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Swiss Ball Exercises As An Alternative To Mckenzie Exercises In Treating Chronic Low Back Pain Among Poultry Workers

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ABSTRACT
Low back pain (LBP) extension-biased, is the most common leading cause of disability among poultry workers who frequently perform repetitive trunk motions such as bending, twisting, and lifting. The incidence of LBP among the poultry worker's has been reported to be 17.2% and it affects the workers capacity in doing functional activities of daily living. Men have higher risk of developing LBP due to the design of their work which involves repetitive trunk bending, twisting and rotation. The common interventions for LBP extension-biased include traction, acupuncture, stabilization, manipulation and Mckenzie exercises. Mckenzie exercises centralize pain, decrease functional disability, and improve spinal mobility. However, Swiss ball exercises are for stabilization exercises that strengthen core muscles, decrease pain perception, increase trunk mobility, decrease functional, and disability, The purpose of the study is to determine the effectiveness of Swiss ball exercises as an alternative to McKenzie exercises in treating Chronic Low Back Pain (CLBP) among poultry workers in terms of the following: relief of low back pain, increasing muscle strength, trunk flexibility, and improving functional ability and performance. The study utilized pre-test and post-test using paired T-test and independent T-test, and Wilcoxon signed ranked test. Sixty poultry workers were randomly grouped into controlled group and intervention group. Results show that there is no significant difference between the two exercises. Therefore, Swiss Ball can be used as an alternative to McKenzie in treating CLBP.

Keywords
Low Back pain; McKenzie Exercises; Swiss Ball exercises; Core muscle.

1. INTRODUCTION

Low Back Pain (LBP) is one of the most considerable musculoskeletal problems worldwide which is commonly treated in health care setting [1]. In the Philippines, chronic pain was reported primarily in the knee (31%), followed by back (22%), lower back (21%), hip (19%), lastly, the leg (18%) [2]. LBP is commonly described as discomfort such as pain perception, muscle tightness, with or without leg pain. As age increases, the chances of developing LBP are higher especially among those 55–65 years age group [3]. LBP is classified based on the onset into three types namely: acute, subacute, and chronic. Acute is defined not greater than 6 weeks; subacute last for 6 weeks to 12 weeks [4]; and chronic which is longer than 12 weeks[5]. Typically, biopyschosocial phenomenon considered as a common affectation among people with LBP. Not only the biological state of the body is affected but also the cultural as well as the social aspect in managing pain perception. Moderate to severe pain commonly affect people's lives, leading to decrease work productivity [2]. LBP is further classified into two, based on the main cause namely: the specific and non-specific. Specific LBP is usually caused by a specific pathophysiological mechanism. Medical conditions such

as herniated nuclei pulposus, infection, osteoporosis, arthritis, and fracture may lead to specific LBP. However, non-specific LBP shows symptoms without any pathophysiological mechanism which contributes 90% of LBP [6].Mechanical conditions are worsened by activity (bending, extending, twisting and lifting) and improves with rest [7]. Non-mechanical medical conditions are caused by infection in the spine and inflammatory arthritis such as ankylosing spondylitis which is common in lumbar leads to the development of LBP symptoms [8].

Pain and disability are the most important symptoms of non-specific LBP [9].The impact of LBP among employees lead to activity limitations and productivity in work place is affected due to absence in work setting [10].

According to Department of Interior and Local Government (DILG) of Cavite, Laguna, Batangas, Rizal, Quezon (CALABARZON), San Jose is a First Class Municipality in the Province of Batangas whose primary production is agricultural specifically poultry and livestock production, both in commercial and backyard scales. Layer farming is considered the primary resources of income generation. The nature of work of the poultry workers are repetitive trunk bending, lifting and carrying heavy loads of eggs which increase the risk of developing LBP. Physical activities such as bending, extending, twisting, and lifting aggravate LBP that leads to restrictions of activities that produce pain [7].

