

**Comparison Between Proprioceptive Neuromuscular Facilitation and Mckenzie Method in Lumbar Range of Motion on Non-Specific Low Back Pain****Lucky Anggiat¹✉, Wan Hazmy Che Hon², Siti Nur Baait³, Nurul Mawaddah⁴**Fakultas Vokasi, Universitas Kristen Indonesia, Jakarta¹School of Medicine, KPJ Healthcare University College, Nilai, Malaysia²Consultant Orthopaedic Surgeon, KPJ Specialist Hospital, Seremban, Malaysia²School of Health Sciences, KPJ Healthcare University College, Nilai, Malaysia^{3,4}**Article History**

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Abstract

One of activity that contributed to non-specific low back pain (LBP) is prolonged sitting. Therapeutic exercise that commonly used for management of non-specific LBP is McKenzie method while the Proprioceptive Neuromuscular Facilitation (PNF) exercise was rarely used for non-specific LBP. The purpose of the study is to find the effect of PNF and McKenzie method in lumbar range of motion (ROM) on non-specific LBP. A quasi-experimental study involving 36 subjects (students and staffs) from the university population. The subjects were 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 lumbar flexion and extension ROM by modified schober method. Measurement was performed at three points: pre-test, mid-test and post-test. The within-between groups repeated measures ANOVA were used to analyse the effectiveness of PNF and McKenzie treatments based on the measurement time. This study showed each treatment has significant improvement lumbar flexion ROM ($p < 0.05$) and extension ROM ($p < 0.05$) after 4 weeks. However, there is no significant difference between PNF and McKenzie method in increasing lumbar flexion ROM ($p = 0.100$) and extension ROM ($p = 0.127$) after 4 weeks. The study findings showed that the PNF exercise and McKenzie method has no difference in improving of lumbar ROM on non-specific LBP subjects.

How to Cite

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INTRODUCTION

Some studies have concluded that having habits with prolonged sitting contribute to prolonged uncomfortable pain caused by high static muscle load (Casas et al., 2016 ; Mozafari et al., 2015; Waongenngarm et al., 2016). 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). A study by Damanhuri et al. (2014) 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. In the same time, another study by 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

Another 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.

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 et al., 2016 ; Waongenngarm et al., 2016).

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 composi-

tion and others (Koley et al., 2010a; Koley et al., 2010b). The mobility of the spine also reduced that caused by disorders in muscle synergies and consequently increased the energy cost of maintaining the postural ability (Gawda et al., 2015).

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.

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).

A commonly used exercise therapy for LBP was developed by Brian McKenzie, which was recognised as McKenzie method (McKenzie, 2011). 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 et al., 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 et al., 2004).

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 et al., 2010). Proprioceptive Neuromuscular Facilita-

tion has been recommended for sensory-motor control training, as well as for stimulating lumbar muscle proprioception (Lee, 2009). 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 et al., 2014; Kumar et al., 2011; Johnson and Johnson, 2002).

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 et al., 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.

METHODS

This is a quasi-experimental study. This study was comparing the effect and value of intervention in between three groups at their pre-test, mid-test and post-test design in which subjects are equally differentiated on the treatment given and control group. The three groups of subjects who have been managed with PNF exercise, McKenzie method and control group respectively were compared. This research was conducted in KPJ Healthcare University College (KPJUC), Nilai, Malaysia. The subjects were KPJUC students and staff who met the selection criteria prior to sample screening. 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. They were underwent a specified treatment for the non-specific low back pain in KPJUC Rehabilitation Centre.

The subjects had to undergo 12 sessions of treatment, 3 sessions in a week for 4 weeks. This study was conducted in a private academic institute and the ethical approval has been obtained from Ethics Committee with reference number KPJUC/RMC/MPT/EC/2017/89, Research Management Centre, KPJ Healthcare University College (KPJUC), in Nilai, Negeri Sembilan, Malaysia before starting the study. The implementation of data collection and testing of the research subjects was from August 2017 - December 2017. Three of the 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. 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 techniques and assessment of the subjects. The subjects were 36 subjects of KPJUC students and staff who met the selection criteria prior to sample screening. The determination of the sample size was done using G*power 3. Three group, using F test, the effect size f is 0.25 and power 0.8. Based on the 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 et al., 2017). The inclusion criteria of this study are subject with non-specific low back pain with age ≥ 18 to 45 years old and study or work in prolonged sitting position ≥ 3 hours a day (Casser et al., 2016 ; Damanhuri et al., 2016 ; Issa et al., 2016). The exclusion criteria in this study are subjects with any history of pathological conditions or diagnosed with disk herniation, spinal stenosis, spondylolysis, spondylitis, radiculopathy, vertebral fracture and surgery to lumbar spine and reported pregnancy (Casser et al., 2016 ; Sihawong et al., 2014).

