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Effects of core stabilization and McKenzie back extension exercises on pain, disability and insomnia in patients with non-specific chronic low back pain

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Abstract. *Aim.* This study compared the effects of core stabilization and McKenzie back extension exercises on pain, functional disability, insomnia and Quality of Life (QoL) in patients with Non-specific Chronic low back pain (NSCLBP). *Material and Method*. Forty-one (41) participants (16males, 25 females) participated in this study. They were recruited from a tertiary Hospital in Lagos state. Participants were allocated into three groups using computer generated random number sequence. Group 1 received core stabilization exercises, Group 2 received McKenzie back exercises and Group 3 received Transcutaneous Electrical Nerve Stimulation (TENS) and back care education. Pain intensity, functional disability, insomnia and quality of life were assessed using Numerical Pain Rating Scale (NPRS), Oswestry disability questionnaire, Insomnia Severity Index (ISI) and SF-36 Quality of life (Qol) questionnaire respectively at baseline, and end of 4thweek post intervention. *Results.* There was an improvement in the clinical outcome, pain (p=0.001, 0.004), functional disability (p= 0.001, 0.01) and insomnia (p= 0.001, 0.012) in both group 1 and 2 but most of the improvement was noticed in group 1 post intervention. Significant improvement was displayed in the general health (p=0.001, 0.004, 0.049), physical function (p=0.001, 0.007, 0.007) and social function (p=0.026, 0.02, 0.007) domains of quality of life post intervention in all the 3 groups (1, 2, 3). Across groups comparison showed, significant difference in both pain (p=0.01), insomnia (p=0.02) and physical function (p=0.002). *Conclusions.* Both core stabilization and McKenzie back extension exercise group had improved outcomes following intervention.
Key words: *exercises, insomnia, pain, disability, quality of life, patients, chronic low back pain.*

Introduction

Low back pain (LBP) can result from degenerative changes and trauma to the spinal vertebrae which lead to atrophy and weakness of structures surrounding the human spine. Low back pain has a lifetime prevalence of 84%, while chronic low back pain has a prevalence of 23% (1). The duration of chronic low back pain (CLBP) is greater than 12 weeks and it lasts longer than the expected healing time (2]). Non-specific chronic low back pain (NSCLBP) is the most common type of back pain that exists (3) and account for 85% of all cases of back pain (4). The patient with low back pain not only experience pain, but also suffers from impairment which obstructs their activities of daily living (5) such as inability to walk and dress up.

The degree of disability in patients with LBP is determined by the severity of pain, but a study shows that the intensity of pain and the degree of disability do not correlate well enough due to their association with different risk factors (6). Insomnia is documented in literature as a warning sign in people with chronic low back pain (7, 8).

It was reported in a study that there was a link between pain severity and insomnia with more than 50 percent increase in the number of chronic low back pain patient reporting sleeplessness (7). Stabilization exercises have demonstrated to be efficacious in the reduction of pain related disability in patients with chronic low back pain than conventional therapy (9). Research report confirmed the improvement in the level of pain and disability in low back pain patients after undergoing treatment with McKenzie extension exercises (10). But literature is sparse on the comparative effects of core stabilization and McKenzie back extension exercises in patients with non-specific CLBP with an extensive variety of interventions obtainable to manage low back pain. In addition, there is limited information on the influence of the McKenzie back extension exercise on insomnia and quality of life (QoL) in patients with NSCLBP. Therefore this study compared the effects of core stabilization and McKenzie back extension exercises on pain severity, functional disability, insomnia and QoL in patients with NSC.

Materials and Method

This study is a single blinded randomized controlled trial, registered with the Pan African Clinical Trial Registry (PACTR201910488116888). Thirty-nine patients with NSCLBP participated in this study.

They were volunteers from a tertiary healthcare facility in Lagos, Nigeria. Non-specific chronic low back pain patients with and without pain radiating to one or both lower limbs and with pain severity greater than or equal to five on the numerical pain rating scale and having directional preference for extension were involved into this study. Participants with history of recent trauma to the back and pelvis, spinal surgeries, infections, neurological disorders, neoplasm were ineligible to take part in this study. Approval for this study was gotten from the Health Research and Ethics Committee of College of Medicine, University of Lagos (CMUL) with approval number (CMUL/HREC/06/19/550). Socio-demographic variables (age, sex, height, and weight) and past medical history of the participants were taken.

