Effects of isotonic and isometric exercise programmes on patients with chronic mechanical low back pain in selected hospitals in Kano metropolis

Farida Garba Sumaila[1] A-F, Abdullahi Ibrahim Darki[2] A-F

1. Physiotherapy Department, College of Health Sciences, Bayero University Kano.
2. Department of Physical and Health Education, Faculty of Education, Bayero University Kano.

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Abstract

Background: Treadmill training is used for gait rehabilitation after stroke. One of the drawbacks of this technique is that optic flow The study was carried out to compare the therapeutic effects of isotonic and isometric exercise programmes in the management of chronic mechanical Low Back Pain (LBP) in Kano metropolis. A total of thirty seven (37) patients comprising male and female aged 20-50 years old, selected from the population of LBP patients in Aminu Kano Teaching Hospital (AKTH) and Murtala Muhammad Specialist Hospital (MMSH) using judgmental sampling technique participated in the study. The subjects were randomly assigned to two groups; the first group received isotonic exercises for six weeks conducted three times per week, while the second group received isometric exercises for six weeks, three times in each week. Subjects were given a visual analogue scale (VAS) and a Rolland-Morris Low Back Pain disability Questionnaire (R-MDQ) to fill before the commencement of the exercise and at the end of the sixth week. The data obtained was analyzed using t-test independent samples. Findings of the study showed a significant difference between the post training scores of the two groups ($P<0.05$) both in level of pain (VAS) and in functional disability(R-MDQ). It was concluded that Isometric exercises are more effective than isotonic exercises in the management of chronic mechanical LBP. It is therefore recommended that isometric exercises should be used more in the treatment of LBP.

Keywords: Work related musculoskeletal pains (WRMSP), Work related musculoskeletal disorders (WRMSD), commercial tricycle drivers (CTDs), pattern.

Introduction

Mechanical low back pain (LBP) is the second most common symptom-related reason for seeing a physician (the first being common cold). For individuals younger than 45 years, mechanical LBP represents the most common cause of disability and is generally associated with a work-related injury[1]. For individuals older than 45 years, mechanical LBP is the most common cause of disability, and a careful history and physical examination are vital to evaluation, treatment, and management [2].

Mechanical low back pain is one of the frequent complaints expressed by patients to emergency physicians in the United States accounting for more than 6 million cases annually[3]. Approximately two thirds of adults are affected by mechanical low back pain at some point in their lives, making it the second most common complaint in ambulatory medicine and the third most expensive disorder in terms of health care financial expenditure surpassed only by cancer and heart disease [4].

LBP reportedly occurs at least once in 85% of adults younger than 50 years, and 15-20% of Americans have at least one episode of back pain per year. Out of these patients, only 20% can be given a precise pathoanatomic diagnosis. Low back pain affects men and women equally [5]. The onset of LBP occurs more frequently in people aged 30-50 years. Low back pain is the most expensive cause of work-related disability in the United States[3]. LBP is generally divided in to three categories; it can be acute (i.e. LBP that has the onset of 0- 6 weeks), sub acute (LBP that has the onset of 6-12 weeks) or Chronic (LBP that has the onset of more than 12 weeks)[6].

LBP is a frequent complaint in adults of all ages, and it is becoming an increasing complaint in children and adolescents [7]. A study following children from age 14 years into adulthood suggests that obesity in childhood, particularly in females, is a risk factor for later hospitalization for sciatica (Pain felt down the back and outer side of the thigh, leg and foot). This study also reported an increased

risk of hospitalization for sciatica in males who smoked at a young age [1, 3, 8].

LBP is one of the musculoskeletal problems affecting both the working and non-working individuals[1].Studies reported[5] showed that 35% of office workers and 47% of labourers in the United States had occupationally related back pain. LBP has been identified as one of the main causes of loss of hours and days among working class individuals[9]. The hours of work loss and cost implications in Nigeria may not be different from that of other countries abroad[10].

