International Journal of Kinesiology & Sports Science
ISSN: 2202-946X
www.ijkss.aiac.org.au

Effect of 12-week Training Program on the Fitness and Performance of Long Jumpers

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ARTICLE INFO

Article history
Received: October 29, 2024
Revised: December 19, 2024
Accepted: January 07, 2025
Published: January 30, 2025
Volume: 13 Issue: 1

Conflicts of interest: None.
Funding: None

ABSTRACT

Background: Horizontal and vertical explosive strength, muscular endurance, flexibility, and speed are essential biomotor abilities for enhancing long jump performance. Regular and well-structured training is essential for improving fitness levels and athletic performance, which extends to improving jumping ability. **Objective:** The objective of this investigation was to apply scientifically oriented instructional methods and finally to evaluate its impact on both fitness levels and long jump performance. **Methods:** A parallel true experimental design was employed involving 40 long jump athletes (28 males and 12 females) selected using stratified sampling based on gender. Subjects were divided into an experimental group (EG) and a control group (CG), each with 20 athletes (14 males and 6 females), assigned through simple random sampling. The subjects' age was 18 to 24 years old. The experimental protocol focused on lower body horizontal strength (LBHS), lower body upward strength (LBUS), speed (SP), static muscular endurance (SME), flexibility (FLX), and long jump performance (LJP). The EG participated in supervised training sessions lasting 60 minutes, conducted four days in a week, over a period of twelve weeks. In contrast, the CG did not receive any treatment. This group served only as comparison purpose. A paired sample t-test was used to compare the mean of the pre- and post-tests for six variables in both the EG and CG. **Results:** The results showed significant improvements in the EG for LBHS, LBUS, SP, SME, FLX, and LJP ($p<0.01$). In contrast, the CG only indicated a notable variation in SP ($p<0.01$), with no significant changes in the other variables ($p>0.05$). An independent t-test of post-test results showed major variations in all variables between the EG and CG ($p<0.05$), indicating notable improvements in the EG across all measured parameters. **Conclusion:** The EG demonstrated significant improvements in fitness and long jump performance compared to the CG, showcasing the effectiveness of the 12-week training program. This study highlights the clear benefits of a well-structured and scientifically designed training regimen for long jump athletes. Therefore, incorporating scientifically based training into long jump programs is essential for maximizing athletes' performance and potential

Key words: Explosive Power, Flexibility, Long Jump Performance, Muscular Endurance, Training Program

INTRODUCTION

The long jump, a staple in track and field, demands a blend of fitness and skill to achieve maximum distance. Mastering specific techniques involves four phases: run, take-off, flight, and landing, each crucial for optimal performance (Linthorne, 2008; Kamnardsiria et al., 2015). Successful long jumpers need sprinter-like speed during the approach run, a critical factor for performance (Theodorou et al., 2017). Athletes must maintain ideal speed and rhythm during the approach run to optimize takeoff accuracy and velocity (Hanley et al., 2022). The takeoff phase aims to maximize vertical velocity while minimizing horizontal velocity loss (Hanley et al., 2022). Flight involves countering forward rotation induced by takeoff, with techniques such as the stride jump, hang style, and hitch-kick (Linthorne, 2008). Additionally, the ability to efficiently transfer horizontal velocity into vertical

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http://dx.doi.org/10.7575/aiac.ijkss.v.13n.1p.45

movement at take-off significantly impacts jump distance (Kinomura et al., 2013). Arm movements also contribute to effective vertical jump mechanics (Pradon et al., 2014). Phase one of the long jump technique's landing resembles movements in the sit and reach, commonly used to assess flexibility (Akınoğlu et al., 2021). The interplay between agility and quickness in long jump execution underscores the significance of focusing on neuromuscular conditioning to optimize explosive power and movement efficiency (Markovic et al., 2007; Skaggs et al., 2015). Fitness stands as a cornerstone of athletes' achievements, serving as the foundational element alongside event-specific techniques and strategies that significantly influence athletic performance (Reza et al., 2024).

