Research Protocol

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Efficacy of Kettlebell Exercise Regimen to Improve Strength and Cardiorespiratory Function among 200-metre Sprinters: A Research Protocol

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ABSTRACT

Introduction: A kettlebell is a cast-iron or cast-steel weight with a handle, resembling a cannonball. It gained popularity in 2015 and is now widely used in fitness routines. Dumbbell training is also beneficial for strength training in sprinters. Dumbbell exercises are used for specific muscles, but kettlebell exercises provide overall body strength, which is beneficial for sprinters. The present study will compare a dumbbell exercise with a kettlebell exercise.

Need of the study: Kettlebell exercises provide several benefits by engaging multiple muscle groups simultaneously, whereas dumbbell exercises typically target specific muscles. While previous studies have highlighted the advantages of kettlebell training, limited research has compared its effectiveness to dumbbell exercises in sprinters.

Aim: This study focuses on kettlebell exercises and their effects on improving the strength and cardiorespiratory function of 200-metre sprinters, compared with dumbbell workouts.

Materials and Methods: This study will be a randomised controlled trial conducted in the sports premises of Subharti University, Meerut, India from March 2025 to September 2026. Participants will be randomly assigned to two groups: Group-A and Group-B. Group-A will engage in a series of kettlebell exercises, while Group-B will continue their regular exercise regimen, which consists of dumbbell exercises. To assess strength, the investigators will utilise the bench press test and the sit-up test. Additionally, the home step test will be employed to evaluate cardiorespiratory function. The Shapiro-Wilk test will be used for data normality. The paired t-test will be employed for comparisons within groups, while the independent t-test will be applied to compare between groups. A p-value will be considered statistically significant if it is less than 0.05.

Keywords: Athletic performance, Cool-down exercise, Sports, Warm-up exercise

INTRODUCTION

Functional training, often referred to as resistance training, encompasses a range of exercises that mimic everyday activities. This type of training utilises various equipment such as resistance bands, medicine balls, heavy truck tires, ropes, dumbbells, and kettlebells [1]. Dumbbell training enhances strength, balance, and coordination. While dumbbell exercise alone does not increase speed, combining it with other activities can improve it. Sprinting requires significant hip power for acceleration, which dumbbell training provides only to a limited extent [2]. In contrast, kettlebell training, especially through swings and cleans, generates greater hip power and supports the acceleration needed for sprinting. To enhance elite fitness within an athletic group, kettlebell training is utilised as a substitute for free weights and weight machines, as it is gaining popularity. Kettlebells are often referred to as 'girya'. They can be described as a cast-iron weight with a handle. Engaging in daily kettlebell workouts offers resistance and heightens cardiovascular exertion. For beginners, the fundamental exercise is the kettlebell swing, which involves rapid eccentric and concentric contractions of the hips [3].

The Kettlebell Lunge Clean (KLC) is an exercise that helps to instruct a powerful lifting technique. It enhances lower body strength, core stability, and reactive power. The Kettlebell (KB) thruster aims to boost enhancing stability and force generation in both the hip and shoulder complexes. Additionally, it serves as a multi-joint exercise [4]. The KB thruster combines a traditional squat with a dynamic movement. The overhead press can be performed either in a standing or sitting posture. This demanding exercise activates the muscles and joints of the shoulder region, upper arm, forearm, and hand. The early stage of the overhead press is crucial, as it requires precise flexion and internal rotation of the shoulder joint for optimal performance [5,6].

The kettlebell consists of a round weight with a handle attached that extends from the top, resembling a tea kettle, which is how it got its name. In contrast to most weights like dumbbells and barbells that have their handles positioned through the center of mass, the kettlebell has its handle placed off-center. This unique design allows for a variety of specific exercises, including the snatch, clean and jerk, bottoms-up carry, and kettlebell swing [7].

