EFFECTS OF 8-WEEK MEDICINE BALL TRAINING ON PHYSICAL AND SKILL PERFORMANCE AMONG BASKETBALL PLAYERS

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By

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KESAN LATIHAN BOLA SEGAR SELAMA 8 MINGGU TERHADAP PRESTASI LATIHAN DAN KEMAHIRAN FIZIKAL DALAM KALANGAN PEMAIN BOLA KERANJANG

ABSTRAK

Latihan bola segar telah dikaji untuk menentukan sama ada latihan ini boleh membantu meningkatkan prestasi fizikal dan kemahiran pemain bola keranjang. Kajian ini menyiasat kesan lapan minggu latihan bola segar terhadap prestasi fizikal dan prestasi kemahiran bola keranjang dalam kalangan pemain bola keranjang lelaki yang berumur 18 hingga 24 tahun. 28 subjek telah diambil dan dibahagikan kepada dua kumpulan, iaitu kumpulan eksperimen (EG) dan kumpulan kawalan (CG). Setiap kumpulan mempunyai 14 subjek (EG: min umur ialah 21.25 ±1.34 dan CG: min umur ialah 20.52 ±1.77). Untuk mengesan perbezaan di dalam dan antara kumpulan kajian, ANOVA langkah berulang telah digunakan. Analisis menunjukkan kesan pra, ujian pertengahan dan ujian pasca yang ketara terhadap prestasi fizikal. Kesemua pembolehubah kecergasan fizikal yang dikaji adalah signifikan dengan nilai $p<0.01$ dan analisis prestasi kemahiran menunjukkan perbezaan yang signifikan dalam semua pembolehubah dengan nilai $p<0.01$. Kumpulan eksperimen (EG) yang menerima latihan bola segar menunjukkan peningkatan dalam prestasi fizikal yang dinyatakan dalam bentuk peratusan dalam pembolehubah berikut: Lontar Bola Segar Atas Kepala (OHMBT) (5.11%), Lompat Jauh Berdiri (SLJ) (4.52). %), Lari Pecut 20 m (Pecut) (1.34%), Ujian-T Ketangkasan (KETIKA) (3.49%), Lompat Menegak (VJ) (6.45%) dan Dinamometer Belakang dan Kaki (BLD) (16.40%). Selain itu, kajian ini juga mendapati mendapati kumpulan eksperimen yang menerima latihan bola segar menunjukkan peningkatan dalam prestasi kemahiran bola keranjang juga, yang dinyatakan dalam bentuk peratusan dalam ukuran berikut: Control Dribble (CD)

(2.14%), Defensive Movement (DM)) (3.22%), Hantaran (LULUS) (6.83%), dan Tangkapan Titik Kelajuan (SSS) (13.29%). Penyelidikan ini mencadangkan bahawa latihan bola segar boleh digabungkan dengan rutin senaman tetap bagi meningkatkan prestasi fizikal dan kemahiran bola keranjang dengan ketara. Jurulatih dinasihatkan supaya menambah bola segar ke dalam rejim latihan harian pemain. Penggabungan latihan bola segar yang selaras dengan kerja kemahiran tertentu boleh meningkatkan prestasi kemahiran bola keranjang. Program senaman bola segar yang disyorkan menyediakan rangka kerja yang berguna untuk menilai peningkatan dalam prestasi fizikal dan prestasi kemahiran bola keranjang dalam kalangan pemain bola keranjang.
Kata kunci: Bola segar, prestasi fizikal, latihan kekuatan, latihan pliometrik, penyaman bola keranjang.

