Low back pain (LBP) is a complex musculoskeletal disorder commonly encountered at physiotherapy units especially at primary health care. It is one of the most common persistent conditions managed at primary health care (PHC) level (Major-Helsloot et al., 2014; Becker et al., 2010). It is reported that LBP affects close to 85% of people throughout their lifetime (Koes, 2010). It is a disabling condition that causes activity restriction and this impacts on the economy. Therefore, this leads to absenteeism from work and frequent health service use (WHO, 2013; Chou, 2012; Balaque et al., 2012; and Gore et al., 2012; Dagenaise et al., 2010). As a result, LBP is considered a public health problem of clinical, social and economic importance, which affects the population without distinctions (Stefane et al., 2013). For example, it is reported that close to half a million dollars is spent on every 1,000 U.S. employees on excess health care treatments and lost work time because of LBP (Harris, 2017). Back pain is positioned as the third cause of disease burden in Australia, accounting for 3.6% of the total burden across all diseases and injuries and also accounting for 1.8% of the total health care expenditure (Rahman, 2016). A study done by Constanza et al., (2018),
revealed that the expected annual costs due to musculoskeletal chronic pain including LBP was $1387.2 which was equivalent to 0.147% of the national GDP in Chile.

It was ranked fourth leading cause of disability-adjusted life years (DALYs) globally in 2015 (Hurwitz et al., 2018). The main cause of LBP is unknown although physical activities, socioeconomic status, general medical health and psychological status, and occupational environmental factors are all thought to contribute to the risk for experiencing types of spinal disorders including trauma-related and degenerative. The following are also implicated as causes of low back pain; herniated discs, spinal stenosis, spondylosisthesis, vertebral fractures, spinal tumors, and the musculature (Baron et al., 2016; Chisenge, 2017).

There are so many therapeutic approaches to the management of low back pain that include surgery (Fritch et al., 2016), pharmacotherapy (Machedo et al., 2017), exercises (Saragiotto et al., 2016), advice and self-care including education and psychological therapies. Physiotherapy is part of the multidisciplinary approach for LBP that aims at pain reduction and improving functional activities.

The national clinical practice guidelines from the United Kingdom, Denmark, Belgium and the United States of America provide an update on the primary care management of non-specific LBP (Oliveira et al., 2018; Quaseen et al., 2017; DHA, 2016). Although these guidelines recommend advice, reassurance and encouragement to stay active as first line of care for all patients, they also recommend exercises and manual therapy as second line of care. Studies done on the efficacy of these interventions has not yet been proven (Fritz et al., 2013).

In a study done on management of LBP at PHC in South Africa revealed that treatment of LBP was ineffective as there was no conformity to the guidelines (Major-Helsloot et al., 2014). Scott, 2010 says that there is a known-do gap that exists among primary care practitioners in relation to diagnosis and treatment of LBP. As such the condition may progresses to chronic LBP in most cases. This means that improving care at primary level ultimately improves outcomes and reduces costs.

Most randomized controlled trials (RCT) have investigated the effectiveness of some of the physiotherapy modalities and revealed that most of these studies have shown small effects that only last for a short period of time (Lingner et al., 2018; Deluca et al., 2017; Sharma et al., 2015).

The studies that have specifically evaluated the effects of manual therapy on pain reduction and functional abilities for patients with LBP have demonstrated that manual therapy could be effective if an appropriate manual therapy technique is used (Patelma, 2011). Although these results are dependent on the type of manual therapy technique and the stage of the condition, the clinical guidelines recommend that manual therapy should be an add-on intervention to exercise therapy (Bernstein et al., 2017). For acute LBP, for example, evidence show that there is moderate to strong evidence that is in support of spinal manipulation and superficial heat while there is insufficient evidence to fully evaluate any therapies for radiculopathy or to support one effective treatment over another (Chetty, 2017; Cohen et al., 2009). On the other hand, studies that evaluated manual and exercise therapy proved that manual therapy when combined with exercise therapy could be effective if an appropriate manual therapy technique and a specific type of exercise program are used.