Pre-intervention assessment of pain, insomnia, functional disability, and quality of life were done with numerical pain rating scale, Insomnia severity index, Oswestry disability questionnaire and SF-36 Quality of Life questionnaire.

43 participants volunteered to be part of the study, 2 were ineligible based on the exclusion criteria. Forty one qualified participants were randomly assigned into 3 groups (A, B, and C) through a computer generated random number sequence, which was created prior to meeting each participant; this allowed them to be distributed into any of the three groups according to their mode of presentation. 13 participants were allocated into groups A, fourteen participants into group B while 14 participants into group C.

Participants in group A were involved in core stabilization exercise to the back for 30 minutes twice weekly for 4 consecutive weeks (8). Participants in group B were involved in McKenzie back extension exercise for 30 minutes twice weekly for 4 consecutive weeks (11, 12), while participants in group C which is the control received back care education (13) and Transcutaneous Electrical Nerve Stimulation (TENS) therapy to the affected low back region for 30 minutes.

Though only 39 participants completed this study, 2 participants did not complete the study due to different reasons ranging from relocation to another state and low participation. These exercises were done twice weekly for 1month. Assessment of pain intensity, functional disability, insomnia and quality of life was done at baseline and end of 4 weeks.

Protocol for core stabilization exercise. Abdominal bracing, bracing during heel slides in supine, bracing during bridging, bracing during leg lift in supine, bracing during bridging and leg lift, Bracing in standing, quadruped arm lift with bracing, quadruped leg lift with bracing, quadruped alternate arm and leg lift with bracing (14, 7).

Protocol for McKenzie back extension exercise. Lying in prone position, lying in prone on elbows, press ups in prone, Progressive extension with pillows, standing extension (11, 12).

Protocol for back care education. Anatomy of the back and biomechanical principle guiding the functions of the human spine, Proper and safe lifting techniques for carrying loads, good postures, avoid prolonged sitting, bending, stooping and squatting (13).

Statistics. Data analyses were done using Statistical Package for Social Sciences (SPSS) version 25. Demographic variables were expressed in mean and standard deviation. Kruskal Wallis test was used to detect any significant difference across the groups (A, B and C). Wilcoxon sign rank test was used to determine the significance difference pre & post treatment within each group. Least significance difference post hoc analysis was used to determine where the significance lies among the groups. Level of significance was set at $p<0.05$.

Results

Forty-one (41) non-specific chronic low back pain patients participated in the study but only39 participants completed the study. The age range of the participants was between 33 years and 75 years with a mean age of 57.17±11.07 years. Sixteen (39%) of the participants were males and 25 (61%) were females.

The result showed that the three groups are homogenous and they differ significantly in physical characteristics (Table 1). Comparison of the outcome measure parameters at pre and post-intervention for each group. Wilcoxon sign rank test showed that there was significant difference ($p<0.05$) between pre-and post-intervention evaluation for the entire outcome measures assessed in groups 1 and 2 but only for functional disability ($p= 0.04$) in group 3) (Table 2).

Table 1. Demographic characteristics of the participants (n=39)

Variables	**All objects** (Mean±SD)	**Group 1**, n=13 (Mean±SD)	**Group 2**, n=14 (Mean±SD)	**Group 3**, n=12 (Mean±SD)	**F-value**	**p-value**
Age (years)	57.17±11.07	53.54±12.29	58.86±9.79	58.86±11.07	1.03	0.37
Height (m)	1.64±0.09	1.64±0.09	1.64±0.08	1.64±0.11	0.01	0.99
Weight(Kg)	75.44±8.29	74.23±9.19	74.22±5.93	77.79±9.45	0.85	0.44
BMI(Kg/m^2)	28.26±3.58	27.78±3.84	27.87±2.89	29.10±4.04	0.57	0.57

**Significance level p ≤ 0.05. Key: Mean ±SD - Mean± Standard Deviation; BMI - Body Mass Index; Group 1- Core stabilization exercise group; Group 2- McKenzie back extension group; Group 3- Control (Transcutaneous Electrical Nerve stimulation & Back-care education) group. F-value- One-way ANOVA.*