EFFECTS OF 8-WEEK MEDICINE BALL TRAINING ON PHYSICAL AND SKILL PERFORMANCE AMONG BASKETBALL PLAYERS

ABSTRACT

Medicine ball training has been studied to determine if it can help to improve physical performance and skills performance of basketball players. This study investigated the effects of eight weeks of medicine ball training on physical performance and basketball skill performance among male basketball players aged 18 to 24 years. 28 subjects were recruited into two groups, namely the experimental group (EG) and the control group (CG), with 14 subjects in each group (EG: mean age was 21.25 ±1.34 and CG: mean age was 20.52 ±1.77). To detect differences within and between the study groups, repeated-measures ANOVA was used. The analyses demonstrated significant pre-test, mid-test and post-test effects on physical performance. All the physical performance fitness variables examined were significant with $p<0.01$ and the skill performance analyses showed significant differences in all variables with $p<0.01$. The experimental group (EG) that received medicine ball training showed improvements in physical performance, which was expressed in the form of percentage in the following variables: Overhead Medicine Ball Throw (OHMBT) (5.11%), Standing Long Jump (SLJ) (4.52%), Sprinting 20 m (SPRINT) (1.34%), Agility T-Test (AGILITY) (3.49%), Vertical Jump (VJ) (6.45%), and Back and Leg Dynamometer (BLD) (16.40%). Moreover, this study found that the experimental group that received medicine ball training showed improvement in basketball skill performance as well, which was expressed in the form of percentage in the following measures: Control Dribble (CD) (2.14%), Defensive Movement (DM) (3.22%), Passing (PASS) (6.83%), and Speed Spot Shooting (SSS) (13.29%). This

research suggests that incorporating medicine ball training into regular exercise routines can significantly increase physical performance and basketball skills. Coaches are advised to include medicine ball workouts into players' daily training regimes. The incorporation of medicine ball workouts that align with specific skill work can improve basketball skill performance. The recommended medicine ball workout program provides a useful framework for evaluating improvements in physical performance and basketball skill performance among basketball players.

Keywords: Medicine ball, physical performance, strength training, plyometric training, basketball conditioning

CHAPTER 1
INTRODUCTION

A basketball game entails running, jumping, speed and agility, which are some of the most important characteristics associated with athletic performance. In particular, basketball games involve intermittent types of movements in addition to running and jumping, which in turn necessitates both strength and endurance on the part of players (Maulder & Cronin, 2005). The game is also characterised by frequently starts, direction changes and stops, all of which are maintained within a particular period (Ransone, 2016). Unlike a quarter of gameplay that lasts eight minutes for an athlete at the high school level, the average play segment in basketball lasts 20 seconds at best, encompassing around 5000 meters within 48 minutes (Delextrat & Cohen, 2008; Ransone, 2016). Glucose provides energy and helps to maintain movements for a longer duration, which accounts for about 70% of the game (Montgomery et al., 2010). A single session of sustained aerobic exercise, which last 30 to 60 minutes at 60% to 70% of maximum oxygen consumption, can considerably lower plasma glucose levels by stimulating GLUT-4 glucose transporter translocation and glucose transport activity in insulin-resistant skeletal muscle (Henriksen, 2002). Improvements in insulin sensitivity and glucose tolerance are chronic physiological benefits of exercise (Weinstock et al., 1998). Chronic exercise enhances maximal oxygen absorption by increasing maximum cardiac output and muscle oxygen intake from the blood. This is achieved by reducing the product of heart rate and systolic arterial blood pressure, which in turn reduces myocardial oxygen needs for similar amounts of external effort (Fletcher, American Heart Association). The physiological and psychological benefits of exercise are well-established: however, it remains uncertain on how to optimise these effects. The greatest advantages of exercise are achieved

through chronic and repeated sessions. Nevertheless, failing to complete a single session of exercise can impede one's capacity to complete a training programme. An individual's capacity to successfully finish an acute bout of exercise is likely influence by their experience during the session. If the exercise is perceived as less stressful, individuals may be more inclined to continue the session and successfully complete the training programme. Therefore, there is a need to focus on physical performance and medicine ball training, particularly in the context of improving physical performance and basketball skill performance as this area that has received limited scholarly attention.

It has been reported that intensity is the most critical factor for improving strength level, which is why the performance of basketball players is mainly evaluated through resistance training (Burgess & Naughton, 2010; Giroux et al., 2016). This is especially important because studies show that explosive strength alone is insufficient to improve basketball performance (Montgomery et al., 2010). Hence, this study focused on the role of strength training in general and medicine ball training in particular to improve various aspects of physical performance.

1.1 Background of Study

This study focused on the use of medicine ball exercises to improve physical performance, specifically strength and explosive power. Physical strength is crucial in most of the sporting activities, including basketball. (Aoki et al., 2015) highlighted that basketball players use both strength and endurance to enhance their performance.

In this study, the effectiveness of medicine ball training in improving the physical performance of basketball players was analysed. The use of medicine ball for training dates back several centuries when it was primarily used as a method of strength training ("Scientific American Supplement Catalogue," 1889). Nowadays, the medicine ball is used to enhance explosive muscular power among athletes and accelerate rehabilitation after sustaining an injury (Ferguson, 2009), making it particularly important for basketball players. Therefore, the effects of medicine ball training on the physical performance and skills of basketball players were investigated in this study.