Therefore, this study focused on assessing the effectiveness of orthopedic manual therapy with motor control exercise against conventional physiotherapy in the management of LBP. In spite of huge spending on health care services for LBP, patients' outcomes have not improved (Deyo et al., 2009). This means that even the global disability associated with LBP will also increase. This could mean that patients may be receiving “low-value” health services that provide little or no benefits or cause harm such as prescriptions for opioids, diagnostic imaging and spinal fusion surgery for patients with persistent LBP (Abdel Shaheed et al., 2016).

**METHODOLOGY**

**Research Design**

This study was a single blinded (assessor) randomized controlled trial (RCT), where two groups of patients with LBP was compared as follows;

1. Group 1 (control) received conventional physiotherapy that includes superficial heat, massage and exercise therapy comprising of back extension exercises and general body exercises.
2. Group 2 (intervention) received conventional physiotherapy, orthopedic manual therapy and motor control exercises.

This study was conducted at three first level hospitals of Lusaka district with physiotherapy departments and offer physiotherapy services to patients with LBP.

All patients that met the inclusion criteria were eligible for selection. From the eligible participants, the sample was determined by simple random sampling method. Randomization of selected participants was done using Graph Pad to allocate numbers randomly to the 2 treatment groups. Random allocation of the subjects is used to ensure that the intervention and control groups are similar in all respects with the exception of the therapeutic intervention being tested (Thiese, 2014).

The study was a single blinded were both patients and assessors were not availed with the critical information on allocation of patients to a particular group. To achieve this, patients were blinded to the type of intervention. This was achieved by allocating different therapy sessions on different days of the week. Blinding ensures that the intervention and standard or placebo treatment appears the same.

**Intervention**

The study participants were given information about the study and the intervention. All the participants received, Hot moist pack, TENS and massage as a part of conventional therapy. The total therapy lasted for 60 min.

**Assessment Procedure**

Treatments consisted of a physiotherapy evaluation (examination) and 8 therapeutic sessions (2 sessions per week) over a period of 4 to 8 weeks. The physiotherapy evaluation for
patients with LBP was carried out using the physiotherapy assessment template for LBP for about 45 minutes to 1 hour. This included both the subjective and objective assessment. The self-reported pain was measured using Visual Analogue Scale, which allowed for each patient’s pain to be quantified and thus statistically analyzed. The scale consists of a 10mm horizontal line with no markings so that the patients are not influenced by the patient’s mark. Participants were blinded to their previous VAS to decrease bias. Participants placed a vertical line on the horizontal line, indicating where they felt their pain was most accurately described.

Self-reported disability was measured using the Oswestry disability questionnaire. Oswestry Disability questionnaire allowed the assessors determine the perceived disability due to low back pain or leg pain and how low back pain was affecting the ability to manage activities of everyday life. It is a tool that measures the patient’s permanent functional disabilities and is considered the gold standard of low back functional outcome tools (Fairbank & Pynsent, 2000). The measurements were designed to determine the efficacy of interventions during a four-week program. Each measurement was taken four times: at baseline level (pretest) and after three therapy sessions, six therapy sessions and the final assessment four weeks post intervention, i.e., after four weeks of therapy.

**Intervention**

The treatment was administered by three physiotherapists with more than two years working experience and who had undergone training in manual therapy techniques and motor control exercises. The treatment was administered as per laid down protocol and adherence to the protocol was monitored by the data monitoring team that comprised of two independent senior physiotherapists and a statistician.

**Manual Therapy**

Maitland manual therapy techniques were used that included manipulations and mobilisation of vertebral joints in specific directions and at different speeds to regain mobility, muscle stretching and passive movement of the affected body part. This was achieved by performing small oscillating movements to the lower back while the patient was in a prone position. The Maitland joint mobilization grading scale was used. Grade 1 and 11 were used for pain relief while grade 111 and 1V for increased range of motion. To prevent the soreness that could be associated with manual therapy, treatment was administered on alternate days. The other techniques that were utilized were hold and relax technique where the patient was instructed to tighten muscles and then relax on the physiotherapist’s verbal command. The combination of these techniques was done for at least 10 minutes per therapy session (Muscolino, 2017).