Loss of work hour due to LBP increases by 40% in comparison to 5.6% for other complaints[11]. LBP on the above account is therefore observed to be one of the most costly medical problems among the musculoskeletal conditions[12]. Back pain affects an estimated 80% of the population in the UK .In fact; it is second only to common cold as a cause of lost work hours[13].

According to the World Health Organisation's International Classification of Functioning and Disability (ICF), the impact of LBP on physical performance has been classified in to dimensions of impairment, activity (limitation) and participation-restriction[14]. The assessment of pain and disability are necessary components of the management of chronic LBP, the two main challenges of assessment are to determine the severity of the syndrome and the degree of the response to treatment[11].

Exercise for lower back pain is generally more effective for chronic low back pain than acute pain[15].Exercise has been shown to have a positive effect on LBP by relieving the pain and increasing functional ability of the patient[16, 17, 18]. Both Isotonic and Isometric exercises have been shown to be effective in the management of LBP[12, 19]. However it is not clear which of the exercise programmes is effective in the management of chronic mechanical LBP. This provided the background that motivated the researcher's interest in this study.

Methodology

The study compared the therapeutic effects of Isotonic and Isometric exercise programmes on the management of chronic mechanical low back pain.

Research Design

This study used a pre-test post-test experimental design. Two intervention groups (isometric exercise group and isotonic exercise group) were used and data were collected before and after the interventions. The study did not have a control group because of the limited number of patients and because of the medical ethics that does not allow one to stop a patient intentionally from his/her treatment for the purpose of studies.

Population

The population for this study comprised all patients with chronic mechanical Low Back Pain receiving treatment in Aminu Kano Teaching Hospital (AKTH) and Murtala Muhammad Specialist Hospital (MMSH) in Kano Metropolis which was eighty (80).

Sample and Sampling Technique

A sample of 40, comprising male and female subjects was selected for this study using purposive sampling technique. The subjects were assigned to two (2) groups randomly. Twenty (20) in Isometric exercise group and Twenty (20) in Isotonic exercise group. However, three (3) subjects dropped from the study, two (2) from isotonic group who were male and a female, and one (1) from isometric exercise group who was a female. So,thirty seven (37) subjects completed the study.

Selection Criteria

The following criteria were used as a guide in selecting the subjects:

- Subjects with Chronic Mechanical Low Back Pain who are recieving treatment in AKTH and MMSH Kano.
- Subjects within the age range of 20 -50 years.

Exclusion Criteria

The following criteria were used as a guide in excluding subjects from being research participants:

- Pregnant women with low back pain
- Any subject with heart disease
-Individuals with LBP of non mechanical origin (visceral pain radiating to the back, history of serious trauma etc)
-Any sign of serious spinal pathology (TB spine, cancers,)
-Obvious spinal deformity
-Deformities affecting lower limbs

Data Collection Instruments

The following instruments were used for collecting data:

1. Weighing scale-A portable bathroom weighing scale (SECA), MODEL: H89 RDE made in china was used to measure the weights of the subjects in kilogram kg.
2. Stadiometer-Calibrated wall used in measuring height of the subjects in meters (m).
3. Visual Analogue scale (VAS)- This is a 10cm calibrated line with zero (0) point indicating no pain and ten (10) point indicating unbearable pain. It was used to assess the level of pain of the patients.
4. Roland-Morris LBP Disability Questionnaire (R-MDQ)- This questionnaire was used in determining the functional limitation of LBP patients.

5. Couch/plinth-(Manumed Enrap Nonius model p001H)-Was used for the exercises i.e. the subjects lay on it during the exercise session.

Data Collection procedure

An introduction letter was obtained from PHE Department which was taken to the management of AKTH and MMSH for permission to carry out this research. Approval was given by the management of both hospitals. Familiarisation visit was carried out by the researcher to the two hospitals to meet subjects and arrange for briefing. Participants were addressed and all the test protocols, demands, benefits and risks were explained to them in details. All the subjects that meet the inclusion criteria were selected for the study. The subjects were given an informed consent form to give their consent in accordance with the use of human subjects in research. Only those that signed the informed consent form were selected.

