Effect Of Kettlebell Training with And Without Lower Limb Plyometric on Core Strength Explosive Power and Anaerobic Power

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***Abstract*—The purpose of the study was to find out the effect of kettlebell training with and without lower limb plyometric training on core strength, explosive power and anaerobic power. Forty-five male players of various games aged between 19 and 25 years were selected for the study. They were divided into three equal groups, each group consisting of fifteen subjects in which three experimental groups and one control group, in which the group I (n=15) underwent kettlebell training with lower limb plyometric training, group II (n = 15) underwent kettlebell training without lower limb plyometric training for three days (alternative days) per week for twelve weeks and group III, acted as control, which did not participate in any training apart from their regular game practice.**

The subjects were tested on selected criterion variables as on core strength, explosive power and anaerobic power at prior to and immediately after the training period.

For testing the core muscle strength was assessed by administering plank test, for measuring the explosive power, Sergeant jump was used and anaerobic power was assessed by administering 300 meters run. The analysis of covariance (ANCOVA) was used to find out the significant difference if any, between the experimental groups and control group on selected criterion variable separately. Since there were three groups involved in the present study, the Scheffé *S* test was used as post-hoc test. The selected criterion variables such as on core strength, explosive power and anaerobic power were improved significantly for all the training groups when compared with the control group. But there was no significant difference was found between the training groups.

Index Terms*—kettlebell training with and without low limb plyometric training, core strength, explosive power and anaerobic power.

I. INTRODUCTION

Humans have continually attempted to excel over one another in core muscle strength, height, strength, endurance, and skill. We aim for outstanding athletic achievement since humans are fundamentally competitive. Even with their charm and profound history, innovative methods rooted in insights and information obtained from hands-on experience, observation, and scientific research have surpassed traditional conditioning approaches. For an extended period, advancements in conditioning methods progressed slowly, but in recent years, significant improvements have led to remarkable performance enhancements (Boucher and Malina, 1993).

In recent years, athletic performance has seen remarkable enhancement. Achievement levels once considered unimaginable are now becoming standard, and the population of athletes able to deliver exceptional performances is growing. Athletics is a demanding sport, and commitment has led to extensive and exhausting hours of training. Coaching has advanced as a result of the efforts of sports experts and researchers. Sports science has transitioned from being descriptive to more scientific. An extensive body of knowledge about athletes is now accessible, influencing training techniques (Bompa, 1999).

Sports training is a methodical approach to athletic development grounded in science, allowing athletes to achieve extraordinary and record-setting performance through the gradual enhancement of mental and physical capabilities, skills, and motivation. Physical training is a crucial element of high-performance conditioning. Physical training aims to enhance an athlete's physiological capabilities and optimize biomotor skills to the highest achievable degree (Harre, 1982).

Sports coaching relies on a scientifically organized educational approach that influences performance capabilities and readiness for competition, aiming to enhance and refine athletic performance while participating in diverse sports events. A training plan is created to enhance an athlete's skill and stamina in readiness for a particular competition. At first, the athlete's ability to perform motor tasks with different levels of power, velocity, endurance, and proficiency to achieve both individual and collective actions—the categories of sports training technique reflected the intensity of sports training across all athletic competitions (Simon, Mihaila and Stanculescu, 2011).

A kettlebell is a weight made from iron or steel featuring a handle, resembling a cannonball. It can be utilized for various workouts, such as ballistic exercises that integrate strength, flexibility, and aerobic fitness. They function as the primary instruments in the weightlifting discipline referred to as kettlebell lifting. It is widely acknowledged that for improving muscle tone, body composition, and strength, machines that isolate muscles are less effective than kettlebell exercises, which involve comprehensive, full-body movements.

Kettlebells improve the strength of ligaments and tendons, leading to stronger joints that are more resistant to injuries. Strengthens every muscle from head to toe. Kettlebell workouts consist of movements that activate the whole body. It is broadly acknowledged that the complex, whole-body actions typical of kettlebell workouts are superior to machines focusing on specific muscles for improving muscle tone, body composition, and strength. Kettlebell workouts should be incorporated into the conditioning programs of all sports, not just those focused on strength. They enhance leg power; muscular strength and endurance will improve all sports. As athletes participate in heightened muscle contractions. That establish the components for the game, as a researcher specifically crafted kettlebell training program [Prabakaran and Sridar, (2016)].