Explosive power is pivotal for athletes as it significantly enhances their performance (Rahman & Sharma, 2023), also enabling jumpers to achieve optimal jump height and distance (Markovic, 2007). To cultivate explosive power, training programs should incorporate exercises targeting major lower limb muscle groups, emphasizing energy systems, strength, power, and skill in succession (Yang, 2023; Tillaar et al., 2023). Specific explosive training is instrumental in developing explosive leg power, inducing neuromuscular adaptations such as increased neural drive, enhanced muscle activation strategies, and alterations in muscle-tendon complex characteristics (Markovic & Mikulic, 2010). This is crucial for vertical and horizontal jumping performance, as evidenced by the strong correlation between upward leap height and lower-limb strength and horizontal distance (Potteiger et al., 1999; Jiménez-Reyes et al., 2018). Meta-analyses and reviews affirm the efficacy of plyometrics training in enhancing jump and distance performance across various types of jumps (Ramirez-Campillo et al., 2023; Kons et al., 2023).

Flexibility training aims to optimize joint range for improved sports performance by incorporating relaxation and stretching exercises (Cissik, 2005). Measures backward and lower extremity: the sit-and-reach test, reflecting the ability to move smoothly within joint ranges. Studies highlight its utility in evaluating agonist muscle strength and antagonist muscle flexibility (Carrasco et al., 2013). Stretching exercises are frequently performed prior to athletic activities to prevent sports injuries by preserving the extent of mobilityand promoting muscle strength through consistent adaptability training (Rahman & Islam, 2020). The extent of mobility refers to the total movement capacity of a joint (Keogh et al., 2019), while adaptability pertains to the ability of soft tissues like muscles, tendons, and connective tissue to stretch throughout this range (Konin, 2012). Flexibility varies depending on the sport, joint, and speed of movement, with specific flexibility patterns associated with different activities (Medeiros et al., 2013). Static flexibility refers to the strength of the quadriceps, hamstrings, and glutes, as well as the potential range of motion of a joint or group of joints. In contrast, dynamic flexibility relates to the ease of movement within this range (Micheo et al., 2012; Akınoğlu et al., 2021). Ballistic stretching involves pushing body components outside of their typical variety of movementto enhance strength and jumping ability (Biswas, 2020). Stretching with Proprioceptive Neuromuscular Facilitation (PNF) seeks to increase muscle flexibility and has been demonstrated to benefit both active and passive movements (Hindle et al., 2012). Researchers Islam et al. (2024) add that to strengthen the back of the leg and prevent injuries, the hamstring curl is one of the most effective exercises for improving hamstring flexibility.

Enhancing speed, defined as the rate of motion irrespective of direction, is pivotal for performance improvement in sports. Coaches employ various strategies to develop speed, which encompasses velocity—a crucial component of effective sports movement (Beato et al., 2018). Key elements in running, such as stride length and frequency, require a balanced approach to achieve optimal speed, and running involves distinct phases, including swing and recovery, which are essential for effective propulsion (Brown & Ferrigno, 2014; DeJong et al., 2022). Training methods for speed focus on enhancing acceleration and maximum velocity through techniques such as over-speed training. Coaches utilize strategies like strength training and plyometrics to develop speed-specific skills, while reaction speed, crucial in sports scenarios, can be improved through focused preparation. Fundamental principles of speed development emphasize proper technique, maximal intensity, and thorough warm-up routines. Exercise, broadly categorized into aerobic and anaerobic types, plays a key role in speed training (Beato et al., 2018; Brown & Ferrigno, 2014; DeJong et al., 2022). Aerobic exercises, such as jogging and swimming, emphasize cardiovascular endurance (Wilmore, 2003), while anaerobic exercises, like weightlifting, target muscle strength and power, enhancing bone density and metabolic rate (Chamari & Padulo, 2015). Squat workouts are effective for building muscles in the upper and lower limbs and can assess static muscular endurance (Goldberg et al., 1994), as they can be performed anywhere using body weight against a wall (Cho, 2013).Sports training programs aim to enhance athletes' physical and physiological performance by refining their innate abilities. This study examines how combining speed, flexibility, endurance, and power into a cohesive training program affects long jump performance. Unlike previous research, which often focuses on these elements individually, this study evaluates their combined effects. It introduces a scientifically designed, multi-component training regimen targeting key biomotor abilities, providing evidence-based insights to improve long jump performance. The hypothesis is that an integrated training approach will yield greater improvements compared to traditional methods that address these components separately. By exploring the combined impact of quickness, flexibility, stable endurance, and powerful strength, along with routine instruction, the study aims to assess their influence on athletes' fitness and long jump performance.

