
EFFECTS OF PLYOMETRIC TRAINING ON IMPROVING MOTOR SKILL FITNESS OF MALE BASKETBALL PROJECT PLAYERS

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Abstract

This study aimed to investigate the effects of plyometric training on the motor skill fitness of male basketball project players in Bonga Town, Ethiopia, a population for which local evidence on explosive power, agility, and speed remains limited. An experimental design with a pre-test and post-test and a quantitative approach was applied. Twenty-four male players from the Bonga Town basketball project participated voluntarily and completed an eight-week plyometric training program of three sessions per week. Explosive power was assessed with the standing long jump, agility with the Illinois agility test, and speed with a sprint run test. Data were analyzed using descriptive statistics and paired-samples t-tests at a significance level of 0.05. The results showed significant improvements from pre-test to post-test in explosive power (mean difference = 7.70 cm; $t(23) = 9.852$; $p < .001$), agility (mean difference = 2.86 s; $t(23) = 5.734$; $p = .001$), and speed (mean difference = 0.54 s; $t(23) = 8.899$; $p = .001$). It is concluded that plyometric training effectively improves explosive power, agility, and speed in male basketball players. Coaches are encouraged to incorporate structured and progressive plyometric programs into regular basketball training sessions.

Keywords: Plyometric training; Motor skill fitness; Explosive power; Agility; Speed

INTRODUCTION

Basketball is an intermittent, high-intensity team sport in which players must frequently execute explosive movements such as sprinting, jumping, rapid acceleration and deceleration, and changes of direction. Strength, power, speed, agility, and neuromuscular coordination are all needed to meet these physical demands and to compete successfully (Ben Abdelkrim et al., 2007; Delextrat & Cohen, 2008; Stojanović et al., 2018). Players often have to change direction quickly in reaction to opponents and teammates, accelerate over short distances, and jump for rebounds and shots. Because basketball demands the integration of both technical and physiological abilities, the evaluation of physical fitness is especially important. Anthropometric characteristics, explosive strength, speed, agility, and other physical abilities have all been linked to success in basketball (Drinkwater et al., 2008; Ziv & Lidor, 2009). The intermittent nature of the game, which involves repeated high-intensity activities during competition, places considerable physiological demands on players (Castagna et al., 2008; Stojanović et al., 2018). As a result, basketball players benefit greatly from training programs that enhance explosive and rapid movement abilities.

Plyometric training has attracted considerable interest in sport science as one of the methods used to develop these abilities. Plyometric training consists of explosive exercises that use the stretch-shortening cycle (SSC), that is, a rapid eccentric muscle action immediately followed by a concentric action. This training approach can improve neuromuscular function, the rate of force development, reactive strength, and the speed of force production (Markovic & Mikulic, 2010; Suchomel et al., 2016). Because successful basketball performance typically depends on the rapid production and application of force during jumping, sprinting, and changes of direction, these adaptations are directly relevant to the sport.

Evidence from systematic reviews and meta-analyses indicates that plyometric training can enhance explosive power and jumping performance. De Villarreal et al. (2009) showed that improvements in vertical jump performance are influenced by plyometric training variables such as training frequency, duration, and volume. Similarly, a systematic review by Slimani et al. (2016) found that team-sport athletes benefited from plyometric training across a number of physical fitness components. These results imply that well-structured plyometric training can develop explosive athletic performance. In addition to jumping ability, plyometric training has the potential to improve speed and sprint performance. Sprinting requires rapid force output and efficient use of the stretch-shortening cycle, especially during acceleration. A meta-analysis by de Villarreal et al. (2012) reported that plyometric training can substantially enhance sprint performance, and Haugen et al. (2019) stressed the importance of developing neuromuscular abilities and explosive force for sprint performance. Furthermore, studies examining different plyometric training methods have found that unilateral, bilateral, and combined plyometric programs improve explosive actions (Ramirez-Campillo et al., 2015; Ramirez-Campillo et al., 2018).

Agility and the ability to change direction are equally important for basketball performance. During both offensive and defensive play, players must repeatedly stop, accelerate, and change direction quickly. Agility, however, is a complex motor skill with technical, perceptual, and physical components. According to Young et al. (2015), training specificity is crucial when attempting to enhance planned change-of-direction speed and reactive agility. Meta-analytic data indicate that plyometric training can enhance change-of-direction performance (Asadi et al., 2016). Furthermore, Falch et al.

(2019) found that various forms of physical training can affect change-of-direction ability, which supports the use of explosive training methods for athletes in invasion sports.

