, KPJ University College, ID : 42721172003, Phone : 0182569765

APPENDIX D

OSWESTRY DISABILITY INDEX

Name: Age:
Department/Course:
No. Phone:
Please mark only the box that most closely describes your current condition.

SECTION 1: Pain intensity	
0	I can tolerate the pain I have without having to use pain medication.
1	The pain is bad, but I can manage without having to take pain medication.
2	Pain medication provides me with complete relief from pain.
3	Pain medication provides me with moderate relief from pain.
4	Pain medication provides me with little relief from pain.
5	Pain medication has no effect on my pain.

SECTION 2: Personal care (e.g. washing, dressing)	
0	I can take care of myself normally without causing increased pain.
1	I can take care of myself normally, but it increases my pain.
2	It is painful to take care of myself, and I am slow and careful.
3	I need help, but I am able to manage most of my personal care.
4	I need help every day in most aspects of my care.
5	I do not get dressed, wash with difficulty, and stay in bed. I can sleep well only by using pain

SECTION 3: Lifting	
0	I can lift heavy weights without increased pain.
1	I can lift heavy weights, but it causes increased pain.
2	Pain prevents me from lifting heavy weights off the floor, but I can manage if the weights are conveniently positioned (e.g. on a table).
3	Pain prevents me from lifting heavy weights, but I can manage light-to-medium weights if they are conveniently positioned.
4	I can lift only very light weights.
5	I cannot lift or carry anything at all. My social life is normal and does not increase my pain.

SECTION 4: Walking	
0	Pain does not prevent me from walking any distance.
1	Pain prevents me from walking more than 1 mile.
2	Pain prevents me from walking more than 1/2 mile.
3	Pain prevents me from walking more than 1/4 mile.
4	I can only walk with crutches or a cane.
5	I am in bed most of the time and have to crawl to the toilet.

SECTION 5: Sitting	
0	I can sit in any chair as long as I like.
1	I can sit only in my favourite chair as long as I like.
2	Pain prevents me from sitting more than 1 h.
3	Pain prevents me from sitting more than 1/2 h.
4	Pain prevents me from sitting more than 10 min.
5	Pain prevents me from sitting at all.

SECTION 6: Standing	
0	I can stand as long as I want without increased pain.
1	I can stand as long as I want, but it increases my pain.
2	Pain prevents me from standing more than 1 h.
3	Pain prevents me from standing more than 1/2 h.
4	Pain prevents me from standing more than 10 min.
5	Pain prevents me from standing at all

SECTION 7: Sleeping	
0	Pain does not prevent me from sleeping well.
1	I can sleep well only by using pain medication.

2	Even when I take pain medication, I sleep less than 6 h.
3	Even when I take pain medication, I sleep less than 4 h.
4	Even when I take pain medication, I sleep less than 2 h.
5	Pain prevents me from sleeping at all.

SECTION 8: Social life	
0	My social life is normal and does not increase my pain.
1	My social life is normal, but it increases my level of pain.
2	Pain prevents me from participating in more energetic activities (e.g. sports, dancing).
3	Pain prevents me from going out very often.
4	Pain has restricted social life to my home.
5	I have hardly any social life because of my pain.

SECTION 9: Travelling	
0	I can travel anywhere without increased pain.
1	I can travel anywhere, but it increases my pain.
2	My pain restricts my travel over 2 h.
3	My pain restricts my travel over 1 h.
4	My pain restricts my travel to short necessary journeys under 1/2 h.
5	My pain prevents all travel except for visits to the physician/therapist or hospital.

SECTION 10: Employment/Study*	
0	My normal study/job activities do not cause pain
1	My normal study/job activities increase my pain, but I can still perform all that is required of me.
2	I can perform most of my study/job duties, but pain prevents me from performing more physically stressful activities (e.g. lifting, standing).
3	Pain prevents me from doing anything but light duties.
4	Pain prevents me from doing even light duties.
5	Pain prevents me from performing any job or study chores.