METHODS

Population of the Study

This study utilized a parallel true experimental design over 12 weeks to assess the effects of a scientific-based training program on the fitness and performance of long jump athletes affiliated in Ethiopia. The target group, with a mean age range of 23-24 years, consisted of 40 participants (28 male and 12 female) who were stratified by gender and randomly assigned into two equal groups: an experimental group and a control group. This method was used to allocate 14 male and 6 female athletes into two equal groups independently. Consequently, 20 athletes were put in charge of the experiment group, while the remaining 20 formed the control group. Participants in this study were selected based on their physical preparedness and health history as outlined in the Physical Activity Readiness Questionnaire (PARQ). Only individuals free from acute or chronic illnesses and without any physical or psychological impairment were included. The study ensured the privacy of participants, protected against potential harm, and guaranteed the confidentiality of their data. Individuals who did not meet these criteria were not permitted to participate. All participants provided informed consent, ensuring their voluntary involvement and understanding of the research procedures.

Variables and Criterion Measures

The study focused on explosive leg horizontal and vertical strength, speed, static muscular endurance, flexibility, and long jump performance as the key measures for jumper athletes (Table 1). These characteristics were measured using appropriate tools and testing methods.

Test Procedure

The standing long jump is a dependable evaluation tool utilized to measure the lower limbs' horizontal strength. In this assessment, individuals start with their heels positioned on a designated line and then leap forward horizontally, exerting maximum effort without any prescribed techniques for arm or leg motions. Upon using both feet when landing, the distance of the jump is gauged from the starting line to the closest heel to it (Thomas et al., 2020). Vertical jump tests essentially involve measuring the lower body upward strength discrepancy between people's standing reach and their maximum jump height. With both feet level on the ground and toes contacting the wall, the patient faces a smooth, black wall. Then, using both hands as high as they can, they mark the wall with chalk. They jump as high as they can, marking the top of their jump. The measure of the difference between the reaching and jumping marks in centimeters represents the vertical jump score (Larkin et al., 2024)). The 30 meter acceleration test consists of one sprint over 30m, with time recorded. Subjects undergo a warm-up before running three 30m sprints from the initial section. On the "GO" command, subjects sprint, and assistants time them. The fastest time of three trials is recorded to the nearest two decimal places (Glaise et al., 2022). The wall squat test was used for a static muscular endurance assessment to measure the strength of the quadriceps, hamstrings, and glutes in the lower body. Participants stood with feet parallel and shoulder-width apart, pressing the back of the head flat against the wall. They then lowered into a sitting, half-squat position, ensuring that ankles, knees, and hips formed right angles (90°). Arms were allowed to hang down at the sides, maintaining contact between the back of the shoulders and arms (down to the palms of the hands) with the wall. Timing starts when the correct position is held and stops when it's lost (Fukuda, 2019). The flexibility test was the sit-and-reach exam. The participants flattened their soles on a box while sitting with their legs extended on the floor. With their legs locked, they reached down the measuring line with their palms facing downward. While the length was being measured, they maintained the stance for one to two seconds. The measurement starts at a zero mark at the participant's fingertips, using a sliding ruler, and is recorded in centimeters when both hands reach the distance (Mayorga-Vega et al., 2014). For the jump performance test, the rules and techniques of the long jump, as defined by the International Association of Athletics Federations (IAAF), were used (worldathletics.org, n.d.). All tests were performed by the researchers and their assistants, ensuring consistency and accuracy throughout the study.