Various exercise therapy such as general physical fitness, flexibility, and stretching exercises are commonly applied in order to promote good physical health [11]. McKenzie exercise is considered highly effective exercise therapy for non-specific spinal pain in relieving symptoms of pain as compared to strength training and spinal mobilization. However, Mckenzie exercise promotes rapid symptom relief but is not used to strengthen back muscles [12]. The McKenzie Protocol (MP) is an exercise which allows repeated movements in back extension, which causes the symptoms to be centralized, and eventually decreases the pain among individuals with Chronic Low Back Pain (CLBP) [13].

The use of Swiss ball exercises improves muscle endurance as well as the trunk flexibility, and muscle strength [14]. Moreover, the exercise strengthens body reflexes, proprioception, and kinesthesia [15].For the past years, it is commonly used for spine treatment. Static exercises performed on Swiss ball increases the spinal stabilizers' activation and facilitation due to unstable characteristic of the ball. The core strength training protocol for Swiss ball can facilitate the global muscles as well as the local muscle groups Swiss ball exercises require a much higher demand on motor system [16].

The purpose of this study was to determine the effectiveness of Swiss ball exercises as an alternative to McKenzie exercises in treating CLBP among poultry workers in terms of the following: relief of low back pain, increasing muscle strength, trunk flexibility, and improving functional ability and performance.

2. MATERIAL and METHODS

2.1 Participants

Participants were recruited through random sampling. The following inclusion criteria were used to determine eligibility: (1) male and female, (2) 18 to 65 years of age, (3) experienced back pain not more than 12 weeks without any radiating pain sensation to the lower extremities, and (4) had not received exercise particularly specific abdominal and spinal stabilization, and manipulation. Participants were excluded if they have the following: (1) anatomical and physiological deformities, (2) presence of neuromuscular conditions and spinal injury (3) underwent spinal surgery, (4) malignancy, (5) inflammatory joint disease,

(6) pregnancy, and (7) general health problems which prevent from participating in an exercise program [16].

Eighty (80) poultry workers from San Jose, Batangas were included in the screening process. However, only 60 participants met the inclusion criteria and became part of the study, 55 males and 5 females. The 60 participants were randomly assigned into 2 groups namely: the control group (McKenzie exercise) and the intervention group (Swiss ball exercise). Each group has 30 participants. Before the start of the intervention, all participants signed an informed consent.

2.2 Instruments

Swiss ball is a large, inflated rubber ball capable of providing resistance among the users. It relies on core muscles activation in order to maintain balance therefore improving muscle strength and flexibility. It typical originates from Italy. The size of the ball uses the guidelines of Togu in which the measurement of the ball depends on the height of the participants (height: ball size). Less than 155 cm the ball size is 45 cm; for 156–165 cm, it is 55 cm; for 165–178 cm it is 65 cm; and over 178 cm it is 75 cm [17].

A nylon mat is a protective material placed on a floor where the participant lies when performing McKenzie exercises.

2.3 Assessment Tools

2.3.1 Numerical Pain Rating Scale (NPRS)

The Numeric Pain Rating Scale (NPRS) was used in order to measure lower back pain perception as well as the intensity. This scale ranges from 0 -10, with a verbal interpretation of 0 which means without no pain, 1-3 is mild, 4-6 moderate, 7-10 being the most severe pain. Participants encircled the number on a rating scale to rate how bothersome their pain is [18].

2.3.2 Goniometer

Goniometer was used to measure the available range of motion (ROM) of specific joints. Lumbar motions that are commonly assessed with this tool are in the sagittal and frontal plane. In measuring side bending to the right or left, the participant stood with the axis of the goniometer properly leveled on the lumbosacral junction. The stationary arm is perpendicular to the floor and the movable arm is in line with C7 [19].

2.3.3 Modified Modified Schober's Index

The Modified Modified Schober's Index was used to measure lumbar range of motion (ROM) specifically flexion and extension. The landmark is posterior superior iliac spine (PSIS) with five (5) cm markings in the midline below the level of the posterior superior iliac spine (PSIS) and ten (10) cm above the level of the PSIS. During the procedure, the participants were asked to flex the trunk forward as much as he/she can and the 2 markings were measured. Fifteen (15) cm are subtracted from the distance between the two markings in order to obtain the value of lumbar flexion. The final length towards trunk extension was subtracted from the 15 cm in in order to obtain the value of lumbar extension [17].