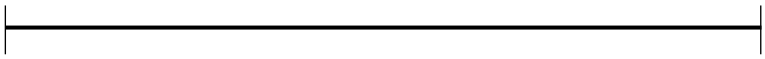
Total:

APPENDIX E

VISUAL ANALOGUE SCALE AND LUMBAR RANGE OF MOTION

Name: **Age:**
Department/Course:

1st Measurement, Date:
Visual Analogue Scale
Please make a mark on the line that most closely describes your current pain condition

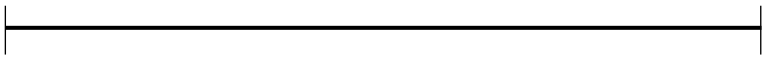


No Pain — Worst Imaginable Pain

Lumbar Range Of Motion

Flexion	Extension

2nd Weeks, Date:
Visual Analogue Scale
Please make a mark on the line that most closely describes your current pain condition

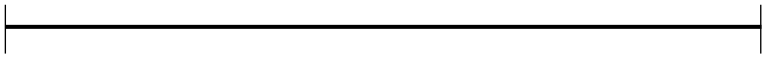


No Pain — Worst Imaginable Pain

Lumbar Range Of Motion

Flexion	Extension

4th Weeks, Date:
Visual Analogue Scale
Please make a mark on the line that most closely describes your current pain condition



No Pain — Worst Imaginable Pain

Lumbar Range of Motion

Flexion	Extension

APPENDIX F

SHORT FORM-12 (SF-12)

Name : Code : SF-12 HEALTH SURVEY

This survey asks for your views about your health. This information will help keep track of how you feel and how well you are able to do your usual activities. **Answer each question by choosing just one answer**. If you are unsure how to answer a question, please give the best answer you can.

1. **In general, would you say your health is**:

☐ Excellent ☐ Very Good ☐ Good ☐ Fair ☐ Poor

The following questions are about activities you might do during a typical day. Does <u>your health now limit you</u> in these activities? If so, how much?

	Yes, Limited a lot	Yes, Limited a little	No, Not limited at all
2. **Moderate activities** such as moving a table, pushing a vacuum cleaner, bowling, or playing golf.	☐	☐	☐
3. Climbing **several** flights of stairs.	☐	☐	☐

During the <u>past 4 weeks</u>, have you had any of the following problems with your work or other regular daily activities <u>as a result of your physical health</u>?

	Yes	No
4. **Accomplished less** than you would like.	☐	☐
5. Did work or activities **less carefully than usual**.	☐	☐

During the <u>past 4 weeks</u>, have you had any of the following problems with your work or other regular daily activities <u>as a result of any emotional problems</u> (such as feeling depressed or anxious)?

	Yes	No
6. **Accomplished less** than you would like.	☐	☐
7. Did work or activities **less carefully than usual**.	☐	☐

8. **During the <u>past 4 weeks</u>, how much <u>did pain interfere</u> with your normal work (including work outside the home and housework)?**

☐ Not at all ☐ A little bit ☐ Moderately ☐ Quite a bit ☐ Extremely

These questions are about how you have been feeling during the <u>past 4 weeks</u>.
For each question, please give the one answer that comes closest to the way you have been feeling.

How much of the time during the <u>past 4 weeks</u>…

	All the Time	Most of the Time	A Good bit of the Time	Some of the Time	A Little of the Time	None of the Time
9. Have you felt calm & peaceful?	☐	☐	☐	☐	☐	☐
10. Did you have a lot of energy?	☐	☐	☐	☐	☐	☐
11. Have you felt down-hearted and blue?	☐	☐	☐	☐	☐	☐

12. **During the <u>past 4 weeks</u>, how much of the time has your <u>physical health or emotional problems</u> interfered with your social activities (like visiting friends, relatives, etc.)?**

☐ All the Time ☐ Most of the Time ☐ Some of the Time ☐ A little of the Time ☐ None of the Time

APPENDIX G

PNF PROCEDURE

Rhythmical Stabilisation Training (RST)

3 Set of 10 Repetition

Duration of 1 repetition: 10 seconds

Total duration of 1 session (including rest intervals):

20 minutes

1. Subject assumes a seated position and faces the physio-therapist.
2. The therapist places his or her hands on upper part of the scapula area, just below the shoulder level.
3. From this position, the subject is instructed to extension the trunk against resistance provided by the therapist.
4. The resistance slowly increases as the subject gradually increases strength.
5. When strength exertion is stabilized (for approximately 5 seconds), the therapist slowly moves one hand to the upper part of thoracic area, just below the shoulder level, aiming to provide resistance to the antagonist movement of the trunk (subject still extend the trunk).
6. When the subject responds to the new position, the therapist moves the other hand and instructs the subject to extend the trunk against the resistance provided.