Studies indicate that kettlebell (KB) training enhances lower body strength and power, endurance, and cardiorespiratory fitness, [Lake, and Lauder, (2012); Farrar, et al., (2010); and Otto, et al., (2012)], and also aids in various performance metrics, such as vertical jump, [Maulit, Archer, and Leyva, (2017)] and one-repetition maximum strength in exercises like deadlifts, squats, and power cleans.

The purpose of kettlebell training is to improve strength and power efficiency, which is commonly characterised as exercising the strength system. Kettlebell training combined with plyometric training have been demonstrated to predict strength and power efficiency, despite the fact that anaerobic workouts lasting forty to forty-five minutes are required.

II. METHODS

The goal of this study was to determine how kettlebell training with and without lower limb plyometric training, affected on core strength, explosive power and anaerobic power. 45 male students of different colleges who were enrolled in and around Hyderabad, Telangana District, during the academic year 2023–2024 were chosen as subjects to fulfil the goal. They were divided into three equal groups of fifteen each and further divided as two experimental groups and one control group, in which the group I (n=15) underwent kettlebell training with lower limb plyometric training, group II (n = 15) underwent kettlebell training without lower limb plyometric training for three days (alternative days) per week for twelve weeks, and group III (n=15) acted as control which did not participate in any special training apart from the regular physical and curricular activities.

There will be changes to the playing ability and systems with every training regimen. After consulting with the specialists, the researchers decided to use the following variables as criteria: 1. Core strength, 2. Explosive power and 3. Anaerobic power. To test the core muscle strength was assessed by administering plank test, for measuring the explosive power, Sergeant jump was used and anaerobic power was assessed by administering 300 meters run

III. ANALYSIS OF THE DATA

The differences, if any, between the corrected post test means on several criteria variables were examined independently using analysis of covariance. The Scheffé *S* test was used as a post-hoc test if the adjusted post-test mean's ‘F’ ratio was shown to be significant. To evaluate the ‘F’ ratio discovered using analysis of covariance, the level of significance was set at 0.05 level of confidence.

Table – I Analysis of Covariance and 'F' ratio for core muscle strength, explosive power and anaerobic power of kettlebell training with and without plyometric training groups, and control group

Variable Name	Group Name	Kettlebell Training with Lower Limb Plyometric Group	Kettlebell Training without Lower Limb Plyometric Group	Control Group	'F' Ratio
Core muscle strength (in Sec)	Pre-test Mean ± S.D.	0.414 ± 0.013	0.407 ± 0.015	0.402 ± 0.017	1.50
	Post-test Mean ± S.D.	0.459 ± 0.016	0.407 ± 0.02	0.402 ± 0.016	23.02*
	Adj. Post-test Mean	0.453	0.436	0.407	37.57*
Explosive power (in cm)	Pre-test Mean ± S.D.	0.209 ± 0.019	0.208 ± 0.018	0.208 ± 0.015	0.028
	Post-test Mean ± S.D.	0.237 ± 0.021	0.260 ± 0.016	0.204 ± 0.011	15.86*
	Adj. Post-test Mean	0.237	0.226	0.204	79.11*
Anaerobic power (in Sec)	Pre-test Mean ± S.D.	64.20 ± 1.37	64.93 ± 1.94	64.60 ± 1.92	0.65
	Post-test Mean ± S.D.	61.87 ± 1.13	62.33 ± 1.76	65.27 ± 2.82	12.44*
	Adj. Post-test Mean	62.156	62.061	65.20	21.28*

* Significant at .05 level of confidence. (The table value required for significance at .05 level of confidence with df 2 and 42 and 2 and 41 were 3.21 and 3.23 respectively).

Table – I shows that the core muscle strength pre-test 'F' ratio value of 1.50 was less than the necessary table value of 3.21 for significant with df 2 and 42 at 0.05 level of confidence. For the post-test mean and adjusted post-test mean 'F' ratio value of 23.02 and 37.57 for the adjusted post-test scores was greater than the necessary table value of 3.24 for significant. According to Table - I, the pre-test averages of explosive power 'F' ratio value of 0.028 was less than the necessary table value of 3.21 for significant with df 2 and 42 at 0.05 level of confidence.