1.2 Significance of Study

Medicine ball exercises are widely recognised as one of the most effective tools for enhancing muscular strength and core stability throughout the body. They have been used extensively in sports and medicine for several years. In particular, medicine ball exercises have proven to be a skilful and practical training for developing the performance of athletes.

However, coaches and physical education teachers have not yet fully embraced these exercises. They do not adequately incorporate medicine ball workouts into their training sessions and curricula, which may be attributed to a lack of understanding of the subject. Hence, the goal of this study was to bridge the research gap by identifying and clarifying the effects of medicine ball workouts on the physical performance of basketball players as part of their performance enhancement.

1.3 Problem Statement & Study Rationale

Most of the literature on basketball players has focused on players' perspective such as their nutrition, training regimens and mental aspects that can directly or indirectly affect their performance. There have been limited studies on the impact of medicine ball training on basketball team players, and no combined studies have been conducted on the physical and skill performance of basketball players. As a result, it is unclear how coaches can effectively use this training method to guide players.

Therefore, the goal of this study was to assist coaches in adopting an integrated approach to their coaching tactics by including medicine ball training. Specifically, the study aimed to explore the impact of medicine ball training on the knowledge of coaches and performance of basketball players within a specific time frame. This study would shed light on a largely unknown facet of medicine ball training and its potential to improve basketball players' physical and skill performance.

1.4 Research Questions

The research questions of this study were shown as follows:

1) Is there any relationship between the medicine ball exercise and basketball performance?
2) What are the most important factors that influence the physical performance of basketball players?
3) How does medicine ball training affect basketball skill performance?
4) What is the relationship between physical performance and basketball skill performance of basketball players?

1.5 General and Specific Objectives

1.5.1 General objective

This study was conducted to evaluate the effects of 8 weeks of medicine ball training on physical performance among basketball players.

1.5.2 Specific Objectives

This study was conducted to improve muscle strength and core stability after going through an eight-week long routine of medicine ball training in addition to the regular exercise routine. To determine the effect of medicine ball training on physical performance after an eight-week training period, the following tests were used: Overhead Medicine Ball Throw, Standing Long Jump, Sprinting 20 m Dash, Agility T-Test, Vertical Jump Test, and Back and Leg Strength Test. According to the analysis of the data, the null hypotheses ($H_0$1, $H_0$2 and $H_0$3) were rejected and the alternative hypotheses (H_A1, H_A2 and H_A3) were accepted.

Besides that, this study also aimed to determine the impact of medicine ball training on basketball skill performance after an eight-week training period, which was measured using the AAHPERD Basketball Skill tests Control Dribble, Defensive Movement, Passing, and Speed Spot Shooting. Based on the analysis of the data, The null hypothesis ($H_0$4) was rejected and the alternative hypothesis (H_A4) was accepted.

1.6 Hypothesis

The hypotheses of this study were entailed as follows:

1) Null Hypothesis ($H_0$1): There is no significant difference in mean muscle strength score among the intervention groups (Back and leg dynamometer and Overhead Medicine Ball Throw).

Alternative Hypothesis (H_A1): There is a significant difference in mean muscle strength score among the intervention groups (Back and leg dynamometer and Overhead Medicine Ball Throw).

2) Null Hypothesis ($H_0 2$): There is no significant difference in mean speed among the intervention groups (Sprint 20 m Dash and Agility).

   Alternative Hypothesis (H_A2): There is a significant difference in mean speed among the intervention groups (Sprint 20 m Dash and Agility).

3) Null Hypothesis ($H_0 3$): There is no significant difference in mean power among the intervention groups (Horizontal jump and vertical jump).

   Alternative Hypothesis (H_A3): There is a significant difference in mean power among the intervention groups (Horizontal jump and vertical jump).

4) Null Hypothesis ($H_0 4$): There is no significant difference in mean basketball skills among the intervention groups [Control Dribble (CD), Defensive Movement (DM), Passing (PASS) and Speed Spot Shooting (SSS).

   Alternative Hypothesis (H_A4): There is a significant difference in mean basketball skills among the intervention groups [Control Dribble (CD), Defensive Movement (DM), Passing (PASS) and Speed Spot Shooting (SSS)].

1.7 Limitation of the study

The limitations of this study included the socioeconomic background, lack of nutritional knowledge and lifestyle factors of the participants. Even though the subjects were verbally motivated, there was no attempt to differentiate their level of motivation during testing and training. The study did not take into account potential differences in environmental conditions. The tests were conducted in dry weather during the pre-test, mid-test and post-test.