Combination of Isotonic Exercises (COI)

3 sets of 10 Repetition

Duration of 1 repetition: 15 seconds

Total duration of 1 session (including rest intervals) approximately: 25 minutes

1. From the seated position, patient asked to flexion the trunk, then physiotherapist provide manual contacts on upper back. Then, the subject extend the trunk against manual resistance provided by the therapist's hands (5 seconds).

2. When optimal trunk extension (neutral sitting position) is achieved, the subject is instructed to maintain the position and the therapist also keep the resistance (5 seconds).

3. Upon maintenance of static position, the subject returns to the starting position (trunk flexion) against resistance provided by the therapist's hands with no change of manual contact (5 seconds).

APPENDIX H

MCKENZIE PROCEDURE

McKenzie Method Procedures

1. **Lying Face down**

Subjects asked to stay on this position for 1-2 minutes.

2. **Lying Facedown with Extension**

Subject asked to start with Lying face down position, then extension on elbow, hold on extension for 5 seconds then back to lying face down position for relaxation. Repeat for 10 times.

3. **Extension on Lying**

Subjects asked to start with lying face down position, then continue to push-up position or maintain on last position for 10 seconds. Then back to lying face down position for relaxation. Repeat for 10 times.

4. Extension on Standing

Subject asked to start position with standing and place the subjects hand in small of the back and the fingers pointing backward. Then, subject asked to bend backward (extension) using hand as a fulcrum. Hold on extension for 5 seconds, then back to starting position and repeat for 10 times.

5. Flexion on Lying

Subject asked to start with lie on the back position with knee bent. Then, subject asked to flexes the trunk with both knee to chest and hold the booth knees with both hands. Hold 5 seconds and back to starting position for relaxation. Repeat for 10 times.

6. Flexion on Sitting

Subject asked to sit on the edge of chair. Then, bend the trunk forward and grasp the ankle or touch the floor with both hands. Hold for 5 seconds and repeat for 10 times.

7. Flexion on Standing

Subject start with standing position, then asked to bend forward (flexion) with fingers down to the legs as far as subject comfortably reach. Hold for 5 seconds, then back to standing position and repeat for 10 times

The subject was asked to do the whole session for two sets with 3 minutes rest interval.

Duration for 1 repetition : approximately 15 minutes

Total duration of 1 session (2 sets) including rest interval approximately : 30 minutes.

APPENDIX I

HOME EXERCISE SHEET

EXERCISE FOR LOW BACK PAIN

An Educational Exercise Sheet

In recent years there has been a move towards more office-based jobs which has resulted in a nation of people who spend hours a day sitting stationary and hunched over in front of a desk. It is not surprising that a growing number of office workers complain of back pain. The lack of activity and movement as well as the bad posture associated with sitting in front of a desk all day means our backs are under a great deal of stress. However, despite this there are ways to protect your back from the strains of office work. Here are some exercise that you can do while at work to reduce the impact of back pain

Forward bend
Bend forward and let your head and arms hang over your knees. Relax into the position and hold for a few seconds. Breathe in as you slowly come back up to seated position.

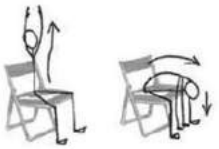
Spinal twist
Sit facing forward and place your left hand on the outside of your right knee. Place your right arm over the back of the chair. Twist to the right while turning your head. Push against your right knee to create more leverage. Hold the position. Release slowly and come back to facing forward and repeat on the opposite side.

Side stretch
Sit facing forward with feet slightly apart. Raise your arms out to the sides. Bend to the left, reaching toward the floor with your left hand and your right hand pointing toward the ceiling. Hole for a few seconds then come back to starting position. Repeat with your right side.

Knee squeeze
Place both hands around the front of your knee and pull your knee to your chest. Lower your head to your knee and hold for a few seconds then release slowly. Repeat with your right side.

Leg lifts
Sit and hold each side of the chair for balance. Lift your straightened left leg and flex your foot. Hold for a few seconds then slowly lower your leg. Repeat the same for your right leg.

Sun pose
Sit back in the chair with legs apart and arms by your side. With a sweeping motion bring your arms up over your head. Look up and stretch. Bend forward between your legs and if you can put your palms on the floor. Slowly rise back up with your arms over your head again, and then lower them to the side.



You can repeat all the session 5-8 repetitions.