**Motor Control Exercises**

Motor control exercises were aimed at strengthening the deep back and abdominal muscles. These include the transverse abdominis, quadratus lumborum, oblique abdominals, multifidus and erector spinae. Exercises targeting these specific muscles were done in a progressive pattern that started with transverse abdominis muscles, multifidus and so on (Norris, 2008).

Examples of motor control exercises include the following: The participants were instructed to pull his/her belly in and up at the navel without moving the rib cage, pelvis or spine. Progression: Gradually build up the duration of the contraction from 30 seconds to 1 minute. Only when the patient could activate the transverse abdominis with minimal muscle intensity (10 repetitions each 30-40%) over a period of time, should more advanced exercises be added. These exercises were done in four-point kneeling. The participants were instructed to stretch the abdominal wall so as to facilitate abdominal hollowing (Norris, 2008).

Contraction of the multifidus muscle was done by encouraging the participant to contract the multifidus and lateral abdominals at the same time. In high sitting the participant were instructed to perform abdominal hollowing, while the physiotherapist was palpating the multifidus muscle. If the therapist felt the contraction, the client could self-palpate and continue the action for 10 repetitions, aiming to hold each for 10 s while breathing normally. The participants also performed pelvic tilts (rolling pelvis forward and backwards) Progression of stability exercises were done in two phases. Phase one comprised of the following activities. Participants in crook lying position, and then instructed to slowly extend one leg with the heel resting on the floor mate. The moment the pelvis anteriorly tilts and the lordosis increases, then draw the leg back into flexion. This was done for 10 repetitions while alternating the legs. In the same position (crook lying) the participants were instructed to bridge from crook lying for at least 10 repetitions (Norris, 2008)

In four-point kneeling position arm and leg lifting 10 repetitions. These exercises were modified further by reducing the base of support for the participants in order to progress

**Conventional Physiotherapy**

Conventional Physiotherapy was defined as the treatment approach to LBP that includes superficial heat, massage and exercises directed to the lower back. The exercise therapy comprised of back extension exercises and general body exercises using a stationary bicycle. This was the prescribed approach to LBP management and adopted by the three institutions.

**Data Analysis**

Data was collected using VAS and ODQ. These tools were scored across the course of the intervention as follows. Baseline (week 0), 1st reassessment (week 1), 2nd reassessment (week 3) and final outcome measurement (week 8). The collected data was entered into excel spread sheet and later exported into Stata version 13.

Descriptive statistics were used to describe participants’ demographics and outcome measures including participants’ age, gender, weight, level of education and marital status. Inferential statistics was expressed as mean and standard deviation. Sample t test was used to determine the mean difference between the two groups. One-way analysis of variance was used to determine the effect of the intervention and Bonferroni post hoc test was used to establish the effect of the intervention. Chi-square was used to determine the relationship between two categorical variables or between a continuous variable and a categorical variable. Pearson’s
correlation was used to determine if they were correlations between the dependent variables (Low Back Pain) and the independent variable (type of treatment, number of therapy sessions, gender, weight and age).

RESULTS

Forty participants (23 females and 17 males) with a mean age of 47.9 years for female participants and 53.6 years for male participants took part and completed the study. Table 1 shows the sample t test results for the baseline, first follow-up, second follow-up and post-interventional scores of pain and disability for both group I and group II. Table 2 shows results of one-way analysis of variance (ANOVA) measures in order to determine the effects of manual and exercise therapy on pain reduction and functional abilities. The mean difference significant was determined at the 0.05 level. Results revealed no significant differences between groups in pain reduction as well as level of disability one-week (after three therapy sessions) post intervention but there was a significant difference after six therapy session and also four weeks after intervention for both groups. The analyses of variance also demonstrated no significance in groups over 4 weeks of time intervention effect between groups in improving ROM (p > 0.05). As depicted in Table 3, there is a significant difference between pre- and post-intervention in all seven groups (p < 0.05).