Instructional Methodology

The subjects followed a training program four times a week—on Mondays, Wednesdays, Thursdays, and Saturdays—for a total of twelve weeks. Each session began with a 15-minute warm-up that included both general and specific exercises. This was followed by a 60-minute main workout consisting of targeted activities with varying intensities, ranging from low to moderate to high intensity. The session concluded with 10 minutes of cool-down exercises. The researchers and their assistants supervised and organized the training program. The training regimen was specifically designed for individuals with limited strength training experience, gradually progressing from lower-intensity drills to more advanced exercises (Singh et al., 2024a; Akınoğlu et al., 2021). Table 2 below is an overview of the training protocol for different intensity levels (based on HRmax).

Participants were instructed to perform all jumps/exercises with maximum effort, aiming for the highest possible height or amplitude while minimizing ground contact time. During the first six weeks, the researchers employed a combination of low and moderate-intensity exercises. In the final six weeks, the program incorporated both moderate and high-intensity exercises. The intensity (HRmax) was monitored by measuring beats per minute at the neck. A common method to calculate maximum heart rate is to subtract the individual's age from 220. On non-training days, athletes continued with their regular daily routines and any standard training they typically engaged in outside the study's intervention. Similarly, the control group maintained their usual activities, including any regular training or physical activities they routinely performed.

Analysis of Data

Both descriptive and inferential statistical methods were used to analyze the gathered data. The data followed a normal distribution as confirmed by the Shapiro-Wilk test. Descriptive statistics included the calculation of the mean and standard deviation. Inferential statistics involved the use of a paired t-test to observe within-group differences from pre-test to post-test results for the experimental and control groups, as well as an independent samples t-test to compare variables between the control and experimental groups. The analysis was conducted using SPSS Version 26, with a significance threshold set at 0.05. Levene's test was used to confirm the equality of variances.

RESULTS

Table 3 presents the descriptive statistics, including the mean, standard deviation, and standard error mean, for the variables between the pre-test and post-test of the experimental and control groups, while Figure 1 illustrates the corresponding mean scores.

In Table 4, a paired sample t-test was employed to assess the pre-test and post-test scores of six variables within both the experimental group (EG) and the control group (CG). The results indicate that the EG exhibited significant changes in all variables from pre-test to post-test ($p < 0.01$). In contrast, the CG showed a notable variation only in SP ($p < 0.01$), with no significant changes observed in the other variables ($p > 0.05$).

Table 5 presents the results of independent t-tests conducted to compare the pre- and post-test scores between the experimental group (EG) and control group (CG) for six variables. In the post-test, the EG exhibited a significant difference compared to the CG in all variables.

Table 1. Variables and criterion measures

Variables	Test Items	Unit of Measure
Lower Body HorizontalStrength (LBHS)	Standing Long JumpTest	Centimeters (cm)
Lower Body Upward Strength (LBUS)	Vertical Jump Test	Centimeters (cm)
Speed (SP)	30 meter Acceleration Test	Second (s)
Static Muscular Endurance (SME)	Wall Squat Test	Second (s)
Flexibility (FLX)	Sit and Reach Test	Centimeters (cm)
Long Jump Performance (LJP)	Long Jump Performance Test	Metres (m)

DISCUSSION

The foremost goal of this study was to see how a 12-week training protocol focusing on agility, lower body strength, plyometric exercise, muscular endurance, and flexibility affected the performance of long jump competitors. Long jump is a demanding athletic event that needs a unique combination of speed, strength, coordination, and explosive power. The integration of agility, strength, and plyometric training into the training routine of long jumpers has been investigated to enhance performance outcomes. A great deal of the long jump requires agility, which is defined as the ability to change direction quickly while maintaining balance and control. This is especially true during the approach run and takeoff. The findings of this study are consistent with earlier research, which has shown that agility training enhances movement efficiency and neuromuscular coordination, which can benefit the transition between the approach and takeoff phases of the long jump (Panteli et at., 2015). Athletes with increased agility can better regulate their body motions, resulting in a more efficient transfer of momentum during the jump. The study's findings show a considerable improvement in approach speed and accuracy, two criteria important for establishing ideal takeoff angles and thereby improving jump distances. These findings support the work of Pereira et al. (2018), which suggested that athletes with superior agility skills are able to better manage their velocity and body positioning, improving overall performance in

Table 2. Training protocol for different intensity levels (HRmax)