In addition, subject with other medical illnesses such as tumor, kidney disease, and visceral disease that can be related with low back pain excluded in this study (Maher et al., 2017). 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 et al., 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 was 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 modified schober method for lumbar flexion is 5.8 to 6.7 cm and lumbar extension 1 to 4 cm (Reese and Bandy, 2002). Subjects in the group I received the PNF exercise intervention (Appendix: Figure 1). The PNF technique performed on the trunk movement. The patient is in sitting position. First, physiotherapist conducted Rhythmic Stabilisation (RS). The RS 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 et al., 2015; Dhaliwal et al, 2014; Kumar et al, 2011; Kofotolis and Kellis, 2006).

The subjects in the group II received the McKenzie method (Appendix : Figure 2). 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 and teach the subjects how to use it as a regular physiotherapy treatment (Bardin et al., 2017; Paatelma et al., 2008). A narrative review by Bardin et al. (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 et al., 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 KPJUC Rehabilitation Centre. All data analyses were performed with the Statistical Package for the Social Science (SPSS) statistic software version 22. Repeated measures ANOVA analysis used to determine the result of differences before and after treatment in every group. Repeated measure ANOVA within-between group analyses were applied to determine the effect between three treatment groups based on time measurement. Bonferroni adjustment were applied for multiple comparison.

RESULTS AND DISCUSSION

A total of 36 subject of non-specific low back pain who were included participate in this study was divided into three groups, those are PNF exercise, McKenzie method and Control group, using simple randomization sampling method with lottery method. The socio-demographic details such as age, gender and occupation are tabulated in **Table 1**.

Table 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)

Table 2 described the within group result of PNF exercise, McKenzie and Control group in lumbar flexion ROM in terms of Mean Differen-

ce (MD) and Confidence Interval (CI). Mauchly's test of Sphericity indicated that the assumption of sphericity had been violated, $\eta^2(2) = 13.46$, $p=0.001$, 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. (**Table 2** in File : Table_Manuscript)

Table 3 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, $\eta^2(2)= 2.09$, $p= 0.35$. 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. (**Table 3** in File : Table_Manuscript)

In order to analyses the lumbar flexion and extension ROM between group interaction, there was no significant mean difference of lumbar flexion ROM ($F=0.542$, $p=0.587$) and lumbar extension ROM between the groups ($F= 0.872$, $p=0.428$). Multiple comparisons were not conducted, as the overall F-test was not significant.

Table 2. Comparison of Lumbar Flexion ROM for each treatment group based on time (n=36)

Comparison	PNF		McKenzie		Control group	
	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 $p<0.05$

Table 3. Comparison of Lumbar extension ROM for each treatment group based on time (n=36)

Comparison		PNF		McKenzie		Control group	
Lumbar	Extension	MD (95% CI)	p-value	MD (95% CI)	p-value	MD (95% CI)	p-value
ROM							
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 $p < 0.05$

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 ($p=0.100$) and lumbar extension ROM based on time ($p=0.127$). It is indicated that the mean of lumbar flexion and extension ROM for each treatment were not significant difference 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. Based on the statistical result of the present study, the three treatment groups have significant effects on lumbar flexion ROM after 4 weeks of treatment. Only the control group treatment has no significant result after 2nd week treatment. Similarly, the result of all the three treatments on lumbar extension ROM showed statistically significant improvement after 4 weeks treatment for each group despite the finding that after 2 weeks of treatment, all the three treatments showed no significant difference in each group. Further study on the 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.

Franklin et al., (2013) showed that the PNF training gave significant improvement on the lumbar flexion and extension ROM among patients with low back pain in within group results. Their 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 gave more focuses on extension of the trunk. Although, the PNF techniques were different compared with the present study, their 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 inc-

creasing lumbar flexion and extension ROM was statistically significant compared to the control group. The studied group underwent five weeks treatment with the frequency 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 comparative study by Tarek et al. (2017) between the McKenzie 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, where the previous study compared McKenzie with passive treatment. Therefore, the previous study supported the present study where both showed no significant difference in increasing lumbar extension ROM between three treatment groups.

The result of this present study on lumbar flexion ROM was also correlated with the study by Garcia et al. (2011) in 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 et al. (2013), showed that both Mat based Pilates and McKenzie method in within-group analysis have significant result in increasing lumbar ROM for both flexion and extension. However, the comparison between both group 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 also supported the result that the PNF, McKenzie and control group as active exercises gave an improvement on lumbar ROM. It can be 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. From the result of our study, we can give some recommendations to the clinical settings to choose combination of the treatment for non-specific low back pain with PNF exercise as the therapeutic touch treatment then teach the patient with proper McKenzie method as a home exercise program. Moreover, as prevention and self-management for the patient who have habits with prolonged sitting, physiotherapist can educate the patients to do exercise based on educational exercise sheet besides their regular treatment with physiotherapist. Some limitations were revealed in this study. The sample size were small, then, in the future large sample size study are recommended. The McKenzie method were only follow the McKenzie's booklet, future study is recommended to use the proper techniques of McKenzie method to compare with PNF exercise. In addition, in this study was only assess the short-term effects, then in future we need to conduct the long-term effect on those treatments

CONCLUSION

Each treatment has statistically significant improvement in increasing lumbar flexion and extension ROM. However, in comparison between PNF exercise and McKenzie methods, showed that both treatment have no difference in increasing lumbar ROM in both flexion and extension ROM on non-specific low back pain subjects.

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