Table 1 Characteristics of participants in different treatment groups

<table>
<thead>
<tr>
<th>Variable</th>
<th>Baseline (mean ± SD)</th>
<th>First follow-up (mean ± SD)</th>
<th>Second follow-up (mean ± SD)</th>
<th>Final follow-up (mean ± SD)</th>
</tr>
</thead>
<tbody>
<tr>
<td>VAS Group I</td>
<td>2.61(0.49) *</td>
<td>1.2(0.61) *</td>
<td>1.80 (0.51) ***</td>
<td>1.19(0.40) **</td>
</tr>
<tr>
<td>VAS Group II</td>
<td>2.8(0.37) *</td>
<td>1.3(2.1) *</td>
<td>1.10 (0.31) ***</td>
<td>1.0(0.1) **</td>
</tr>
<tr>
<td>ODQ Group I</td>
<td>47.3 (SD 7.2)</td>
<td>40.9 (SD 5.4)</td>
<td>36.6 (SD 6.1)</td>
<td>32.4(SD 6.5)</td>
</tr>
<tr>
<td>ODQ Group II</td>
<td>51.1 (SD 1.9)</td>
<td>34.7 (SD 7.2)</td>
<td>22.2 (SD 5.7)</td>
<td>14.0 (SD 3.3)</td>
</tr>
</tbody>
</table>

One-way analysis of Variance to show the effect of intervention between groups

One-way analysis of variance (ANOVA) was done to discover the effects of the intervention between the groups that had shown improvement in values of the VAS after 8 weeks (power of effect 15.42, P = 0.001). A Bonferroni post hoc test showed a significant difference (0.697, P = 0.001) between the two groups.

Table 2 Effects of the intervention on reduction and improvement in functional abilities.

<table>
<thead>
<tr>
<th>Source</th>
<th>SS</th>
<th>df</th>
<th>MS</th>
<th>F</th>
<th>P &gt; 0.05</th>
</tr>
</thead>
<tbody>
<tr>
<td>Between groups</td>
<td>5.41934732</td>
<td>2</td>
<td>2.70967366</td>
<td>15.42</td>
<td>0.001</td>
</tr>
<tr>
<td>Within groups</td>
<td>6.32422424</td>
<td>36</td>
<td>0.175673401</td>
<td>32.4</td>
<td></td>
</tr>
<tr>
<td>Total</td>
<td>11.7435897</td>
<td>38</td>
<td>0.309041835</td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

In order to identify the factors that affect treatment outcome, the type of intervention the participants received was compared at baseline and post intervention after week 8. Both measurement of self-reported pain on the VAS and level of disability based on the ODQ were compared.

Paired t test of means of the self-reported pain on VAS at baseline showed no difference between group I (2.61 (SD0.11), P= 0.12) and group II (2.8 (0.85), P= 0.12). However, there was a significant difference between group I (1.19(SD0.1), P=0.04) and group II (1 (SD 0.1), P=0.04). Further pairwise comparisons between group I and group II computed at each time showed a mean difference of (0.22, SE 0.14, P= 0.12) at baseline indicating that there was no statistical significant difference between the groups at baseline but there was a significant mean difference between the two groups (0.33, SE 0.13, P=0.022) with participants in group II reporting less pain in comparison to group I.

For the Oswestry Low Back Pain Disability Questionnaire (ODQ) analyses, similar to the previous analysis. Within the intervention groups, there were notable changes observed over time. This was more evident in group II. There was a significant statistical difference in the level of disability from baseline (2.85,(SD 0.47), P =1.0 to 2.04(SD 0.38), P=0.000) at week 8 for group I and (2.94 (SD 0.49), P = 0.2 to 1.05 (SD 0.22), P=0.000 for group II.

Further pairwise comparison between the two groups was computed to show the means differences between baseline disability score to be (0.09, SE 0.17, P=0.60) and (-0.99, SE 0.10, P=0.000) which suggests that there was a decrease in the level of disability from baseline to discharge and discharge to follow-up after 4 weeks. See Table 3.