Table 2. Outcome measure parameters at pre-treatment (baseline) and post-treatment (End of the 4th week) of each group

	Outcome Measure	**Pre-Rx Baseline** (Mean±SD)	**4th week - End** (Mean±SD)	**z-value**	**p-value**
GROUP 1	Pain	6.62±1.04	3.15±0.90	-3.24	0.001*
	FD	20.31±5.62	12.46±3.43	-3.18	0.001*
	Insomnia	12.15±4.20	5.62±2.93	-3.19	0.001*
GROUP 2	Pain	6.43±1.22	4.50±1.56	-2.91	0.004*
	FD	18.86±7.18	14.36±6.13	-2.58	0.010*
	Insomnia	9.71±6.44	7.50±4.38	-2.50	0.012*
GROUP 3	Pain	6.14±1.10	4.92±1.68	-1.88	0.060
	FD	18.71±5.03	16.67±6.17	-2.05	0.040*
	Insomnia	12.00±6.31	12.42±6.64	-0.98	0.329

**Significance level p ≤ 0.05; Key: Group 1- core stabilization exercise; Group 2- McKenzie back extension exercise Group 3- TENS & Back care education. FD- Functional Disability; z- Wilcoxon sign rank test..*

Comparison of 4th week, post intervention mean values of the participants using Kruskal Wallis test revealed that only the pain severity (p=0.01) and insomnia (0.02) were significant when across group comparison was done.

The result shows that there was significant difference between group 1 and 2 (p=0.02) and group 1 and 3 (p= 0.001) on pain, and between group 1 and 3 (p=0.001) and 2&3 (p= 0.014), on insomnia when post hoc analysis was done (Table 3).

Table 3. Outcome Measure parameters at baseline, end of 4th week across groups

	OUTCOME MEASURE	**GRP1,** n=13 (Mean ±SD)	**GRP2**, n=14 (Mean ±SD)	**GRP3**, n=12 (Mean ±SD)	**H-Value**	**p-value**
(Pre-Rx) Baseline	Pain	6.62±1.04	6.45±1.22	6.14±1.10	1.24	0.54
	FD	20.31±5.62	18.86±7.18	18.71±5.03	0.61	0.74
	Insomnia	12.15±4.20	9.71±6.44	12.00±6.31	2.67	0.26
(Post-Rx) End of 4thwk	Pain	3.15±0.90	4.50±1.56	4.92±1.68	8.74	0.01*
	FD	12.46±3.43	14.36±6.13	16.67±6.17	4.18	0.12
	Insomnia	5.62±2.93	7.50±4.38	12.42±6.64	7.79	0.02*

*Significance level p ≤ 0.05. Key: GRP1 - Group 1, core stabilization exercise; GRP 2- Group 2, McKenzie back extension exercise; GRP 3- Group 3, TENS & Back care education. FD- Functional Disability; H-Kruskal Wallis, Rx- treatment

Table 4 presents an evaluation of mean changes across the groups for the analysis of physical functioning, energy, emotional wellbeing, social functioning and general health domain of QoL questionnaire. The significant lies (p=0.001) between group 1 and 3 for physical function when least significant difference post hoc analysis was done. Within group comparison shows that there was significant difference in the general health, social and Physical function domains of quality of life (p<0.05) for all the groups (Table 5).

Table 4. Kruskal Wallis results of quality of life domains of the participants across the groups at baseline (pre-intervention) and 4th week post intervention

		Group 1 (Mean±SD)	**Group 2** (Mean±SD)	**Group 3** (Mean±SD)	**H-value**	**P-value**
Pre-Rx	GH	64.62±8.53	66.79±17.50	65.00±7.69	0.03	0.99
	E/V	49.81±7.67	61.46±19.01	58.07±16.21	3.05	0.22
	EW	77.54±13.81	76.21±8.23	73.07±6.13	0.76	0.68
	SF	59.62±17.04	60.54±23.33	55.18±21.04	0.98	0.61
	PF	46.92±15.21	57.14±16.02	45.36±9.30	4.94	0.09
Post-Rx	GH	80.39±8.77	77.50±12.97	71.67±8.62	5.34	0.069
	E/V	58.85±9.61	57.14±11.22	57.71±12.13	0.24	0.889
	EW	82.15±9.88	78.50±8.42	73.92±5.70	5.35	0.069
	SF	69.23±13.13	72.68±15.77	71.25±12.55	0.31	0.858
	PF	85.77±5.72	79.64±12.48	61.67±16.14	12.89	0.002*

