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ORIGINAL ARTICLE

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

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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

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INTRODUCTION

University population mainly consists of the students, support staff and academicians. 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. A study by Nordin, Devinder, and Kanglun, revealed that 31% of students usually sat in the classroom or working in front of the computers everyday between 6 to 8 hours¹. 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% prevalence².

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%³.

Nordin Devinder and Kanglun also reported that on the health sciences undergraduate students have demonstrated approximately 60% of younger population experience LBP due to their physical fitness and prolonged sitting¹.

From all the above 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 life³. The limitation in academic activities due to pain was 29.8% and other researchers concluded moderate disability due to LBP among physiotherapy students in Mumbai⁴. 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-up, which consequently, drop the company's productivity if it has a significant number of employees absent from work due to having LBP⁵.

There are several options and suggestions, on the treatment to reduce LBP in the population^{6,7,8}. Exercise also one of physiotherapy treatment that can promote the strengthening of muscle that supports the spine⁹. Exercise therapy was found to be the best choice to reduce low back pain and increase body functions in adult people who suffered low back pain¹⁰. The therapeutic exercise for LBP uncommonly performed by physiotherapist is Proprioceptive Neuromuscular Facilitation (PNF), however; this treatment is commonly used for neurological conditions¹¹. PNF has been recommended for sensory-motor control training, as well as for stimulating lumbar muscle proprioception¹².

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^{13,14,15,16}.

A commonly used exercise therapy for LBP was developed by Brian McKenzie, which was recognised as McKenzie method¹⁷. A systematic review study has shown 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 exercises¹⁸. McKenzie method can be a

familiar treatment and is one of the common choices used by most physiotherapists for treating low back pain.

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 which is effective with good result for LBP^{13,14,15,16,18,19,20}. However, these studies did not do any comparison between PNF exercise and McKenzie method to verify the effectiveness of each treatment. Hence, this study will specifically carry out to compare the PNF exercise and McKenzie method for the treatment of LBP in the university population specifically to assess the pain score.

METHODOLOGY

This is an experimental study using randomized clinical trial. Clinical trial is defined as study 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. All subjects that included in this study were assigned randomly to three groups. Subsequently, the physiotherapist assessed the subject based on the measurements, which is pain score using VAS. In addition, age, gender, occupation and years of working or study were collected and presented as socio-demographic data of the subjects. Then the subject divided into three treatment groups by simple randomization using lottery method. The three groups of subjects who have been managed with PNF exercise, McKenzie method and control group respectively were compared.

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. The subjects were

undergoing 12 sessions of treatment regime, 3 sessions in a week for 4 weeks. This study conducted in a private academic institute and the ethical approval has been obtained from School of Health Sciences, Research Management Centre, KPJ Healthcare University College (KPJUC), in Nilai, Negeri Sembilan, Malaysia before starting the study.

The subjects were 36 subjects of KPJUC students and staff who met the selection criteria prior to sample screening. The timing for the implementation of data collection and testing of the research subjects was from August 2017 - December 2017.

The determination of the sample size was done using G*power 3. Three groups, using F test, the effect size f is 0.25. Based on the data, the calculated total sample size is thirty and an additional subject is 20% from total sample size, which is six, then total sample size is 36 with twelve subjects for each group²¹.

Inclusion Criteria: Subject with non-specific chronic low back pain and with age > 18 to 45 years old^{2,22}. Study or work in prolonged sitting position ≥ 3 hours a day²³.

Exclusion Criteria: Subjects with any history of pathological conditions or diagnosed with disk herniation, spinal stenosis, spondylolysis, spondylitis, radiculopathy, vertebral fracture and surgery to lumbar spine²³. Subject with reported pregnancy or with other medical illnesses such as tumor, kidney disease, and visceral disease^{24,25}.

Measuring Tools: Perceived level of pain was measured using visual analogue scale (VAS). The scale is most commonly 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]). The pain VAS is self-completed by the respondent. The respondent asked to place a line perpendicular to the VAS

line at the point that represents their pain intensity. VAS took one minute to complete²⁶.

Intervention Procedures: Subjects in the group I received the PNF exercise intervention. The PNF technique performed on the trunk movement. The patient is in sitting position. First, physiotherapist conducted Rhythmic Stabilization 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 technique consists of alternating concentric and eccentric contractions of agonists without relaxation. The 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. Then, all PNF exercise will be held for 30-45 minutes^{15, 27, 28, 29}.

The subjects in the group II received the McKenzie method treatment. The physiotherapist guided the subject to conduct four extension exercises and three flexion exercises. The extension exercises started with; first, lying face down for two minutes. Second, lying face down with extension, the subject 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 position 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, 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, subjects asked 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 asked to standing position, then instructed to bend forward or flexion the trunk with fingers down to the legs as far as subject comfortably reach. Subject asked to hold the last position for five seconds and back to standing position as a relaxation. Then, all flexion exercise 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^{17, 30}.

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 it³¹. A narrative review by Bardin, King and Maher, revealed that hot pack consider as a first line care for non-specific low back pain along with self-management with home

exercise³². The exercise based on the educational exercise sheet lasted for 7-10 minutes that can be done at the home or the office³³. All of the subjects in each group were undergoing 12 sessions of treatment regime, 3 sessions in a week for 4 weeks.

Data analysis

All data analyses were performed with the Statistical Package for the Social Science (SPSS) statistic software version 22. Repeated measures ANOVA used to determine the differences before and after the treatment

within every group. ANOVA used to determine the effects between three treatment groups based on time measurement. Bonferroni adjustment was applied for multiple comparisons.