Table 3 Comparison between the baseline measurements and outcome measurements for both VAS and ODQ

<table>
<thead>
<tr>
<th>Pair wise comparison VAS</th>
<th>Mean Difference</th>
<th>Standard error</th>
<th>P value</th>
<th>Confidence interval</th>
</tr>
</thead>
<tbody>
<tr>
<td>Group II vs Group I Baseline</td>
<td>0.223</td>
<td>0.14</td>
<td>0.12</td>
<td>-0.061 -0.507</td>
</tr>
<tr>
<td>Manual vs conventional physiotherapy Outcome</td>
<td>0.331</td>
<td>0.13</td>
<td>0.022</td>
<td>0.049- 0.611</td>
</tr>
<tr>
<td>ODQ</td>
<td>0.090</td>
<td>0.17</td>
<td>0.60</td>
<td>-0.262 -0.443</td>
</tr>
<tr>
<td>Manual vs conventional Baseline</td>
<td>0.049</td>
<td>0.507</td>
<td>-0.220 -0.789</td>
<td></td>
</tr>
</tbody>
</table>

DISCUSSION

This study aimed at assessing the effectiveness of manual and exercises therapy in the management of patients with low back pain at selected first-level hospitals of Lusaka district.

There was a 90.9% response rate, out of the 40 participants in study 23 (57.5%) were female and 17 (42.5%) were male. The age of the study participants for both male and female was between 20 and 80 years. When age was compared for both male and female participants in this study, the mean age for the male participants was 53.6 (SD 18.6) and 47.3 (SD 12.5) for male and female participants in this study, the mean age of the study participants for both male and female was 53.6 (SD 18.6) and 47.3 (SD 12.5) for the female participants. These results revealed that the male participants were slightly older with the mean difference of 5.7 (SD 4.9) years than the female participants. This was in line with a study done by McIntosh, (2017), who observed that back pain can affect any age group, as the population ages, the chances of developing LBP increases due to factors that have to do with previous occupation as well as degenerative disc disease. Another study by Ramdas et al., (2018), observed that although LBP affects any age group, their study revealed that LBP was more prevalent among the females rather than the males. This was also mirrored in a study done by Bhadauria & Gurudut, (2017) who also observed that a large number of their
study subjects were female patients. The present study also observed that the female participants were slightly overweight with the mean weight difference of 2.8 (SD 3.2) kg as compared to the male participants. This was also observed in a study done by Bhadauria & Gurudut (2017) who revealed that the female patients had more weight compared to the male patients. Shiri et al., 2010 also made a similar observation and concluded that compared with persons of normal BMI, overweight/obese people had an increased LBP prevalence.

In this study it was found that both the manual and exercise therapy and conventional physiotherapy proved to be effective but when the pre and post intervention were compared, the inter group comparison proved that the group II (manual and motor control exercises) was superior in reducing pain when compared to group I (conventional group).

The conventional physiotherapy for LBP included moist hot packs, massage and general exercises. Moist heat was used to reduce pain and superficial muscle spasm. It is also reported that moist heat improves extensibility of the soft tissues around the lower back. The exercises were used to improve functional abilities and increase range of motion in the lumbar spine.

The reason behind the effectiveness of manual and motor control exercise was because of the Maitland manipulation and mobilisation of the vertebral joints in specific directions at different speeds to regain mobility, muscle stretching and passive movement of the affected body part. This offered pain relief through decreasing the nervous systems sensitivity to painful stimuli. This was achieved by performing small posterior anterior oscillating movements to the lower back while the patient was in a prone position. The Maitland joint mobilization grading scale was used. Grade I and II were used for pain relief. To prevent the soreness that could be associated with manual therapy, treatment was administered on alternate days.

Some of the potential mechanisms of this neuro-physiological effect are; pain gating which is a theory that states that stimulation of the mechano-receptive peripheral afferent nerves in the muscles produces sensory inputs that interferes with nociceptive impulses at the spinal cord level (Shanhank & Ghai 2014). The input from the larger sensory nerves inhibits the transmission of pain through the smaller nociceptive nerves to the brain leading to a pain relieving effect. As a result, the processes of stimulating mechanoreceptors through mobilisation produces short term pain relief through the mechanism of pain gating (Pallavi 2018).