Protocol	Low-Intensity (40%–60% HRmax)	Moderate-Intensity (60%–70% HRmax)	High-Intensity (70%–85% HRmax)
Exercises	- ABC drills - Squat jumps - Lateral jumps to box - Jumps to a box - Slow bend and reach	- Split squat jumps - Trunk jumps - Lateral box push-offs - Bounding with rings - Box drills with rings - Two-foot ankle hops - Double-leg tuck jumps - Pike jumps - Vertical jumps (both double and single leg)	- Depth jumps - Zigzag hops - Single-leg trunk jumps - Single-leg lateral hops
Duration	10-15 minutes	5-10 minutes	10-15 minutes
Frequency	2 sets of 5 to 2 sets of 8 repetitions	2 sets of 5 to 3 sets of 8 repetitions	2 sets of 5 to 3 sets of 8 repetitions
Recovery Time	5 minutes between sets	5 minutes between sets	5 minutes between sets
Period in Program	First 6 weeks	Entire 12 weeks	Last 6 weeks

Table 3. Descriptive statistics for the variables between the pre-test and post-test of the experimental and control groups

Variables	Group	Test	N	Mean and SD
LBHS	EG	Pre-test	20	2.21 ± 0.15
		Post-test	20	2.44 ± 0.15
	CG	Pre-test	20	2.31 ± 0.15
		Post-test	20	2.32 ± 0.15
LBUS	EG	Pre-test	20	51.10 ± 2.98
		Post-test	20	58.90 ± 2.30
	CG	Pre-test	20	49.74 ± 4.77
		Post-test	20	50.21 ± 4.29
SP	EG	Pre-test	20	4.46 ± 0.16
		Post-test	20	4.07 ± 0.08
	CG	Pre-test	20	4.43 ± 0.14
		Post-test	20	4.38 ± 0.12
SME	EG	Pre-test	20	77.35 ± 5.91
		Post-test	20	86.20 ± 5.55
	CG	Pre-test	20	73.75 ± 5.54
		Post-test	20	74.10 ± 4.59
FLX	EG	Pre-test	20	18.65 ± 3.98
		Post-test	20	25.10 ± 3.48
	CG	Pre-test	20	17.15 ± 3.30
		Post-test	20	17.55 ± 3.39
LJP	EG	Pre-test	20	6.15 ± 0.24
		Post-test	20	6.40 ± 0.20
	CG	Pre-test	20	6.15 ± 0.34
		Post-test	20	6.22 ± 0.33

LBHS: Lower body horizontal strength; LBUS: Lower body upward strength; SP: Speed; SME: Static muscular endurance; FLX: Flexibility; LJP: Long jump performance; EG: Experimental group; CG: Control group

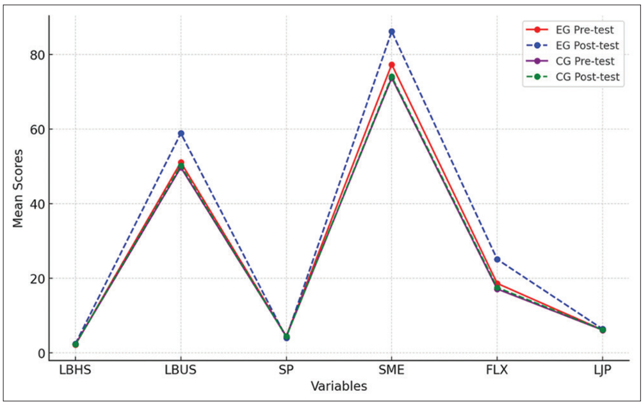

Figure 1. Pre-and post-test scores of experimental and control groups

dynamic sports activities like long jumping. The long jump's takeoff phase requires significant lower body strength, particularly in the quadriceps, hamstrings, glutes, and calves (Akınoğlu et al., 2021). The 12-week training plan greatly boosted muscle power and explosive strength, both of which are required for maximum vertical and horizontal force output during takeoff.