*Significance level $p \leq 0.05$. Key: GH - General Health; SF-Social Functioning; Group 1- core stabilization exercises; E/V-Energy/Vitality PF- Physical Function; Group 2- McKenzie back exercises; EW- Emotional Wellbeing; Z- Wilcoxon sign rank test; Group3- Control; Rx- Treatment; Rx- Treatment

Table 5. Outcome measure parameters at pre-treatment (baseline) and post-treatment (end of 4th week) of each quality of life domain per group

	Outcome Measure	**Pre-Rx Baseline** (Mean±SD)	**4th week End** (Mean±SD)	**z-value**	**p-value**
GROUP 1	GH	64.62±8.53	80.39±8.77	-3.20	0.001*
	E/V	49.81±7.67	58.85±9.61	-2.68	0.001*
	EW	77.54±13.81	82.15±9.88	-1.55	0.121
	SF	59.62±17.04	69.23±13.13	-2.23	0.026*
	PF	46.92±15.21	85.77±5.72	-3.20	0.001*
GROUP 2	GH	66.79±17.50	77.50±12.97	-2.88	0.004*
	E/V	61.46±19.00	57.14±11.22	-0.83	0.407
	EW	76.21±8.23	78.50±8.42	-1.00	0.319
	SF	60.54±23.33	72.68±15.77	-2.33	0.020*
	PF	57.14±16.02	79.64±12.48	-3.18	0.007*
GROUP 3	GH	65.00±7.69	71.67±8.62	-1.97	0.049*
	E/V	58.07±16.21	57.71±12.13	-0.54	0.589
	EW	73.07±6.13	73.92±5.70	-0.30	0.765
	SF	55.18±21.04	71.25±12.55	-2.71	0.007*
	PF	45.36±9.30	61.67±16.14	-2.70	0.007*

**Significance level $p \leq 0.05$; Key: GH- General Health ; SF-Social Functioning; Group1- core stabilization exercises E/V-Energy/Vitality ; PF- Physical Function; Group2- McKenzie back exten. exercises; EW-Emotional Wellbeing; Z- Wilcoxon sign rank test Group3- Control; Rx- Treatment.*

Discussion

This study was designed to reveal the effect of core stabilization exercises and McKenzie back extension exercises on pain, functional disability, insomnia and QoL in the management of patients with NSCLBP.

There was a marked improvement in clinical outcomes (pain intensity, functional disability, and insomnia and some domains of quality of life) in both core stabilization and McKenzie back extension groups but core stabilization group was more effective in the improvement of all the clinical outcome parameters.

This aligns with the result of the study by Suresh (9) on the effectiveness of core stabilization exercises in the improvement of pain, functional disability and sleep disturbance (7) and on quality of life (14) in NSCLBP patients. This is also in conformity with the conclusion of systematic review of literature and findings by

O'Sullivan et al (15). These researchers found that training method that embraced the principles of segmental stabilization and neuromuscular control was quite effective in the reduction of pain and disability in individuals with chronic low back pain.

Garcia et al (16) also reported an improvement in McKenzie protocol compared to back care education. This is aligns with the result of this study that revealed the superiority of McKenzie exercise group to control group which is TENS therapy and back care education when post hoc analysis was done.

All outcome measures of the study improved significantly post-intervention except those of the control group (TENS therapy & back care education) which only had significant improvement in pain severity and physical function domain of QoL.

The findings of this study revealed that there was marked improvement in core stabilization and McKenzie back extension groups. This buttresses the use of exercise therapy in the management of patients with CLBP. However, this study shows that both core stability exercises and McKenzie back extension exercises are effective in the management of non-specific chronic low back pain.

Other studies (9, 17) compared either stabilization exercises with general exercises or Pilate exercises.