For post-test and adjusted post-test mean 'F' ratio values of explosive power were 15.86 and 79.11 was greater than the necessary table value of 3.24 for significant. The anaerobic power pre-mean values 'F' ratio value was 0.65 which was insignificant. For and post-test and adjusted post-test mean 'F' ratio values of anaerobic power was 12.44 and 21.28 was greater than the necessary table value of 3.24 for significant. Further, to find out which training group has significant improvement on selected criterion variables, Scheffe *S* post-hoc test was applied and presented in table – II.

Table – II Scheffẽ S Test for the difference between the adjusted post-test mean of core muscle strength, explosive power and anaerobic power

Kettlebell Training with Lower Limb Plyometric Group	Kettlebell Training without Lower Limb Plyometric Group	Kettlebell Training with Lower Limb Plyometric Group	Mean Difference	Confidence Interval at 0.05 level
Adjusted Post-test Mean for Core muscle strength				
0.453	0.436	…	0.017*	0.014
0.453	…	0.407	0.046*	0.014
…	0.436	0.407	0.029*	0.014
Adjusted Post-test Mean for Explosive power				
0.237	0.226	…	0.010*	0.006
0.237	…	0.204	0.032*	0.006
…	0.226	0.204	0.022*	0.006
Adjusted Post-test Mean for Anaerobic power				
62.156	62.061	…	0.095	1.41
62.156	…	65.250	3.094*	1.41
…	62.061	65.250	3.189*	1.41

* Significant at 0.05 level of confidence.

IV. RESULTS

The adjusted post-test mean difference in core muscle strength between kettlebell training with lower limb plyometric group and kettlebell training without lower limb plyometric group, kettlebell training with lower limb plyometric group and control group and kettlebell training without lower limb plyometric group and control group was 0.017, 0.046 and 0.029, respectively, and these differences were significant at the 0.05 level of confidence, according to Table II. Based on the study's findings, it can be said that between kettlebell training with lower limb plyometric group, kettlebell training with lower limb plyometric group boosts the core muscle strength ability. Moreover, kettlebell training with lower limb plyometric group has significant improvement in core muscle strength than the kettlebell training without lower limb plyometric group.

The adjusted post-test mean difference in explosive power between kettlebell training with lower limb plyometric group and kettlebell training without lower limb plyometric group, kettlebell training with lower limb plyometric group and control group and kettlebell training without lower limb plyometric group and control group was 0.010, 0.032, and 0.022, respectively, and these differences were significant at the 0.05 level of confidence, according to Table - II. said that between kettlebell training with lower limb plyometric group, kettlebell training with lower limb plyometric group boost the core muscle strength ability. Moreover, kettlebell training with lower limb plyometric group has significant improvement in explosive power than the kettlebell training without lower limb plyometric group.

The adjusted post-test mean difference in anaerobic power between kettlebell training with lower limb plyometric group and control group and kettlebell training without lower limb plyometric group and control group, was 3.094 and 3.189 according to Table - II. The table II also indicate that there was no significant difference was occurred between the training groups (0.095).

Based on the study's findings, it can be said that serial training practice group and parallel training group considerably boost the LBM.

V. CONCLUSIONS

The results of the study reveal a significant enhancement in core muscle strength after kettlebell training combined with lower limb plyometric exercises and kettlebell training alone. Beltz et al. (2013), Seethalakshmi and Suresh (2023), and Parasuraman and Mahadevan (2018) found that the kettlebell training solo regimen led to a significant enhancement in core muscle strength. The training groups showed no significant differences in core muscle strength.

According to the results of the study, it was found that the kettlebell combined with plyometric and kettlebell training regimen greatly enhanced vertical jump performance. Kim, Jaber, and Yim (2024) observed a notable enhancement in vertical jump following the integration of a kettlebell and plyometric training regimen. Researchers Maulit et al. (2017) and Meigh et al. (2022) found that the kettlebell program greatly enhanced vertical jump performance. Additionally, a notable difference was observed among the training groups, particularly in favor of the combined kettlebell and plyometric training group.

The results of the study indicated a significant enhancement in anaerobic power after the treatment that involved both kettlebell and plyometric exercises, as well as with plyometrics alone. Rufo-tavares et al. (2019) discovered a notable enhancement in anaerobic power following kettlebell training. As stated by Assunçã et al. in their 2018 study, the plyometric training program led to a notable enhancement in anaerobic power. Kalidasan and Nageswaran (2021) indicated that there was a notable enhancement in anaerobic capacity following the strength and plyometric training regimen

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