Plyometric training significantly enhances long jumper performance by improving lower body strength, explosive power, and jump execution. This training accelerates force generation, resulting in quicker and more powerful takeoffs (Huang et al., 2023). Studies have shown that athletes in plyometric training programs outperform those in resistance training in quickness, explosiveness, and power gains (van de Hoef et al., 2020; Permana et al., 2022). The findings align with research emphasizing the role of leg strength in maximizing ground reaction force and forward momentum during the takeoff phase (Markovic & Mikulic, 2010). Plyometric exercises like jumps, hops, and bounds enhance the stretch-shortening cycle of muscles, improving elasticity and power output, crucial for jump height and distance (Chu, 1998; Mola & Bayeta, 2020). This study confirms the effectiveness of plyometric training in boosting performance, echoing similar results in increased sprint speed and jump ability (Fischetti et al., 2018), making it indispensable for long jump athletes.

The integration of agility, lower body strength, and plyometric training offers a holistic approach to improving long jump performance by addressing key aspects of athleticism, such as speed, strength, coordination, and explosiveness (Pereira et al., 2018). This multi-faceted training strategy is more effective than focusing on a single component, as supported by Thomas et al. (2009) and El-Ashker et al. (2019), who demonstrated that programs combining strength, power, and agility result in greater performance gains. Beyond overall physical conditioning, this approach emphasizes muscular endurance in the quadriceps, hamstrings, and calves, which is vital for sustaining high forces during the approach and takeoff phases. Enhanced muscle endurance minimizes fatigue and leads to more consistent performance (Jeffreys, 2015), while greater endurance helps athletes maintain speed and form during the approach, thereby optimizing jump distance (Makaruk et al., 2020).

The 12-week training program effectively enhanced long jump performance by targeting flexibility, lower body strength, and explosive power. Flexibility training, focused on the hip flexors, hamstrings, and lower back, improved the range of motion (ROM), enabling more efficient takeoffs and greater flight distances, aligning with Kallerud and Gleeson (2013). Enhanced flexibility also reduced injury risk by improving joint mobility and muscle elasticity, as noted by Akınoğlu et al. (2021). Lower body strength and explosive power were developed through exercises like squat jumps, power skipping, and lunges, supporting findings by Singh et al. (2024b) and Fenta and Mola (2023) that structured training improves strength and overall athletic performance. Plyometric training further increased muscle mass, agility, and leg strength, critical for optimal jump performance (Huang et al., 2023). Overall, the program demonstrated that a multi-component, progressive regimen significantly improves takeoff efficiency, jump distance, and overall fitness while minimizing injury risks.

Table 4. Paired sample t-testfor the variables between the pre-test and post-test of the experimental and control groups

Variables	Group	Test	Mean Difference	Std. Deviation	Std. Error Mean	t	df	Sig. (2-tailed)
LBHS	EG	Pre-test	0.23	0.13	0.03	7.65	19	0.000*
		Post-test						
	CG	Pre-test	0.00	0.01	0.00	2.02	19	0.058
		Post-test						
LBUS	EG	Pre-test	7.80	2.86	0.64	12.17	19	0.000*
		Post-test						
	CG	Pre-test	0.47	1.25	0.28	1.67	19	0.112
		Post-test						
SP	EG	Pre-test	0.39	0.18	0.04	9.85	19	0.000*
		Post-test						
	CG	Pre-test	0.05	0.03	0.01	7.49	19	0.000*
		Post-test						
SME	EG	Pre-test	8.85	2.03	0.45	19.47	19	0.000*
		Post-test						
	CG	Pre-test	0.35	1.73	0.39	0.91	19	0.376
		Post-test						
FLX	EG	Pre-test	6.45	3.61	0.81	8.00	19	0.000*
		Post-test						
	CG	Pre-test	0.40	1.05	0.23	1.71	19	0.104
		Post-test						
LJP	EG	Pre-test	0.25	0.20	0.04	5.74	19	0.000*
		Post-test						
	CG	Pre-test	0.07	0.18	0.04	1.80	19	0.088
		Post-test						

LBHS: Lower body horizontal strength; LBUS: Lower body upward strength; SP: Speed; SME: Static muscular endurance; FLX: Flexibility; LJP: Long jump performance; EG: Experimental group; CG: Control group; *: Significant at 0.05 level

Table 5. Independent samples t-test results for pre and post test between the experimental and control groups