In case if the subject requires any information or complains due to the treatment, subject may contact the physiotherapist or researcher, through following contact:

KPJUC Rehabilitation Centre	: 06-798 4450
Lucky Anggiat	: 0182569765
Madam Siti Nur Baait Binti Mohd Sokran	: 0123565325

Exercise booklet provided by : www.backcare.org.uk

APPENDIX J

PUBLICATION 1

THE INCIDENCE OF LOW BACK PAIN AMONG UNIVERSITY STUDENTS

Lucky Anggiat[1], Wan Hazmy Che Hon[2], Siti Nur Baait[3]

[1] Physiotherapy Program, Christian University of Indonesia, Jakarta, Indonesia
[2] Consultant Orthopedic Surgeon, School of Medicine,
KPJ Healthcare University College, Kota Seriemas, Nilai, Malaysia
[3] Department of Physiotherapy, School of Health Sciences,
KPJ Healthcare University College, Kota Seriemas, Nilai, Malaysia
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Abstrak

Salah satu kebiasaan paling umum di kalangan mahasiswa adalah duduk dalam waktu lama. Duduk lama telah diidentifikasi sebagai salah satu faktor yang menyebabkan nyeri punggung bawah (NPB) di kalangan siswa di universitas. Oleh karena itu, sejumlah besar mahasiswa dapat mengalami NPB karena menghabiskan terlalu banyak waktu dalam duduk untuk membaca atau bekerja di komputer. Penelitian ini bertujuan untuk menyelidiki prevalensi LBP di kalangan mahasiswa. Studi cross-sectional ini dilakukan di kalangan mahasiswa dalam empat minggu. Informasi mengenai NPB dikumpulkan dengan menggunakan kuesioner NPB sederhana yang dibuat dengan formulir daring. Kuesioner terdiri dari pertanyaan pada data sosio demografi, tahun studi, aktivitas duduk yang lama dan riwayat NPB. Perangkat lunak Statistical Package for the Social Sciences (SPSS) versi 20 digunakan untuk menganalisis data yang dikumpulkan. Seratus dua puluh dua mahasiswa berpartisipasi dalam penelitian ini. Prevalensi keseluruhan NPB di kalangan mahasiswa adalah 74,6%. Siswa dengan lama duduk lebih dari 3 jam dalam sehari dilaporkan mengalami NPB dengan 79% sementara 63,9% siswa dengan lama duduk kurang dari 3 jam dalam sehari juga mengalami NPB. Adanya insiden NPB yang tinggi pada mahasiswa dengan waktu duduk lebih lama maupun kurang dari tiga jam dalam sehari.

Kata kunci : duduk lama, mahasiswa, NPB

INTRODUCTION

Students usually attended the classroom session for the theories input and at the same time working in front of computer to browse through for resources, which involved prolonged sitting in most of their daily activities. The study by Voon et al. (2013) have shown, the total of about 64.7% students, who spent at least 90 minutes, sitting while attending the classroom theory session, and students sitting with working on computers for 45 minutes, 60 minutes and 90 minutes or more in a day were reported respectively by 10%, 18.4 % and 61.6 %. While other study by Nordin, Devinder, and Kanglun (2014) also revealed similar results, with which 31% of students usually sat in the classroom or working in front of the computers everyday between 6 to 8 hours. The sitting activity at least 2 hour in a day defined as a prolonged sitting and led to increased body discomfort (Waongenngarm et al., 2016). Several other studies have had concluded that students have a habits with sitting for too long remain on a prolonged uncomfortable posture have developed with high static muscle load (Casas et al.,

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APPENDIX K

PUBLICATION 2

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International
Journal of Medical and Exercise Science
(Multidisciplinary, Peer Reviewed and Indexed Journal)

ORIGINAL ARTICLE

COMPARATIVE EFFECT OF PROPRIOCEPTIVE NEUROMUSCULAR FACILITATION AND MCKENZIE METHOD ON PAIN IN NON-SPECIFIC LOW BACK PAIN AMONG UNIVERSITY POPULATION