In basketball, the value of strength-related and plyometric training is well established. Studies involving basketball players have demonstrated the importance of explosive strength and physical fitness for performance (Sallet et al., 2005; Santos & Janeira, 2011). For instance, Santos and Janeira (2011) found that resistance training improved explosive-strength indicators among adolescent basketball players. Basketball-specific research further shows that the sport involves repetitive explosive actions and considerable physical and physiological demands (Conte et al., 2015; Stojanović et al., 2018). Consequently, training programs that enhance lower-limb strength, speed, and agility may help prepare players for the demands of competition.

These improvements are underpinned by adaptations of the neuromuscular system. Plyometric exercises may improve the efficiency of the stretch-shortening cycle, the ability to rapidly recruit and activate motor units, and the coordination of muscle activation (Markovic & Mikulic, 2010). Because a greater force-producing capacity enables the expression of power during explosive movements, muscular strength is a crucial foundation for athletic performance (Suchomel et al., 2016, 2018). To maximize adaptation and minimize excessive fatigue, training volume, intensity, exercise selection, and recovery must be manipulated appropriately; the changes produced by plyometric training have been shown to be influenced by training dose and inter-set recovery (Ramirez-Campillo et al., 2014, 2018).

Although there is substantial evidence supporting plyometric training worldwide, most of the available research has been conducted on athletes from Europe, North America, South America, and other regions, with soccer and other team sports receiving most of the attention. There is still little evidence that specifically examines Ethiopian male basketball project players. This is a significant contextual gap, because an athlete's training history, age, physical attributes, access to facilities, coaching methods, and competitive environment can all affect the effectiveness of a training program. In addition, access to scientifically planned strength and conditioning programs may be limited for basketball development projects in small Ethiopian towns. The basketball project in Bonga Town therefore offers an important context for examining the practical outcomes of an organized plyometric intervention, since its players need physical attributes that match the demands of basketball, specifically explosive power, agility, and speed. However, there is little empirical evidence on whether male basketball project players in Ethiopia can improve these motor fitness components through a systematically progressive plyometric program.

Therefore, the purpose of this study was to determine the effects of plyometric training on the motor skill fitness of male basketball project players in Bonga Town, Ethiopia, with specific attention to explosive power, agility, and speed as key basketball-related components of motor fitness. By analyzing changes in these components after a structured plyometric training program, the study aims to provide context-specific evidence that can help coaches, physical education professionals, sport scientists, and basketball development programs design more effective training interventions.

METHODS

Research Design

This study applied an experimental design with a pre-test and post-test and a quantitative approach in order to establish the effect of plyometric training (independent variable) on selected motor skill-related physical fitness components (dependent variables). The pre-test was administered at the beginning of the first month and the post-test at the end of the second month of the intervention. The participants trained three days per week (Monday, Wednesday, and Friday) for eight weeks.

Participants

The study involved male basketball players who were officially registered and actively participating in the Bonga Town basketball project. All eligible players available during the study period were included using a total (complete) sampling technique, resulting in 24 participants. The participants' mean age was 17.0 ± 1.5 years, mean height 1.75 ± 0.07 m, mean body mass 66.5 ± 6.8 kg, and mean basketball playing experience 3.2 ± 1.2 years. They regularly took part in basketball training and competed in local (town-level) project competitions. Participation was voluntary, and all participants were in good health. All 24 players returned signed consent forms, completed the pre-test, the two-month training program, and the post-test, and were included in the analysis.

Training Protocol

The eight-week plyometric training program consisted of three 45- to 60-minute sessions per week. The exercises included squat jumps, countermovement jumps, tuck jumps, broad jumps, lateral jumps, box jumps, and repeated vertical jumps. Training began with moderate workloads for familiarization, after which training volume and intensity were progressively increased. Each session included warm-up, stretching, and cool-down exercises. The participants continued their usual basketball activities and were given adequate rest between exercises.

Instruments and Measurements

A measuring tape, stopwatch, whistle, wooden blocks, mats, a horizontal bar, pen, and paper were used both for the training and for data collection (American College of Sports Medicine, 2021). The selected variables and their criterion measures are presented in Table 1. Explosive power was measured with the standing long jump in centimeters, whereas agility (Illinois agility test) and speed (sprint run test) were recorded in seconds using a stopwatch.

Table 1. Selected Variables and Their Criterion Measures

No.	Physical Fitness Variable	Test	Instrument	Unit of Measurement
1	Explosive power	Standing long jump	Measuring tape	cm
2	Agility	Illinois agility test	Stopwatch	s
3	Speed	Sprint run test	Stopwatch	s

Data Analysis

Data obtained from the tests and measurements were analyzed using the Statistical Package for the Social Sciences (SPSS) version 20.0. Descriptive statistics (mean, standard deviation, and standard error) were calculated, and paired-samples *t*-tests were used to examine the differences between pre-test and post-test results. The

level of significance was set at $p < 0.05$. The results were tabulated and interpreted in relation to the changes observed in each fitness component among the participants of the training program.