Before participating in this study, all subjects were instructed to ensure that they were will-rested. Although the researcher chose a period when the subjects had at least 48 hours before and after a competition, the researcher was unable to control for the intensity of sport practise within these time limits. Furthermore, the researcher was unable to monitor the nutritional intake of individuals; thus, the researcher could not ensure the consistency in eating habits or monitor the use of alcohol, cigarettes or illicit substances.

1.8 Definition Operational

Despite using controlled testing techniques, there may have been some environmental variances among the examined teams. Each team conducted all their performance tests in the same setting for each data point for each test. Training is defined as an exercise programme which is designed to improve the skills of athletes and increase their energy capacities for a specific event. Sports training is the fundamental format of preparation for athletes. Sports training is a planned and controlled process in which changes in complex sports motor performance, ability to act and overall performance are achieved through various contents, methods and organisational measures to achieve a goal. Sports training is a scientifically-based and pedagogically-organised process that aims to improve an athlete's performance ability and overall performance improvement, ultimately leading to success in competition (Fox, 1984).

Plyometrics are training drills that are meant to build in athletes the ability to bridge the gap between pure strength and the power necessary to perform explosive reactionary actions, which can be seen in sports such as leaping, throwing and sprinting. According to Wilt, the word "plyometric" is derived from the Greek word "Plethgeis", which means to increase and "ometric" implies the same length.

Plyometric exercises are those in which athletes strive to improve the performance of the next activity by performing a forced eccentric contraction such as a drop from a height (Bedi et al., 1987).

CHAPTER 2
REVIEW OF THE LITERATURE

2.1 Introduction

Athletes are required to improve physical performance in basketball games in order to develop speed, strength, agility and endurance due to specific demands and characteristics of the game. For this reason, it is essential to focus on both strength training and endurance training under an integrated approach so that the performance of basketball players can be improved (Zweifel, 2017). Since there are very little studies conducted on the effectiveness of medicine ball training in improving basketball performance, this study aimed to fill this gap in research by focusing on its importance and contribution to this sport. Previous research mainly focused on vertical jumps and did not consider locomotion on physical performance and skill performance. Therefore, this research focused on the importance of medicine ball training in improving the quality of physical performance, which could enhance basketball performance (Dobbs et al., 2015).

Research shows that lateral movement is helpful in improving speed, performance and endurance in basketball games (Zweifel, 2017). Conditioning exercise increases a broader range of fitness variables. During a six-week training intervention, resistance training can improve speed (Nur Iman Bin Md Rahim & Oleksandr Krasilshchikov, 2015). Furthermore, incorporating the use of a medicine ball can further enhance the physical abilities required for basketball. According to Wang and Zhang (2016), using a medicine ball in training sessions can help improve explosive power, which is essential for basketball players. Focusing on specific training methods can improve the physical performance and basketball skills of basketball players. To address the research gap in this area, this study focused on the

effectiveness of medicine ball exercises in improving both physical performance and related game skills in basketball players.

2.2 Medicine Ball

The medicine ball was originally designed by Robert Jeffries in 1895 as a training tool for athletes. Since then, the ball has been recognised as a critical tool for training athletes. Nowadays, the ball is typically used with weights ranging from one to six kilograms for various exercises and drills. However, larger medicine balls weighing up to twelve kilograms are used by football players for training to enhance their physical performance (Ravi & Divya, 2019). Most exercises involving medicine ball usually involve throwing, catching and lifting the ball. To perform these activities effectively, athletes need to engage the core muscles, which include the gluteal, spinal erector, and abdominal muscles (Van Den Tillaar & Marques, 2013; Vincent, n.d.). These muscles are often referred to as the power zone of the human body as they generate force and power that can be transferred to other extremities. Basketball players can significantly benefit from strengthening their core muscles since the sport involves running at high speeds, jumping vertically and horizontally, and generating speed at high intensity within a short period.