Kettlebell workouts provide an affordable option to engage various muscle groups through functional movements that can be done at home and serve as a substitute method to improve aerobic capacity and power, as well as maximal and explosive strength, in fitness and athletic performance settings [8].

REVIEW OF LITERATURE

Sprinters need high muscular strength and effective cardiorespiratory function to sustain repeated high-intensity efforts during both training and competition. While sprinting is mainly anaerobic, cardiorespiratory fitness helps with oxygen delivery, recovery, and fatigue resistance. Kettlebell training is increasingly popular in sprint conditioning because of its dynamic, ballistic, and multi-joint movements, which can boost strength and place significant cardiovascular stress [3]. Conversely, dumbbell exercises tend to be more controlled and may produce different physiological effects. This study will therefore focus on sprinters to compare the effects

of kettlebell training and dumbbell exercises on strength and cardiorespiratory health.

Kartages K et al., conducted a study on 20 healthy participants (12 male and 8 female). The participants were from a sports background, including soccer, rugby, basketball, track and field, and martial arts. The study demonstrated that Kettlebell Swings is not effective for potentiating 20-m sprint performance; Thus, any potential benefit from the inclusion of Kettlebell Swings is considered a preconditioning exercise. Individual strength capabilities are influenced by sprinting [9].

Chen HT et al., investigated a study that included samples from the community centre and research centre. A total of 33 women with sarcopenia (aged 65-75 years) were recruited. The KT group received an 8-week intervention, 60-minutes sessions twice a week, whereas the control group performed their daily routine workout. The study concluded that the kettlebell training significantly improved the sarcopenia index, grip strength, and back strength [10].

An experimental study by Falatic JA and Plato PA investigated the effects of high-intensity kettlebell training on cardiorespiratory fitness. Seventeen female collegiate soccer players participated in a 4-week kettlebell snatch training programme, performed three times per week. The results demonstrated a significant improvement in VO_2max following the intervention, suggesting that kettlebell training can promote cardiovascular adaptations in addition to strength development [11].

Jay K et al., conducted a study to assess the effects of kettlebell resistance training on physical fitness and cardiovascular health. Forty recreationally active adults were assigned to either a kettlebell training group or a control group for eight weeks. The kettlebell group showed significant gains in muscular strength, along with reduced perceived exertion and fatigue, and signs of improved cardiovascular efficiency. The authors concluded that kettlebell training effectively enhances strength and may offer cardiorespiratory benefits due to its dynamic, continuous movements [12].

Thus, this study aims to focus on kettlebell exercises and their effects on improving the strength and cardiorespiratory function of 200-metre sprinters, compared with dumbbell workouts.

Primary objectives:

1 To evaluate kettlebell exercise effects on improving strength and cardiorespiratory function of 200-metre sprinters.

2 To evaluate dumbbell workouts effects on improving strength and cardiorespiratory function of 200-metre sprinters.

Secondary objective:

1. To compare the effects of kettlebell exercise and dumbbell workout on improving strength and cardiorespiratory function of 200-metre sprinters.

Null hypothesis (H_0) There will be no significant improvement in the efficiency of a kettlebell workout regimen for boosting strength and cardiorespiratory ability in 200-metre sprinters.

Alternate hypothesis (H_1) There will be a significant increase in the efficacy of the kettlebell exercise regimen for developing strength and cardiorespiratory function among 200-metre sprinters.

MATERIALS AND METHODS

This study will be a randomised controlled trial, conducted in the sports premises of Subharti University, Meerut, India, from March 2025 - September 2026. The ethics committee of Galgotias University has granted approval for the protocol (protocol ID: SEC/SAHS/PHD/24/03). This research has been recorded in the clinical trial registry, and the reference number is CTRI/2025/03/082260. Prior to commencing the intervention, all participants who meet the criteria will be required to sign a consent form, which will be provided in English, and the primary researcher will ensure that confidentiality is maintained. The intervention will commence once all assessments have been finalised and all demographic information and baseline measurements have been collected.