Search engine: www.ijmaes.org

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ABSTRACT

Background of the study: *One of the factors leading to non-specific low back pain among University students and staff is prolonged sitting. Exercise therapy is one of the mainstays in the management of non-specific low back pain. One of the most common exercise therapy for non-specific low back pain is the McKenzie method, whereas the Proprioceptive Neuromuscular Facilitation (PNF) exercise is seldom been used to treat non-specific low back pain cases.* ***Objective:*** *The purpose of the study was to find the effectiveness PNF and McKenzie method on non-specific low back pain among University population.* ***Methods:*** *A randomized clinical trial involving 36 subjects (students and staffs) from the University population. The subjects were randomly chosen and assigned to three treatment groups: PNF group, McKenzie group and control group (hot pack and educational home exercise sheet) which underwent 12 treatment sessions distributed over three times in a week for four weeks duration. Subjects were measured on pain score using visual analogue scale. Measurement was performed at three points: pre-test, mid-test and post-test. Repeated measures ANOVA were used to analyse the difference within each group and ANOVA used between the groups in order to find and compare the effectiveness of three treatments.* ***Result:*** *This study showed that there was significant mean difference between PNF and McKenzie method on pain score ($p < 0.05$) after 4 weeks.* ***Conclusion:*** *The study findings showed that PNF exercise has more effect than McKenzie method on reduction of pain among non-specific low back pain among University population.*

Keywords: *McKenzie method, Non-specific Low Back Pain, PNF*

Received on 15th August 2018, Revised on 21st August 2018, Accepted on 26th August 2018

APPENDIX L

PUBLICATION 3

The Effectiveness of Proprioceptive Neuromuscular Facilitation and Mckenzie Method in Quality of Life on Non-Specific Low Back Pain

Lucky Anggiat, BPT,[1,2] Wan Hazmy Che Hon, MD, MSOrtho,[3,5] and Siti Nur Baait, BPT, MPT[4]

ABSTRACT

Background of study: Prolonged sitting has been identified as one of the factors leading to non-specific low back pain among students and staffs in university. Non-specific low back pain will also affect the quality of life of the patient or university population. The impact of low back pain on quality of life can be due to the severity of pain. Exercise therapy is one of the mainstays in the management of non-specific low back pain. One of the most common exercise therapy for non-specific low back pain is the McKenzie method, whereas the Proprioceptive Neuromuscular Facilitation (PNF) exercise is seldom been used to treat non-specific low back pain cases. There were not many studies being done to compare these two techniques on its effectiveness for PNF and McKenzie method on non-specific low back pain.

Objective: The purpose of the study is to find the effectiveness of PNF and McKenzie method on non-specific low back pain in quality of life.

Design and Participants: In this study, a randomised clinical trial method was involving 36 subjects (students and staffs) from the university population was randomly chosen to participate based on the selection criteria set by the study protocols.

Intervention: The subjects were randomly assigned to three treatment groups: PNF group, McKenzie group and control group (hot pack and educational home exercise sheet) which underwent 12 treatment sessions distributed over three times in a week for four weeks duration.

Measurement: Subjects were measured health-related quality of life by SF-12. Measurement was performed at three points: pre-test, mid-test and post-test. Repeated measures ANOVA were used to analyse the study results. The within-between groups analysis performed to analyse the difference between the effectiveness of three treatments based on the measurement time.

Results: This study showed each treatment has significant improvement in health-related quality of life ($p<0.05$) after 4 weeks. However, there is no significant difference between PNF and McKenzie method ($p>0.05$) after 4 weeks.

Conclusion: The study findings showed that the PNF exercise and McKenzie method has equal improvement in health-realted quality of life on non-specific low back pain. **KPJ Medical Journal 2018; 7:14–25**

Keywords: PNF, McKenzie, non-specific low back pain, health-related quality of life

INTRODUCTION

Prolonged sitting is one of the factors causing musculoskeletal pain specifically the office staffs who suffered from having low back pain which commonly reported. A study done from one of the University in Columbia, found that 45% of the university population were having severe chronic pain specifically in the lower back region which led several limitations during academic activities at the range of about 29.8%.[1] A study done by Nordin Devinder and Kanglun, on the health sciences undergraduate students have demonstrated approximately 80% of younger population experience LBP due to their physical fitness and sitting for too long.[2]

From studies reported, both office workers and students are at risk to develop low back pain, which has been proven in some researches with having negative impact to their activities in the university. A study by Casas et al., found that the prevalence of limitation for academic activities was almost 30% and which affected both office workers and students, on their daily life activities and causing potential effect on both office workers and students quality of life.[1] The limitation in

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APPENDIX M

GANTT'S CHART

Research Activities	YEAR 2017											YEAR 2018										
	FEB	MAR	APR	MAY	JUE	JUL	AUG	SEP	OCT	NOV	DEC	JAN	FEB	MAR	APR	MAY	JUN	JUL	AUG	SEP	NOV	DEC
Proposal																						
Colloquium 1																						
Data Collection																						
Data Analysis																						
Progress Presentation																						
Thesis Writing																						
Mock Viva																						
Final Viva																						
Thesis Correction																						
Convocation																						