Measurement Procedures

Height- A calibrated wall was used. Subjects' stood bare footed against the wall with feet together and the head in upright position. The point of greatest height was marked and then measured with a tape in Meters (m) [20].

Weight- Subjects stood bare footed on the weighing scale with minimal dressing, with the head in an upright position. The reading on the scale was then taken in kilogram (kg) [20].

The Height, Weight, age and sex of the subjects was recorded. All the subjects in the two groups were given a sheet of paper with a ten (10) cm mark visual analogue scale (VAS) and Roland-Morris LBP disability questionnaire. The subjects were enlightened on how to mark/fill the scale and the questionnaire in a manner that would not influence their response, after which the subjects were randomly assigned into either Isometric group or Isotonic group. Two research assistants who were professionals in the field helped in the data collection.

Training Protocols

Prior to the commencement of the exercise programme, participants were assessed for readiness to be involved in the exercise training programme using a physical activity readiness questionnaire (PAR-Q). Any participant who answered yes to any question on the PAR-Q was automatically disqualified. Similarly, eligible subjects in both groups commenced activity with an initial 5 minutes warm-up programme followed by the exercise intervention and then finally received a warm-down training of 5 minutes to terminate the session. The exercises were carried out in the respective hospitals of the patients simultaneously with the help of the research assistants. Subjects were trained on each exercise programme for six (6) weeks three times in each week within the morning hours between 8am and 12noon this was to rule out the effect of temperature on the blood pressure of the subjects, to carry out the exercises while the subjects are fresh and not stressed –up and because the time is the most convenient for the subjects. The subjects were given a VAS (to assess severity level of the pain) and Roland-Morris LBP disability Questionnaire (to determine functional limitation in the subjects) to fill before the exercise intervention and after the final exercise (the sixth week).The programme for each exercise training is described below [21].

Isometric exercise programme

The isometric exercise treatment procedures are:

1. Lying in prone with both arms by the side of the body and lifting the head and the trunk off the plinth from neutral to extension and hold for 10 seconds.
2. Lying in prone with the hands interlocked at the occiput so that shoulders are abducted to 90', and elbows flexed and lifting the head and trunk off the plinth (couch) from neutral to extension and hold for 10 seconds.
3. Lying in prone position with both arms elevated forward, and lifting the head and trunk off the plinth from neutral to extension and hold for 10 seconds.
4. Lying in prone position and lifting the head, trunk and contra lateral arm and leg off the plinth from neutral to extension and hold for 10 seconds.
5. Lying in prone position with both shoulders abducted and elbows flexed to 90' and lifting the head trunk and both legs off the plinth and Hold for 10 seconds.

Isotonic exercise programme

The isotonic exercise treatment procedures are:

1. Participant lying in prone with both arms by the side of the body and lifting the head and the trunk off the plinth from neutral to extension patient is then instructed to repeat same exercise 10 times without "holding". Patient can rest in neutral position for about 3 seconds.
2. Participant lying in prone with the hands interlocked at the occiput so that shoulders are abducted to 90', and elbows flexed and lifting the head and trunk off the plinth (couch) from neutral to extension. Same exercise was repeated 10 times.
3. Participant lying in prone position with both arms elevated forward, and lifting the head and trunk off the plinth from neutral to extension. To be repeated 10 times.

4. Participant lying in prone position and lifting the head, trunk and contra lateral arm and leg off the plinth from neutral to extension. To be repeated 10 times.
5. Participant lying in prone position with both shoulders abducted and elbows flexed to 90' and lifting the head trunk and both legs off the plinth. To be repeated 10 times.

*(note: for isometric exercise patient was instructed to hold in the extended position for 10 seconds).

Data Analysis

Data collected were summarised using descriptive statistics of mean and standard deviation and inferential statistics of student t-test was used to compare the two groups and a paired t-test was used to compare the pre and post treatment outcome within each of the groups at probability level of 0.05.

Results

The result of this study is presented in tables. The physical characteristics of subjects are presented in

Table 1 shows a descriptive statistics of mean and standard deviation of the physical characteristics of the subjects. Total number of the subjects was 37, their mean age (yrs) was 34.2 ± 8.59, mean height (m) of 1.59 ±0.026 and mean weight (kg) of 64.891±6.28 (Table 1).