In this context, it was hypothesised that an integrated training program comprising strength and endurance training in conjunction with basketball practice could improve athletes' performance (Santos & Janeira, 2008). Medicine ball exercises can help to build core strength (Vincent, n.d.) by focusing on specific strengths during workout sessions to enhance overall power. Moreover, some medicine ball exercises augment explosive movements such as horizontal jumps and resistance training that can enhance muscle architecture and endurance, which are important in basketball (Thomasian, 2015). To promote practical training using the medicine ball, sports

experts have designed some guidelines to inform the practice (Bompa & Haff, 2009; Ferguson, 2009). The first step involves using medicine balls of varying sizes and weights. Secondly, before commencing the training session, the trainer must explain all procedures to athletes regarding all exercises that need to be performed. The third step involves all the athletes undertaking activities to get warmed up sufficiently before engaging in the training session. These guidelines were followed strictly in this study. Training sessions should begin with lighter activities with low-weight balls and gradually advance to more strenuous exercises with high-weight balls (Ferguson, 2009). Additionally, the trainer should design an exercise plan that involves all parts of the body.

2.3 Patterns of the Medicine Ball

Different patterns are followed in medicine ball training to target specific muscle groups and improve athletes' power output. A study conducted by Ikeda et al. (2007) analysed the effects of fast side medicine-ball throw (FS-MBT) and side medicine-ball throw (S-MBT) on the physical abilities of male and female athletes in various sporting activities. The findings of the study showed that S-MBT was a better option for improving athletes' fitness, including basketball players' strength, endurance and agility (Davis et al., 2008). The overhead throw was determined as a valuable contributor to develop the strength of upper body, which is vital to enhance the performance of basketball players. Thus, this study focused on analysing the effectiveness of the S-MBT method in the context of medicine ball training.

2.4 Medicine Ball Exercise Vs. Other Exercises

Ebben (2002) stated that plyometric training is more effective than medicine ball training for improving muscle power. Similarly, (A. D. Faigenbaum et al., 2007) conducted a study involving young boys aged 12 to 15 who were given plyometric training. In comparison to individuals who followed other exercise regimens, these young boys exhibited better physical health and fitness levels. However, a recent study by Ignjatovic et al. (Ignjatovic et al., 2012) stated that medicine balls play an essential role in strengthening athletes' muscles. Similarly, (Meylan et al., 2010a) observed that medicine ball training is more effective than other approaches, which is why many athletes, fitness centres, physiotherapists and gyms are increasingly buying medicine balls. The inconsistency in findings could be due to the age group of participants, the aim of the study, and the specific muscle groups targeted by a training program. Additionally, The combination of medicine ball training with weight training not only can strengthen explosive power, but also can drastically improve hand-eye coordination, core strength, ability to change direction quickly, and develop arm and leg muscles, thus enhancing overall athletic performance within a limited training space. Other training methods such as plyometrics are unable to provide the same benefits as medicine ball training, even when combined with gym training.

2.5 Effectiveness of Medicine Ball

Cordasco et al. (1996) stated that the use of a medicine ball during rehabilitation can enhance the recovery process and yield better results. Another study was conducted on high school subjects to examine the effects of medicine ball training on them. The findings of the study showed that the experimental group subjects passed the fitness test with a higher ratio than the control group subjects. The data demonstrated that medicine ball training can enhance muscles strength, running,

jumping and push-up skills, thus improving overall physical health (Faigenbaum & Mediate, 2006). The authors also found that kindergarten-aged children who received medicine ball training experienced significant improvement in their muscle strength. Therefore, they recommended the incorporation of medicine ball training into athletes' training sessions to enhance their physical health.

Similarly, Ignjatovic et al. (2012a) conducted a study on young female handball athletes who were randomly grouped into control and experimental groups. The experimental group received twelve weeks of medicine ball training, after which their muscle strength and power were tested. The results showed that the participants in the experimental group were more energetic and physically fit, thus providing evidence that using a medicine ball in sports training can yield positive results in enhancing athletes' performance. Earp and Kraemer (2010) stated that medicine ball training can improve muscle strength, particularly in the rehabilitation process.

2.6 Understand the Basketball performance and physiological demands

Basketball is a sport that requires specific skills to be performed under dynamic conditions. Successful basketball players need to possess high levels of strength, power and agility while maintaining a relatively lean body composition. This study aimed to investigate scientific data on the structural and functional demands of elite basketball players and establish the physiological profile of successful athletes. To achieve success in basketball, players need to focus on developing strength, agility and power through short and intense workouts. Research has shown that elite players have faster agility and sprint times than average players. While strength, power and agility may predict basketball success, endurance is also a critical component in the sport. Both aerobic and anaerobic systems contribute to the overall energy demands of basketball (Montgomery et al., 2010).