Mobilisation also leads to activation of pain inhibitory pathways that originate in the midbrain and travel down the spinal cord. The activated pathways produce pain relieving effect by the inhibitory mechanism. Evidence also shows that mobilisation promotes adaptations of the nervous system with a decrease in the level of neural input from the painful site. It also increases the pain threshold levels that could come about by the electrochemical changes in the regulation of threshold potential (Shum et al., 2013).

With regards to the motor control exercises, these exercises were aimed at contraction of the multifidus muscle and lateral abdominals at the same time. This developed the pattern of setting the deep abdominal and multifidus in feedforward pattern and helped to maintain the holding capacity and in coordination with the global muscles. Moundjian (2011) says that activating a muscle increases stiffness of both the muscle and joints around it. Therefore, abdominal muscle activity is needed to create higher intra-abdominal pressure (IAP) in order to increase spinal compressive load while stabilizing the spine. One theory for this spinal stability is that the IAP produces an external moment that assists the erector spinea in supporting the spine. Another theory is that abdominal muscles with other trunk muscles serve to stiffen the spine causing an air splint to develop around the spine (Kamali et al., 2018).

As a result of reduction in levels of back pain, participants in this study indicated that there was a significant difference in the level of disability between the groups over the course of treatment. For group II showed a significant decrease in the level of disability from baseline (week 0) to second follow up at week 3 and from week 3 to 8 weeks follow up. This was the same with group I which also demonstrated significant difference in the level of disability from baseline to 8 weeks follow up. The sample t test showed no difference between the two groups at baseline. However, there was a significant difference between group I and group II at 8 weeks with group II showing a greater decrease in disability as compared to group I.

The findings of this study support the findings of a study by Ramadan 2019 who assessed the effectiveness of manual therapy approach in the treatment of LBP due to lumbar spinal stenosis and revealed that there was a significant difference between the manual and exercise therapy group as compared to the exercise group only. Franca et al., 2012 also compared the effects of two exercises (segmental stabilization exercises and stretching of the trunk and the hamstrings muscles) on functional disability, pain for patients with chronic LBP and revealed that although both treatments were effective in relieving pain and improving disability P < 0.001, those in the segmental stabilization group showed a significant higher gains for all variables. This was also highlighted in the study by Ramadan, 2019 who indicated the importance of exercises as an intervention for the management of chronic LBP.

Another study by Sharma et al., 2015, showed a statically significant difference between pre and post measurement readings with time ($p = 0.00$) and between groups ($p < 0.05$) with respect to pain and function, but, with respect to ROM readings, showed statistical significance with time ($p = 0.00$) and no significance between groups ($p > 0.05$), indicating manual therapy group-I was improving faster and better than conventional physical therapy group-II.

This study also revealed that there was no significant difference in the level of self-reported pain and disability immediately after three therapy sessions.

These findings are similar to the observations in the study by (Dale 2016; Balthazard et al., 2012), who revealed that there was an immediate analgesic effect following manual therapy but there were no significant differences found between treatment groups and changes in dependent variables in the immediate post intervention. Meaning that one week of intervention is not enough to have significant reduction in pain and disability in patients with LBP. This is suggesting that one treatment of combined therapy does not significantly decrease LBP. These findings were also similar to a study by Castro-
CONCLUSION

This study suggests that manual therapy and motor control exercise are effective for providing clinically significant reduction in back pain and disability in patients with LBP compared to conventional physiotherapy (Hot moist pack, TENS and massage). Therefore, recommendations are that manual and exercise therapy should be considered as part one of the treatment options for low back pain.

Declaration

Acknowledgement

I would want to acknowledge the contribution of my participants in this study and also the study sites that permitted this study to take place in their facility.

Author Contribution

Concepts of the study were developed by CL, HS and MCB. Manuscript was written by BCC and CL. Data analysis was done by CL. All authors read and approved the final manuscript before submission.

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