2.3.4 Manual Muscle Test (MMT)

Manual muscle testing was used to measure muscle strength. A score of five (5) was given to a participant if maximum resistance against gravity was tolerated; four (4) if moderate resistance against gravity was tolerated; three (3) if participants was able to complete active range of motion (AROM) without resistance; two (2) cannot perform the movement against gravity eliminated; one (1) with visible or palpable contraction upon muscle movement, and zero (0) if no visible contraction during movement was noted [20].

2.3.5 Oswestry Disability Index (ODI)

The Oswestry Disability Index (ODI) is an extremely important tool and considered the gold standard when measuring functional disability and performance of people with LBP [21].

2.4 Research Design

An experimental randomized controlled trial (RCT) using fishbowl method was utilized to determine differences between the two intervention groups in terms of improvements in pain intensity, trunk muscle flexibility, strength, and functional performance of the subjects with LBP.

2.5 Procedure

Pre and post assessments were done by a registered physical therapist before and after each intervention that was blinded. All participants were assessed using the following: numeric pain rating scale for pain intensity, (2) modified modified Schober's index for trunk flexibility, (3) manual muscle testing for trunk muscle strength grade, and (4) modified Oswestry disability index, for functional disability.

The control group received Mckenzie extension using McKenzie protocol. The participants started on the first exercise position and eventually progress on the next exercise depending at their own pace if they could hold a given position for 10 seconds. The exercise progressions are as follows: first, the participant lay in prone position with both arms on the sides of the body then he/she lift the head and trunk off the plinth from neutral to extended position. From that position, he/she proceeded on the second step wherein he/shelaid in a prone position with the hands interlock at the occiput so that shoulders are abducted to 90° and the elbows are flexed. He/she then again lift his/her head and trunk off the plinth from neutral to extended position. If tolerated, he/she continued on the third step wherein he/shelaid again in prone position with both arms elevated forwards. Then he/she lift again his/her head, trunk and elevated his/her arms off the plinth from neutral to extended position. If no symptoms occur, he/she continued on the fourth step wherein he/shelaid in prone position, lift his/her head, trunk, and contralateral arm and leg off the plinth from neutral to extension. Finally, he/shelaid in prone position with both shoulders abducted and elbows flexed to 90° and then lift his/her head, trunk, and both legs (with knees extended) off the plinth.

If the pain was aggravated during the exercise, the participant was asked to stop the execution of the exercise protocol. However, if the pain diminishes within 5 minutes after the exercise, he/she was asked to continue further and maintained the exercise position for only 5 seconds. If the participant can still tolerate the given position without any adverse response noted, he/she was asked to maintain further the given position for another 10 seconds. Each exercise protocol should be repeated for 10 times. After 10 repetitions, the participant was instructed to take a rest for 30 seconds to a minute. The static holding time of the exercise position should gradually increase into 20 seconds in order to provide a greater training stimulus. The dosage for 10 repetitions was adopted from a previous protocol for participants with sub-acute LBP, which decreases pain severity [13]. The intervention group received three times a week for eight Swiss ball exercises for 45 minutes. The protocol consists of the following: straight arm crunch, Swiss-ball alternate arm, Swiss -ball wall squat, Swiss-ball shoulder Bridge, Swiss-ball back extension, Swiss-ball hamstring curl, and Swiss-ball leg raise. A 10-minute warm-up and cool-down protocol incorporated before and after Swiss-ball exercises to minimize risk of injury. The warm-up and cool-down protocol consisted of 5 minute walk at an easy pace to be followed by light static stretches for 2 sets, 15 seconds for each major muscle tendon groups [16].

2.6 Statistical Analysis

Statistical analyses were computed using paired t-test for the pretest and posttest of goniometric measurement and pain intensity measurement. Wilcoxon signed ranked test was

used for manual muscle testing of the trunk muscles and functional performance of the participants between Mckenzie and Swiss ball.