2.7 Developing the fitness in Basketball – plyometric

Plyometric training is commonly used in team sports such as football, rugby, basketball and handball to improve physical fitness. To date, no study is conducted to examine the effects of different training protocols on the physical fitness of team sport athletes. During an intermittent team game, players perform a variety of explosive movements such as kicking, tackling, jumping, turning, sprinting as well as changing pace and direction. Plyometric training (PT) is a stretch-shortening cycle operation that occurs during the transition from a rapid eccentric muscle contraction to a rapid concentric muscle contraction. SSC tasks take advantage of connective tissue and muscle fibre elastic properties by allowing the muscle to accumulate elastic energy during the deceleration/negative phase and release it later during the acceleration/positive phase.

Plyometrics, which are also known as jump training or plyos, are exercises that focus on producing the most muscle force in the shortest amount of time to improve speed and power. With a PT frequency of two sessions per week, short PT programmes have proven to be effective in groups of individuals with varying physical fitness levels and sport experience. Some studies have shown a slight increase in jump height (Hnlein & Mu¨ller, 2014), sprint performance (Arazi & Asadi, 2011; Chelly et al., 2015; Asadi et al., 2017) and agility (Siegel, 2008a).

2.8 Theory related to plyometric training

The premise of plyometric training is based on the concept that muscles can develop maximum force during rapid eccentric contractions. However, muscles rarely perform a single type of contraction in isolation during athletic movements (Zisis, 2013). The force generated by a muscle can be dramatically increased when a concentric contraction (muscle shortening) occurs immediately after an eccentric

contraction (Flanagan, 2009). This phenomenon is known as the stretch-shortening cycle (SSC) and it is the fundamental mechanism of plyometric training.

2.9 Related study to the loading parameters in plyometric training

Plyometrics is a type of resistance training that includes a rapid eccentric contraction and is followed by a rapid concentric contraction to produce a quick, powerful movement. Before beginning plyometric training, athletes must have a certain level of basic strength. Plyometric training is one of the regimens designed to improve an athlete's strength and conditioning (Brini et al., 2020). It plays a significant part in the final phase of a rehabilitation programme, which attempts to improve athletic performance.

Plyometric training consists of three phases. The first phase, which is also known as the preload or facilitative phase, is characterised by the stretching of the muscle at the musculotendinous junction. In the concentric phase, the energy stored throughout this phase is released. The second phase, which is known as the amortisation phase, entails a brief delay between the first phase and the third and final phase, which is the concentric shortening phase. By utilising the biomechanical features of pre-stretched muscles, the concentric phase entails quick power output. These three phases are combined to improve muscle performance (Singla et al., 2018). In this study, it was expected that there would be a substantial difference between the two groups with regard to the improvement of basketball players' strength, running speed (Felder et al., 2014) and agility (Asadi, 2013). According to the studies, plyometric training has a positive impact on a variety of sports performance-related indicators (Fernandez-Fernandez et al., 2016).

2.10 Effects of Medicine ball on Performance – Basketball

The Basketball Plyo Push-Ups can help basketball players learn how to transmit and receive force effectively and efficiently. Mastering this workout can result in faster and more explosive hand movements and a stronger upper body. Meanwhile, the Medicine Ball Wall Throws drill is excellent for improving hand-eye coordination and can significantly enhance a player's ability to pass, catch and control the basketball. When combined with increased upper body strength, these exercises can lead to improved passing and catching skills on the court (Hernández et al., 2018).

The Medicine Ball Rotational Side Wall Throws Drill is another excellent strength workout that every basketball player should master. It promotes hand-eye coordination, which is essential to become a competent basketball player. Additionally, it substantially enhances core strength and ability to change direction quickly. Medicine Ball Slam is an excellent upper-body strength and power-building exercise for basketball players. This exercise is fantastic since it can be performed in a very small area and can enhance athletic performance (Andrejić, 2012).

Like other forms of therapeutic exercise, safe and successful therapies involving plyometrics require doctors to be conversant with applicable neuromuscular physiologic concepts. The utilisation of plyometrics as a training strategy is based on two key dynamic properties of muscle tissue: elasticity and contractility. Along with neuromuscular control, strength and flexibility, these tissue properties determine the capacity of working muscles to generate more (or maximum) force in a brief period (Hernández et al., 2018, 2018): Mediate, 2006; Siegel, 2008a). In fact, most of the early physiology studies pertinent to plyometrics identified a muscle activity known as the stretch-shortening cycle. The SSC is now the physiologic hypothesis which is

based on plyometrics (Maulder & Cronin, 2005; (Zisis, 2013, 2013); (Usgu et al., 2020).