The physical characteristics of subjects with respect to their groups are presented in table 2 (Table 2). The mean age, weight and height for isotonic group are 34.1± 8.37, 63.4±14.9 and 1.60± 0.018 respectively, while the mean age, weight and height for isometric group are 34.4±9.01, 66.26±17.79 and 1.58±0.025 respectively. The analysis in table 3 indicated a significant difference between isotonic and isometric exercises on post training level of pain [t (35) =3.155, p<0.05] which is greater than the critical value 2.021 (Table 3). The mean of the Isometric group was significantly lower (m=1.789, sd=2.0015) than the mean of the Isotonic group (m=3.0556,sd=1.39209) which means that Isometric exercises are more effectivein reducing level of pain of LBP patients than Isotonic exercises. The null hypothesis was therefore rejected.

Table 1: Physical characteristics of the subjects

(N=37)

Variables	X ± SD	SD Error
Age (yrs)	34.2±8.59	1.41
Weight (kg)	64.891±6.28	2.68
Height (m)	1.590±.026	0.004

Table 2: Physical characteristics of subjects in respect to their groups

N_1 =18 N_2 =19

Groups	Age (yrs)		Weight (kg)		Height (m)	
	X±SD	SE	X±SD	SE	X±SD	SE
Isotonic	34.1±8.37	1.97	63.4±14.9	3.51	1.60±0.018	0.004
Isometric	34.4±9.01	2.07	66.26±17.79	4.08	1.58±0.025	0.006

Table 3: t-test summary on post training level of pain among patients with LBP

N_1 =18 N_2 =19

Groups	$\underline{X}$±sd	sd error	df	t	prob.
Isotonic	3.056±1.392	0.328	35	3.155	0.003
Isometric	1.789±1.032	0.237			

t = 2.021, df = 35 (p< 0.05).

Table 4: t-test summary on post training functional disability among patients with LBP

N_1 =18 N_2 =19

Groups	X± sd	sderror	df	t	prob
Isotonic	6.333±2.544	0.599	35	4.022	0.0001
Isometric	3.316±2.001	0.459			

t = 2.021, df =35 (p<0.05).

Table 5: t-test summary on the effect of Isotonic exercises on level of pain and functional disability among patients with LBP.

N =18

Variable		X±sd	sd error	df	t	prob
Pain	Pre	5.594±1.170	0.276	17	12.042	0.000
	Post	3.06±1.392	0.328			
Functional	Pre	12.78±2.713	0.639	17	11.600	0.000
Disability	Post	6.33±2.544	0.600			

t =2.109 , df=17 (p<0.05); t=2.109 , df=17 (p<0.05)

Table 6: t-test summary on the effect of Isometric exercises on level of pain and functional disability among patients with LBP

N=19

Variable		X±sd	sd error	df	t	prob
Pain	Pre	4.97±1.206	0.277	18	11.340	0.000
	Post	1.79±1.032	0.237			
Functional	Pre	12.47±3.549	0.814	18	10.700	0 .000
Disability	Post	3.32±2.001	0.459			

t=2.105 , df=18 (p<0.05); t=2.105,df=18 (p<0.05).

The analysis in table 4 above indicated a significant difference between isotonic and isometric exercises on post training functional disability [t (35)=4.022,p<0.05] which is greater than the critical value 2.021 (Table 4). The mean of the Isometric group was significantly lower (m=3.316, sd=2.001) than the mean of the Isotonic group(m=6.333,sd=2.544) which means that Isometric exercises are more effective in reducing functional disability of LBP patients than Isotonic exercises. The null hypothesis was rejected.

Table 5 indicated a significant difference between pre and post training level of pain in Isotonic exercise group [t = 2.109, df=17 (p<0.05)]; and a significant difference between pre and post training functional disability in Isotonic exercise group [t=2.109 , df=17 (p<0.05)] (Table 5).This shows that Isotonic exercises are effective in reducing level of pain and functional disability of LBP Patients. The null hypothesis was rejected on the account that significant difference exist.