3. RESULTS AND DISCUSSION

Table 1 shows that majority of the participants were male (91.7%) aged 54-59, with 151-156 cm height, weighing 62-67 kg, with less than 3 years length of service, working for 12-15 hours whose nature of work is carrying, with an estimated weight lifted of more than 17 kg and above, with 16-21.5 meter distance travelled and the common trunk movement is repetitive flexion and extension. Men have a higher percentage in developing LBP. These natures of works were common among men who were involved in this type of environment that engages in repetitive activities including repetitive trunk flexion loads contributes to an increase force on the lumbar area. This may weaken the abdominal muscles which contribute to LBP which is similar to the study of Mokhtarinia et al. [22]. Changes in the age composition do explain as the age increases, the chances of developing LBP are higher which typically occurs in ages between 24 and 39 years old [23] and are higher between 20 and 59[24]. Individuals in this age group have a higher prevalence of LBP.

Table 1. Characteristics of participants

Description	**Frequency**	**Percentage (%)**
Gender		
a. Male	55	91.7
b. Female	5	8.3
Age		
a. 18-23 years old	8	13.3
b. 24-29 years old	9	15.0
c. 30-35 years old	8	13.3
d. 36-41 years old	9	15.0
e. 42-47 years old	8	13.3
f. 48-53 years old	8	13.3
g. 54-59 years old	10	16.7
Height		
a. 145-150 cm	18	30.0
b. 151-156 cm	28	46.7
c. 157-162 cm	14	23.3
Weight		
a. 50-55 kg	12	20.0
b. 56-61 kg	14	23.3
c. 62-67 kg	20	33.3
d. 68-73 kg	4	6.7
e. 74-79 kg	10	16.7
Length of service		
a. < 1 year	8	13.3
b. < 2 years	12	20.0
c. < 3 years	14	23.3
d. < 4 years	12	20.0
e. < 5 years	10	16.7
f. > 5 years	4	6.7
Number of working hours		
a. < 8 hours	6	10.0

b. < 11 hours	22	36.7
c. < 15 hours	30	50.0
d. > 15 hours	2	3.3
Nature of work		
a. Lifting	18	30.0
b. Feeding	14	23.3
c. Carrying	28	46.7
Estimated weight being lifted/carried		
a. 5-10.5 kg	5	8.3
b. 11-16.5 kg	25	41.7
c. 17 kg and above	30	50.0
Distance travelled		
a. 10-15.5 m	15	25.0
b. 16-21.5 m	35	58.3
c. More than 22 m	10	16.7
Trunk movements commonly performed		
a. Repetitive flexion and extension	51	85.0
b. Rotation	5	8.3
c. Lateral flexion	4	6.7

Table 2 shows the pre and post pain perception using numerical rating pain scale. As shown in Table 2, both interventions can decrease the pain intensity at the lower back. This means that both interventions can decrease pain perception. However, the Swiss ball had a greater effect. This is in contrast to the study of Al- Obaidiet al.[25] & Sekendiz et al. [16] that Mckenzie exercises promotes rapid symptom relief rather than any LBP intervention. Nonetheless, the results support the notion that Mckenzie and Swiss ball exercises are both effective in reducing low back pain.

Table 2. Pre and post pain perception using NRPS between McKenzie and Swiss Ball

	Mean	
	Mckenzie	**Swiss ball**
Pain scale Pre	4.40	5.73
Pain scale Post	3.00	2.97

Table 3 shows the measurement of active range of motion of trunk flexibility between Mckenzie and Swiss ball exercise. There was a difference between the pre and post exercise on both treatment interventions. However, the Swiss ball has a greater change. This implies that both exercises have the capability to increase the degree of trunk flexibility in terms of lateral flexion and rotation. That supports the study of Rajkumar [26] that task oriented Swiss ball training are effective to improve trunk control and functional balance.

Table 3. Measurement of trunk flexibility using goniometry for Active Range of Motion (AROM) between Mckenzie Exercise and Swiss Ball

Trunk motion	**Mean**	
	Mckenzie	**Swiss ball**

Pre right lateral flexion	9.33	11.60
Post right lateral flexion	7.30	6.97
Pre left lateral flexion	8.33	9.80
Post left lateral flexion	6.83	5.10
Pre right rotation	12.60	13.43
Post right rotation	11.13	8.00
Pre left rotation	11.60	12.67
Post left rotation	9.37	7.77

Table 4 shows the pre and post passive range of motion of trunk flexibility between Mckenzie and Swiss ball exercise. There was a difference between the two treatment interventions except for the pre and post rotation to the left which show similar results. This implies that similar results of pre and post of passive left rotation of both intervention is due to the achievement of full range of motion However, participants under Swiss ball exercises has a greater degree of passive movement secondary to increased trunk flexibility and decreased pain perception during passive trunk movement which was supported by Lee et al [15].