CHAPTER 3
METHODOLOGY

3.1 Introduction

In this section, the research methodology was conducted. A 8-week medicine ball training study was conducted to investigate significant physical and skill performance differences. The method chosen for collecting data was experimental, with two groups formed: the Control Group (CG) and Experimental Group (EG). The experimental group was used to collect data, while the control group was made to compare the collected data.

3.2 Research Design

This study employed a two-group, randomised, experimental design, with subjects completing an eight-week training intervention. The participants were thoroughly informed about protocols of the study and were asked to sign an informed consent form, with the approval of the University of Human Research Ethics Committee. This study undertook an experimental approach, where participants were required to undertake medicine ball exercises for eight weeks. With reference to the results of the Northern Province Basketball championships and Department of Sports and Basketball Associations tournaments during the last five years, 200 basketball players from five districts meet the inclusion and exclusion criteria for selection.

A total of 28 participants were chosen for this study. The selection was determined using G-Power software to require 22 subjects plus a 20% dropout rate, resulting in six subjects dropped and a total of 28 subjects for this study. Before conducting the baseline test (Pre-Test), the recruited participants were randomly assigned to two groups, which were Experimental Group (EG) and Control Group (CG) with fourteen athletes in each group. Prior to the intervention, the Experimental

Group (EG) participated in two familiarisation sessions in one week. Both groups took part in the baseline test (Pre-test). After four weeks, both groups participated in the mid-test during the intervention period. After completing the 8-week training session, all the participants took part in the post-test. The performance tests for the experimental group (EG) were performed to determine the effectiveness of the medicine ball exercises. The Control Group (CG) was included to compare performance data with the collected data.

3.3 Data Collection

3.3.1 Ethical Approval

Prior to participating in the study, all subjects were provided with an informed consent form that contained information about their right to make choices and the importance of minimising or avoiding harm in research (Ochieng, 2012). The participants signed the form upon agreeing to take part in the study. They were briefed on the potential benefits and risks associated with the study. To ensure confidentiality, all participants who took part in the survey remained anonymous. The study was approved by the University of Human Research Ethics Committee under JEPeM Code: USM/JEPeM/21060489 on 21 October 2021, with the approval letter being attached in Appendix 8.7.

3.3.2 Ethical Consideration

Participants who met the inclusion criteria were provided with a full verbal and written explanation of the study procedures. They were also informed of right to withdraw from the study at any time without penalty. All participants provided informed consent if they wished to participate. To protect participant privacy, all personal information was de-identified and stored on a secure database maintained by

the university. The findings of the study would only be used for research purposes and would not be disclosed to any third parties.

The participants were able to receive a copy of their individual and findings of the study if they requested to have the findings. The researcher complied with ethical standards outlined by the Ethics Advisory Committee and treated all participants with courtesy and respect. The researcher would also make himself available to address any questions and concerns that participants might have about the study. The participants were protected through the design of the study. The project might be published in scholarly journals. Nevertheless, the participants were assured of complete confidentiality of the data gathered, and their identity would never be made public.

3.3.3 Research Location

This study was conducted in Sri Lanka, where basketball players were selected to participate in the study. The study was conducted in the Northern Province of Sri Lanka, with testing protocols for both groups being conducted in the same environment and place. All participants selected for the study were adult male athletes.

3.4 Sample Size and Population

3.4.1 Sample Size

The methods for collecting the sample size involved 6 stages of a step-by-step approach, which was designed to ensure that the conclusions were reached after considering every basketball player in the Northern Province of Sri Lanka aged between 18 and 24 years.

The first stage in the sampling procedure was to identify and define the target population. The sports officers and the basketball coaches identified and collected players who are still actively participate basketball.

The Department of Sports, Northern Province, and Basketball Associations have compiled a database of basketball players for the last five years. In addition, circulate recruitment posters for research participants to all sports clubs, playing groups. Resulting in a total of 375 basketball players identified from the population (n=375).

The second stage was to select a sample frame. Eligible participants aged between 18 and 24 years who met the inclusion requirements were included in the sampling frame. Therefore, the sampling frame consisted of everyone whose name appeared on the player's list of a constituency (n=200).

The third stage was to pick a sampling technique. Probability sampling methods were employed in this study by simple random selection. This is because each subject has equal worth, and rights and any individual may be included in the sample regardless of caste, community or religion. Throughout the Northern Province, various samples were collected from various regions.