RESULT

The socio-demographic details such as age, gender and occupation are tabulated in Table 1. The total number of subjects is 36 were divided in 3 treatment groups, and each consisted of 12 subjects.

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 1: Socio-demographic distribution of the subjects (n=36)

Table 2 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). There was a significant effect of time on weight $F=79.90$, $p=0.001$. 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.

Comparison	PNF		McKenzie		Control group	
	MD (95% CI)	<i>p</i> -value	MD (95% CI)	<i>p</i> -value	MD (95% CI)	<i>p</i> -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 $p < 0.05$

Table 2: Comparison of VAS within each treatment group based on time (n=36)

Comparison	MD (95% CI)	<i>p</i> -value	<i>F</i> -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 $p < 0.05$.

Table 3: Overall mean difference of VAS among three treatment group based on treatment effect (n=36)

The following is describing the findings from the comparison of the effectiveness 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. 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 difference between PNF with McKenzie as $p=0.117$, and McKenzie with Control group as $p=1.00$. However, there is statistically significant between PNF with control group as $p=0.019$. At 4 week period, the value of p decrease some more statistically significant between PNF and McKenzie as $p=0.037$, PNF with control group as $p=0.001$ and McKenzie with Control group as $p=0.029$.

Variable	Comparison	Mean Difference (95% CI)	p-value
VAS			
Pre-treatment	PNF-McKenzie	-10.83 (-24.69, 3.02)	0.171
	PNF-Control	-5.167 (-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	-3.5 (-15.04, 8.04)	1.000
4 weeks treatment	PNF-McKenzie	-9.16 (-17.89, -0.43)	0.037*
	PNF-Control	-18.66 (-27.39, -9.93)	0.001*
	McKenzie-Control	-9.5 (-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 $p < 0.05$.

Table 4: Comparison of mean VAS Score among three treatment group based on time (n=36)

DISCUSSION

The result of the current study indicated that there were positive effects of those three treatments in pain by visual analogue scale (VAS) in within group analysis. Each group showed extremely significant result both, for 2 weeks and 4 weeks after the treatment. In the within-between group analysis showed that PNF have significant difference result between control group treatment, while no significant difference between PNF and McKenzie after 2 weeks. On the 4th week treatment, PNF showed more dominant with significant difference result between McKenzie and control group. All treatments in this present study was 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 promotes the reduction of the pain in work-related musculoskeletal disorders in lumbar spine³⁴.

Following this result, a previous study also supported that PNF, with same procedure in present study, shown more statistically significant in pain reduction between the control groups after 4 weeks treatment compared with educational booklet³⁵. The result of comparison between PNF and McKenzie group can be related with study performed by George, Kumar and Nikhil, which identify the PNF for low back pain compare with the conventional back exercise training³⁶. They also found the PNF exercise was more significantly difference result on pain score than the conventional exercise training for low back pain after three weeks. This can also be related with the result of present study that showed the PNF have had significant improvement after 2 weeks treatment with better improvement before the completion of the 4 weeks compared with the control group.

According to a study by Jadeja et al, emphasized the result analysed in their study showed that when the back-muscle strengthen with pain after PNF as compared with the conventional back exercise showed that the PNF, which consisted of RST and COI, was extremely significant in reducing the pain and strengthen the core muscle²⁷. Thus, the previous study concluded that the PNF was also provided the strengthening exercise for the core stability, 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 whereas COI used all muscle action types (eccentric, concentric, and isometric), while that was not provided by the McKenzie exercise. The improvement of core muscle strength was also reported in a study performed by Chitra and Das³⁷. In their assessments, the deep abdominal muscle strength using aneroid sphygmomanometer and a stopwatch. The results showed that the PNF was significant to improve the core muscle strength after 4 weeks treatment of the PNF which consistent with the present study. A study by Tanna, Thiyagarajan and Gounder, comparing the effectiveness of motor control exercise versus McKenzie exercise for mechanical back pain, showed that the motor control exercise (MCE) gave clinically significant improvement in reducing pain than the McKenzie³⁸. The MCE was defined as specific stabilisation exercise and focuses on regaining control of trunk muscles (multifidus and transversus abdominis), which similar with the purpose of the PNF exercise in the present study. While, the study by Dhaliwal et al, reported that the PNF exercise had significant difference result in reducing the pain for low back pain than the core stabilisation exercise²⁹. It was concluded that those previous studies supported the superiority of PNF in strengthening the core muscle of low back pain compared to the McKenzie method in the present study.

CONCLUSION

In this study, it has been proven that the non-specific low back pain has affected both the students and the staff in the University. The students and staffs habitual routine of prolonged sitting more than 3 hours were the main causative factor. Consequently, in this study, the three treatments have statistically significant improvement for patient pain scores in each group analysis. However, further comparison between PNF exercise and McKenzie method showed that PNF exercise have better outcomes on the low back pain with significantly in the pain score than the McKenzie method.

Recommendation:

The researcher recommended using PNF exercise for the physiotherapist in order to get better outcome for non-specific low back pain patient. Furthermore, as a preventive and self-management for the patients who are engage with prolonged sitting, the physiotherapist can provide them with educational exercise sheet and McKenzie method for home exercise program besides their regular treatment with physiotherapist.

The fact that the three treatments gave good results, the physiotherapist can give priority for PNF exercise and McKenzie method to replace electro physical agents or other passive treatment to manage the non-specific low back pain patient hence making the treatment more cost-effective.

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