The improvement in the outcomes assessed in the core stability group, that is; pain, functional disability, insomnia and quality of life could be as a result of restoration of the normal control of the deep spinal muscles (DSM), thus reducing the activity of the more superficial muscles which when recruited stiffens the spine and increases the activity of the low back muscles.

This may be due to the ability of the exercises to mobilize and stabilize the body thereby activating specific muscles in a functional sequence at controlled rate laying emphasis on precise quality movement. This enables the co-contraction of the local muscles within the neural zone (18).

Assessment of pain severity was done using the numerical pain rating scale (NPRS) and core stabilization exercise reduced the level of pain severity post intervention. McKenzie back extension exercise group also showed marked improvement in the reduction of pain severity post intervention. This may be as a result of the series of techniques used in carrying out both exercises.

This finding concurs with the report of the study by Hosseinifer et al (19) who revealed improvement in pain severity after undergoing both core stabilization exercises and McKenzie exercise though the McKenzie protocol used in this present study was McKenzie back extension exercises.

The outcome of this study revealed an improvement in the functional ability of the participants in this study after undergoing core stabilization and McKenzie back extension exercises. Improvement in this perspective may be due to different stages of core stabilization and McKenzie back extension exercises used in the treatment of the participants. However, the control group consisting of both TENS therapy and back care education did not show significant improvement in functional disability associated with NSCLBP.

This finding was supported by the result of a study conducted by Igsoo et al (20), Akodu et al, (21) and Nava-Bringas et al (22) which reported a significant improvement in the functional ability of their participants after adhering to stabilization exercise.

This outcome conforms with conclusion of the study by Hosseinifar et al (19), who revealed that core stabilization exercise and McKenzie exercises is effective in the treatment of individuals with NSCLBP.

The benefit of the McKenzie back extension exercise protocol may be due to the ability of the extension movements to relieve pain by reducing the forces acting on pain-sensitive tissues (11). But the result is in variance with the report of the study by Garcia et al (16) who revealed that McKenzie exercise did not show improvement when used to treat patients with NSCLBP.

Assessment of insomnia was done with insomnia severity index and both core stabilization exercise and McKenzie back extension groups showed significant effect in the sleep quality compared to the control group in the treatment of patients with NSCLBP non-specific chronic low back pain.

This is possibly due to the reduction of pain and improvement of functional disability in patients with low back pain. This assertion was supported by the study of Akodu and Akindutire (8), who in their own study found that core stabilization exercise, was effective in the improvement of sleep quality associated with non-specific chronic low back pain.

As pain has a bidirectional relationship with sleep. It increases the pain thresholds and the mental capacity to manage pain (23). Literature is sparse to support this evidence for McKenzie back extension exercise.

It was revealed in this study that there was a statistically significant difference in the general health, physical and social functioning aspect of the quality of life of the participants after undergoing core stabilization and McKenzie back extension exercises and TENS and back care education.

This improvement could be as a result of the significant change in the outcome parameters following intervention. This is in line with the report of the study by Moussouli et al (24) who concluded that stabilization exercises improved the quality of life of women with chronic low back pain.
The report of the study by Horng et al. (25) and Schiphorst et al. (26) asserted that psychological factor and functional status seem to determine quality of life in chronic low-back pain patients. This corroborates the finding of the study by Akodu et al (27), who reported that stabilization exercise is effective in improving the psychological and social aspect of QoL in individuals with NSCLBP.
Mbada et al (10) in their study reported an improvement in all the quality of life domains assessed after McKenzie back extension exercises in patients with NSCLBP. This study was limited in the area of the treatment outcomes that were measured over a short period of time.
It was concluded that Core stabilization exercises and McKenzie back extension exercises were both effective in the reduction of pain, improvement of functional disability, insomnia, physical function, general health, and social functioning of quality of life variables of patients with non-specific chronic low back pain (NSCLBP) than the combination of TENS therapy and back care education (control).
Therefore we can safely conclude that core stabilization and McKenzie back extension exercises are worthwhile exercises that can be used in the treatment of patients with non-specific chronic low back pain but core stabilization exercises produced better effect.
Therefore physiotherapist can suitably use any of the exercises (Core stabilization exercise and McKenzie Back extension exercise) in the management of patients with NSCLBP, since the study shows that both are effective in the treatment of NSCLBP.
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