The fourth stage was to determine the sample size. The number of subjects to be taken in a sample would be sufficient to draw inferences regarding the population with specific accuracy and precision (n=200). Finally, 200 basketball players were selected throughout the filtering process by simple random selection.

The fifth stage involved selecting the sample size via the use of G*Power software Version 3.1.9.2, which determined the necessary sample size to be (n=22) with a 20% dropout rate (n=6), resulting in a total sample size of 28 (n=28).

The final stage sample size was gathered by simple random selection using the website (https://www.randomizer.org/) and was divided 28 into two groups: the control group (CG) and experimental group (EG), with 14 participants in each group. The sampling method used in this study was simple random selection of the population

(Sharrock et al., 2011) using the website (https://www.randomizer.org/) and was implemented using the G*Power software Version 3.1.9.2 (Faul et al., 2007).

In this study, a sample of twenty-two participants were randomly chosen from a population of 200 with a 20% dropout rate, which resulted in a total sample of 28 subjects. Participants who had played basketball at the provincial level within the past five years were identified through the Department of Sports, Northern Province, and the recruitment was conducted via social media posters. (Faul et al., 2007; Urbaniak, G. C., & Plous, 2013)**.** Simple random selection was used, which is an acceptable method for studies with a sample size of 14% or less (Delice, 2001). However, randomisation was limited to the selection of two groups only (Delİce, 2001)**.**

The participants of this study were involved in field-based activities with a strong basketball component and regular resistance training during the study period. The experimental group received medicine ball training twice a week in addition to their routine training. Both groups followed the same protocol. The training lasted for an hour, including warm-up and cool-down periods. Prior to participation, the participants were screened for injuries and underwent a medical check-up to ensure they were physically fit.

The study aimed to recruit basketball players from Sri Lanka's Northern Province who had participated in the Northern Provincial Sports Festival and Basketball Association tournaments over the last five years. Around 200 basketball players met the selection criteria. Given the relatively small sample size, simple random sampling was used to select 22 participants from this population for the study.

ANOVA: Repeated measures, within-between interaction

Analysis: A priori: Compute the required sample size

Input:	Effect size f	=	0.36
	α err prob	=	0.05
	Power (1-β err prob)	=	0.95
	Number of groups	=	2
	Number of measurements	=	3
	Corr among rep measures	=	0.5
	Nonsphericity correction ε	=	1
Output:	Noncentrality parameter λ	=	17.1072000
	Critical F	=	3.2317270
	Numerator df	=	2.0000000
	Denominator df	=	40.0000000
	Total sample size	=	22
	Actual power	=	0.9549318 (Faul et al., 2007)

Randomization process using randomizer software “https://www.randomizer.org”

Research Randomizer Results: 2 Sets of 14 Yes Numbers Per Set:
Range: From 1 to 200

Set 1 (CG)

Numbers: 160, 198, 25, 48, 23, 166, 199, 120, 118, 89, 127,115, 2, 103

Set 2 (EG)

Numbers: 61, 139, 67, 108, 68, 72, 144, 146, 132, 186, 91, 6, 1, 138

3.4.2 Participants

A total of 28 adult athletes voluntarily decided to participate in this study. They were randomised and divided into the experimental group (EG) and the control group

(CG). Fourteen participants were allotted in each group, which was conducted online at the website (https://www.randomizer.org). All participants were asked to check the essential anthropometric characteristics necessary for this study. The participants were all male basketball players aged between 18 and 24 (Age21 ± 3).

3.4.3 Inclusion Criteria

The study population was male adult athletes who had experience in playing basketball. The population selected had a minimum of two years of training experience, actively participated in sports, and competed in the provincial-level basketball competitions. The selected athletes were aged between 18 and 24, basketball players, and had passed the PAR-Q pre-screening process. The medical screening check-ups were conducted to ensure that all participants were physically fit and had no injuries.

3.4.4 Exclusion Criteria

The participants who had the experience of less than two years were excluded from the study. Those with less than two years of training were excluded from the intervention and would not participate in 25% of the training. The participants who did not play basketball were also excluded. If the participants undergo any major operation, they would also be excluded. The researcher informed the participants that they could withdraw from the study at any time without any penalties. Anyone who failed to complete the PAR-Q pre-screening would be excluded.

3.5 Training Methods

This study used an experimental approach to address the problem, in which participants were required to undertake medicine ball exercises for eight weeks. All participants completed a baseline examination before the intervention (pre-test). Both