Variables	Tests	Experimental	Control	t	P-value
		Mean and SD	Mean and SD		
LBHS	Pre-test	2.21 ± 0.15	2.31 ± 0.15	2.18	.035*
	Post-test	2.44 ± 0.15	2.32 ± 0.15	2.58	.014*
LBUS	Pre-test	51.10 ± 2.98	49.74 ± 4.77	1.08	.287
	Post-test	58.90 ± 2.30	50.21 ± 4.29	7.98	.000*
SP	Pre-test	4.46 ± 0.16	4.43 ± 0.14	0.69	.497
	Post-test	4.07 ± 0.08	4.38 ± 0.12	9.20	.000*
SME	Pre-test	77.35 ± 5.91	73.75 ± 5.54	1.99	.054
	Post-test	86.20 ± 5.55	74.10 ± 4.59	7.52	.000*
FLX	Pre-test	18.65 ± 3.98	17.15 ± 3.30	1.30	.202
	Post-test	25.10 ± 3.48	17.55 ± 3.39	6.95	.000*
LJP	Pre-test	6.15 ± 0.24	6.15 ± 0.34	0.05	.957
	Post-test	6.40 ± 0.20	6.22 ± 0.33	2.14	.039*

LBHS: Lower body horizontal strength; LBUS: Lower body upward strength; SP: Speed; SME: Static muscular endurance; FLX: Flexibility; LJP: Long jump performance; EG: Experimental group; CG: Control group; SD: Standard deviation *: Significant at 0.05 level

Limitations and Future of Present Study

While the results of this study are promising, several restrictions must be recognized. First, the sample size was relatively small, which may limit the generalizability of the findings. Additionally, the study did not account for the potential influence of technical skill training, which could also have contributed to improvements in performance. Future research should explore the long-term effects of combined agility, strength, and plyometric training, as well as the interaction between physical conditioning and technical training in long jump performance.

Strengths and Practical Implications

This study's key strength is its scientifically designed, multi-component training program that combines speed, flexibility, endurance, and power to enhance long jump performance. It provides a comprehensive framework for coaches and trainers, emphasizing structured, progressive training tailored to athletes' skill levels. The gradual progression from low to high-intensity exercises ensures safer and more effective protocols, benefiting both novice and experienced athletes.

CONCLUSION

The results indicate significant improvements both fitness levels and long jump performance in the experimental group compared to the control group, demonstrating the effectiveness of the experimental intervention. The study underscores that a well-designed 12-week training program can notably enhance the fitness and performance of long jump. Therefore, integrating scientifically designed training programs into long jump program is crucial for optimizing athletes' performance and potential.

ACKNOWLEDGMENT

The authors express their gratitude to all participants who contributed to the study.

AUTHOR CONTRIBUTIONS

DWM contributed to the conception, design, data collection, and data analysis. He also prepared the tables and figures, drafted the manuscript, and revised and finalized it for publication. MHR contributed to the conception, design, and data analysis. He also prepared the tables and figures, drafted the manuscript, and revised and finalized it for publication. RRU contributed to the conception, design, planning, and supervision of the research. He set the goals, provided substantive supervision, and finalized the manuscript for publication. AKA contributed to the conception, design, planning, and supervision of the research. He set the goals, provided substantive supervision, and finalized the manuscript for publication. ST contributed to the conception, design, planning, and supervision of the research. She set the goals, provided substantive supervision, and finalized the manuscript for publication. DA contributed to the data analysis and the interpretation of results, and revised and finalized the manuscript for publication. MSI contributed to the conception, design, planning, and supervision of the research. He set the goals, provided substantive supervision, and finalized the manuscript for publication.

ETHICS APPROVAL AND CONSENT TO PARTICIPATE

The study was approved by the College of Natural and Computational Sciences, Department of Sport Science, Board of Research Studies (Ref No: GSRCNCS/1610/24) at Addis Ababa University Participants were assured of voluntary participation and their right to withdraw at any time. They were also informed of their rights throughout the study, in accordance with the Declaration of Helsinki.

DATA AVAILABILITY STATEMENT

The authors can provide data upon reasonable request.

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