Table 6 shows a significant difference between pre and post training level of pain in Isometric exercise group [t=2.105 , df=18 (p<0.05)]; and a significant difference between pre and post training functional disability in Isometric exercise group [t=2.105,df=18 (p<0.05)] (Table 6). This shows that Isometric exercises are effective in reducing level of pain and reducing functional disability of LBP Patients. The null hypothesis was therefore rejected .

Discussion

The main objective of this study was to compare the therapeutic effects of isotonic and isometric exercises in the management of chronic mechanical LBP.

Following statistical analysis on the therapeutic effects of isotonic and isometric exercises on LBP, a significant difference was found in level of pain [t (35) =4.022, p<0.05] after isotonic and isometric exercise in patients with LBP. The significant difference found was in harmony with the study of Nwuga and McKenzie which stated

that both isotonic and isometric exercises are effective in the management of LBP[12, 19].

The result also revealed a significant difference in functional ability [t(16)=1.230,P>0.05] after isotonic and isometric exercise in patients with LBP, this is in agreement with the work of [16,17] which stated that exercise have a positive effect on LBP by relieving pain and increasing functional ability of the patient .This is also in line with [3] who stated that LBP affects male and female equally and the response to the management of LBP is also the same [6].

It could also be deduced from the study that both isotonic and isometric exercises are effective in the management of LBP; this is in line with what [12, 19] reported in their work that isotonic and isometric exercises are both effective in the management of LBP. However, isometric exercise was found to be more effective on the management of LBP [22, 23]. It is however, contrary to the work [24, 25] which reported isotonic exercise to be more effective when compared with other forms of exercise in the management of LBP.

Exercise has long been a standard of treatment for back pain. Over the last two decades, the use of intense, non–pain-contingent exercises for treatment of chronic back pain has received increasing advocacy. The main goals of these treatments are to improve functioning of painful lumbar soft tissue and to decrease the fears and concerns of patients about using their backs for daily activities[25]. As a therapeutic modality, exercise has a primary goal of reducing pain and improving functions of the targeted tissues, that is, tissue length, tissue resilience, muscle strength and endurance [22].

The mounting evidence supporting the role of aerobic exercise in reducing the incidence of low back injury and in the treatment of patients with low back pain is compelling [26]. A recent investigation into loads sustained by the low back tissues during walking confirmed very low levels of supporting passive tissue load coupled with mild, but prolonged, activation of the supporting musculature. Epidemiological evidence also sheds light on the effects of different types of aerobic exercise [27].

Despite the wide variety of exercises that are prescribed for the low back, the scientific foundation to justify their choice is not as complete as one may think, or expect [7]. Thus, the clinician must often call upon “clinical opinion" when selecting exercise. Given that low back tissues may need stressing to enhance their health but too much loading can be detrimental, choosing the optimal exercise requires judgment based on clinical experience and scientific evidence [23].

Conclusions

Based on the findings of the study, the following conclusions were drawn:

- Both isotonic and isometric exercises have significant effect on Low Back Pain
- Isometric exercise is more effective in pain reduction in patients with chronic mechanical Low Back Pain LBP.
- Isometric exercise is more effective in improving functional ability in patients with chronic mechanical Low Back Pain LBP.

Recommendations

From the findings of this research the following recommendations were made:

1. Isometric exercises should be incorporated in the management of patients with chronic mechanical Low Back Pain.
2. Physiotherapists and other health personnel should be enlightened on the benefits of Isotonic and Isometric exercises on LBP.
3. Patients should be educated on the effects of Isometric exercises and how to carry them out as the exercises are safe and easy to administer at home.

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Correspondence Address:
Farida Garba SUMAILA,
Physiotherapist, Physiotherapy Department, Bayero University Kano.
P.M.B 3011 Kano, Nigeria.
E-mail: fareedat2006@gmail.com
E-mail: fgsumaila.pth@buk.edu.ng
Phone Number: +2348036164228

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