Table 4. Passive Range of Motion (PROM) between McKenzie Exercise and Swiss ball exercise

Trunk motion	**Mean**	
	Mckenzie	**Swiss ball**
Pre right lateral flexion	4.63	8.57
Post right lateral flexion	3.43	2.23
Pre left lateral flexion	3.93	7.23
Post left lateral flexion	2.63	2.37
Pre right rotation	7.23	8.53
Post right rotation	6.63	4.90
Pre left rotation	6.27	7.83
Post left rotation	5.57	7.83

Table 5 shows the measurement of pre and post trunk muscle flexibility using modified modified Schober test. There is a difference between the pre and post exercise on both treatment intervention. The results show that both interventions have the capability to improve trunk flexion and extension. This indicates that both interventions can be effective in increasing trunk flexibility towards extension and flexion, supported by the study of Lee et al. [15]. However, the Swiss ball has a greater influence in increasing trunk motions by promoting the dynamic stability of the trunk muscle and strengthening of abdominal muscle which have a greater contribution to avoid LBP.

Table 5. Trunk muscle flexibility using MMST between McKenzie and Swiss ball

Trunk motion	**Mean**

	Mckenzie	Swiss ball
Pre trunk flexion	5.33	6.03
Post trunk flexion	5.07	4.97
Pre trunk extension	2.53	3.37
Post trunk extension	2.13	2.70

Table 6 shows the significance of pre and post trunk motion strength between Mckenzie and Swiss ball exercise. The statistical difference is 0.05 this implies that both interventions has no significance in increasing trunk motion towards flexion and extension. This is contradictory to the study of Sekendiz et al. [16] which stated that Swiss ball exercise had improvements in strength of the lower back and abdominal muscles.

Table 6. Trunk muscle motion measurement between Mckenzie and Swiss Ball

Trunk motion	Significance
Pre trunk flexion	0.190
Post trunk flexion	0.411
Pre trunk extension	0.741
Post trunk extension	0.456
Pre trunk rotation	0.338
Post trunk rotation	0.385

Table 7 shows the pre and post functional performance using Oswestry disability index. Both intervention shows improvement in all functional performance. However, sitting and sleeping were significant. According to Lee et al. [15], trunk exercises such as Swiss Ball are effective in improving functional ability and increasing muscle endurance due to muscle co-contraction specifically which transverses abdominis and multifidus when weakened it contributes to low back pain that can decreased functional performance.

Table 7. Functional performance of the participants

	Significance
Pre pain intensity	0.207
Post pain intensity	0.503
Pre personal care	0.684
Post personal care	0.763
Pre lifting	0.524
Post lifting	0.612
Pre walking	0.082
Post walking	0.217
Pre sitting	0.007
Post sitting	0.154
Pre standing	0.227
Post standing	0.698

Pre sleeping	0.024
Post sleeping	0.118
Pre social life	0.248
Post social life	0.628
Pre travelling	0.342
Post travelling	0.362
Pre household	0.385
Post household	0.296

4. CONCLUSION

This study investigated the effectiveness and efficiency of Swiss ball and Mckenzie exercise for chronic low back pain among patients. Both interventions decreased pain, increased trunk muscle strength, trunk flexibility and improved functional ability and performance. Nonetheless, there is no significance difference between the two exercises. Therefore, Swiss ball can be used as an alternative to McKenzie in treating CLBP.

5. RECOMMENDATIONS

It is recommended that Swiss ball exercises be used in treating other types of orthopedic conditions with presence of pain, limitation of motion in trunk movements, and functional disability to prove its effectiveness. Swiss ball exercise also can be used as an adjunct with other modalities in decreasing pain on the trunk musculature.

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