Inclusion criteria:

- 200-metre sprinters;
- Both gender (male and female);
- Age group between 18-25 years;
- University level students.

Exclusion criteria:

- Any recent surgery (anterior cruciate ligament, posterior cruciate ligament, or medial collateral ligament repair/reconstruction);
- Systemic disease;
- Recent disease that can limit sprinter performance.

Sample size calculation:

Formula use for sample size: $2\ (Z_{\alpha/2}+Z_{\beta})^2/d^2$

Group-1 mean- 86, SD- 20

Group-2 mean- 114, SD - 33 [13],

Effect size(d) - $(M_2- M_1)/SD_{pooled}$

SD pooled= $\sqrt{SD_1^2+SD_2^2/2}$

$= \sqrt{744.5} \approx 27.29$

$d=(M_2-M_1)/SD_{pooled}$

$=1.02$

Two-tailed, Effect size is 1.02, Alpha is 0.05, Power is 0.95

Sample size=$2\ (Z_{\alpha/2}+Z_{\beta})^2/d^2$

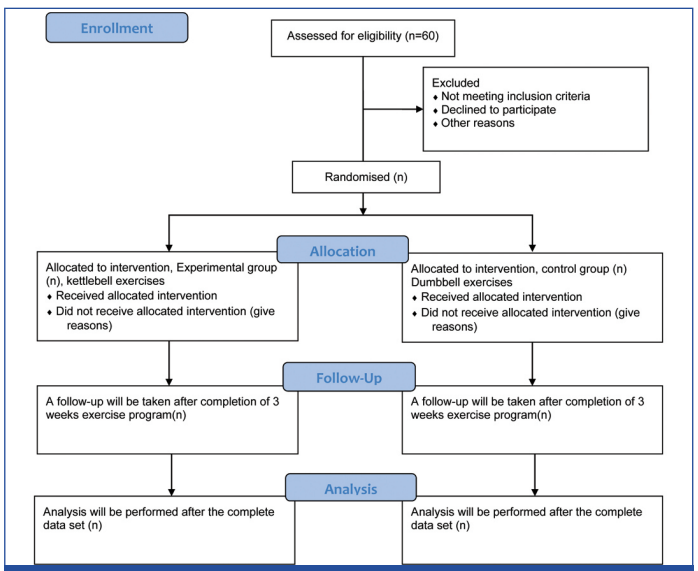
$=2\ (1.96+1.645)^2/(1.02)^2$

$2\ (3.605)^2/(1.02)^2=2\times13.00/1.04=25.00$

The total sample size will be 50. To account for potential dropouts, a 20% increase was applied, giving a final sample size of 60 participants.

Participants will be randomised using simple randomisation. Allocation concealment will be ensured using sequentially numbered, opaque, sealed envelopes. The faculty member from the Department of Physical Education will generate and implement the randomisation sequence [Table/Fig-1]. The data analyst will be blinded.

Participants will carry out their regular workout regimen, Group-A kettlebell exercises [Table/Fig-2] and Group-B dumbbell exercises [Table/Fig-3]. Group-A male participants will be compared with Group-B male participants, and consequently, with the female participants. To avoid tiredness, athletes perform Cool-down exercises after completing their entire workout [Table/Fig-4]. Each participant will receive treatment three times a week for three weeks.



[Table/Fig-1]: CONSORT flow chart.

Three-Week Exercise Protocol			
S. No.	Exercises	Sets	Repetitions
1.	Kettlebell thruster	3	10
2.	Kettlebell swing	3	10
3.	Kettlebell goblet squat	3	10
4.	Kettlebell lunges clean	3	10
5.	Kettlebell overhead press	3	10

[Table/Fig-2]: Group A (Experimental—Kettlebell Exercises): These exercises will be performed according to one-Repetition Maximum (1RM) (4 kg for females and 6 kg for males).

S. No.	Exercises	Sets	Repetitions
1.	Dumbbell deadlift	3	10
2.	Dumbbell bent over row	3	10
3.	Dumbbell bicep curl to press	3	10
4.	Dumbbell lateral flies	3	10
5.	Single-arm dumbbell clean	3	10

[Table/Fig-3]: Group-B (Control- Dumbbell exercises) These exercises will be performed according to one-Repetition Maximum (1RM) (4 kg for females and 6 kg for males).

S. No.	Warm up	Cool down	Sets	Repetitions
1.	Pre- workout stretch with TheraBand	Post- workout stretch with TheraBand	3	10
2.	Wrist, elbow, shoulder, ankle, knee and hip circles	Arm and leg swings	3	10
3.	Jumping Jacks	Walking knee hugs	3	10
4.	Lunges	Butt kicks	3	10
5.	Curl- up	Cross- body toe touch	3	10

[Table/Fig-4]: Warm-up and cool-down exercises (used for relaxation and prevention of fatigue).
TheraBand exercises are used in both the warm-up and cool-down phases. During the warm-up, they are performed as dynamic, repetition-based movements, whereas during the cool-down, they are performed as static, duration-based stretches

Group-A (Experimental group)

In the experimental group, participants will engage in kettlebell exercises, which include the kettlebell thruster, kettlebell swing, kettlebell goblet squat, kettlebell lunges clean, and kettlebell overhead press. Prior to the exercise sessions, investigator will assess the athletes' strength and cardiorespiratory fitness using sit-ups, bench press tests, and home step tests. Also, conduct these assessments again after the 3-week intervention period to evaluate any improvements in strength and cardiorespiratory fitness. The exercise sessions will be conducted three times a week, lasting approximately 60 minutes with 30 seconds rest, including warm-up and cool-down activities [10].

Group-B (Control Group)

In the control group, the athlete will engage in dumbbell exercises. They will begin with warm-up activities before doing dumbbell exercises and will conclude with cool-down exercises after completing all the workouts. Before the exercises, the athlete's strength and cardiorespiratory function will be assessed through sit-ups, bench press, and home step-up tests, which will be evaluated again after the entire treatment session, marking the end of the three-week protocol. Both groups will undergo pre- and post-treatment assessments [14,15]. It will be performed for 60 minutes with 30 seconds resting period [11].

Primary Outcome Measures

Bench press test for strength: This test will be evaluated based on the one-Repetition Maximum (1RM) and used to measure upper limb strength. The 1RM will be used to measure maximum active strength, such as the bench press, which includes the upper body exercises. The 1RM evaluates highest load a person can lift once in the correct posture [16]. During the examination, participants will be required to lower the bar to their chest without using a bouncing technique off the chest. They needed to push the bar until their elbows fully extended to ensure a valid lift. Participants will be given five minutes of passive recovery between each attempt [17].

Sit-ups for strength: This test will be designed to measure abdominal strength and the strength of the hip flexors. It will be performed on a flat, cushioned surface where the participant lies down. The individual tightens their abdominal muscles and bends their knees. Afterward, they attempt to touch their knees, and the best out of three attempts is counted [18].

Secondary Outcome Measures

Home step up test for cardiovascular fitness: It will be used to measure an athlete's cardiorespiratory and cardiovascular systems. For this test, the investigator will use a stepper and ask the participant to step-up and down as fast as possible for three minutes [19]. The follow-up will be assessed after completion of three weeks protocol.

STATISTICAL ANALYSIS

Data analysis will be conducted using version 16.0 of the statistical software (SPSS Inc., Chicago, IL). The data will be gathered and examined by the principal investigator. The Shapiro-Wilk test will be utilised to assess the normality of the gathered data. Descriptive statistics will be displayed as either mean ± standard deviation or median and interquartile range, depending on the normality of the data. The paired t-test will be employed for comparisons within groups, while the independent t-test will be applied to compare between groups. A p-value will be considered statistically significant if it is less than 0.05.

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