Ethical Considerations

The confidentiality of the information provided by the participants was guaranteed, and the potential risks associated with participation were explained. The study protocol was reviewed and approved by the Department of Sport Science, Bonga University, in accordance with institutional guidelines. Written informed consent was obtained from all participants, and the relevant project bodies were formally informed by letter before data collection began.

RESULTS AND DISCUSSION

Results

Explosive Power

Table 2 presents the descriptive statistics for explosive power. The mean standing long jump score increased from 19.60 ± 0.15 at the pre-test to 27.30 ± 0.24 at the post-test, indicating that the participants performed better after the plyometric training program.

Table 2. Effects of Plyometric Training on Explosive Power

Test	N	Mean	SD	SE
Pre-test explosive power	24	19.60	0.15	0.04
Post-test explosive power	24	27.30	0.24	0.06

Table 3 presents the paired-samples t -test results for explosive power before and after the intervention. The analysis revealed a statistically significant improvement in explosive power between the pre-test and post-test measurements, $t(23) = -9.852$, $p < .001$. The mean difference was -7.70 ($SD = 0.195$, $SE = 0.064$), with a 95% confidence interval ranging from -0.765 to -0.499 . These findings indicate that the intervention had a significant positive effect on the participants' explosive power.

Table 3. Paired-Samples t -Test for Explosive Power

Comparison	Mean Difference	SD	SE	95% CI Lower	95% CI Upper	t	df	p
Pre-test vs. post-test	-7.70	0.195	0.064	-0.765	-0.499	-9.852	23	< .001

Agility

Table 4 presents the descriptive statistics for agility performance before and after the intervention. The participants ($n = 24$) had a pre-test mean Illinois agility time of 18.08 ± 1.69 s ($SE = 0.36$), which decreased to 15.22 ± 0.75 s ($SE = 0.17$) at the post-test. The lower post-test mean and smaller standard deviation indicate an improvement in agility performance, with the participants demonstrating faster and more consistent agility times following the intervention.

Table 4. Effects of Plyometric Training on Agility

Test	N	Mean (s)	SD	SE
Pre-test agility	24	18.08	1.69	0.36
Post-test agility	24	15.22	0.75	0.17

A paired-samples *t*-test was employed to determine whether there was a significant difference in agility performance between the pre-test and post-test. The difference was statistically significant, $t(23) = 5.734$, $p = .001$, with a mean improvement of 2.86 s (Table 5).

Table 5. Paired-Samples *t*-Test Comparing Pre-Test and Post-Test Agility Scores

Comparison	Mean Difference	SD	<i>t</i> (df)	95% CI	<i>p</i>
Pre-test vs. post-test	2.86	1.130	5.734 (23)	[1.349, 2.872]	.001

Speed

Table 6 compares sprint run times between the pre-test and post-test. The mean scores were 4.39 ± 0.15 s and 3.85 ± 0.27 s, respectively, indicating that sprint time improved by an average of 0.54 s after the plyometric training program.

Table 6. Effects of Plyometric Training on Speed

Test	N	Mean $\pm$ SD (s)	SE
Pre-test speed	24	4.39 ± 0.15	0.03
Post-test speed	24	3.85 ± 0.27	0.06

A paired-samples *t*-test was used to compare the players' speed before and after the plyometric program. The difference between the pre-test and post-test was statistically significant, $t(23) = -8.899$, $p = .001$ (Table 7).

Table 7. Paired-Samples *t*-Test for Speed

Comparison	Mean Difference	SD	SE	95% CI	<i>t</i>	df	<i>p</i>
Pre-test vs. post-test	-0.54	0.21	0.045	[-0.700, -0.436]	-8.899	23	.001

Summary of the Training Effects

Table 8 summarizes the effects of the plyometric training program on all three motor fitness components. Higher explosive power scores indicate better performance, whereas lower agility and speed times indicate better performance.

Table 8. Overall Summary of the Effects of Plyometric Training

Variable	Pre-test Mean $\pm$ SD	Post-test Mean $\pm$ SD	Mean Difference	<i>t</i> (df)	<i>p</i>	Interpretation
Explosive power (cm)	19.60 ± 0.15	27.30 ± 0.24	7.70	9.852 (23)	< .001	Significant improvement
Agility (s)	18.08 ± 1.69	15.22 ± 0.75	2.86	5.734 (23)	.001	Significant improvement
Speed (s)	4.39 ± 0.15	3.85 ± 0.27	0.54	8.899 (23)	.001	Significant improvement

Note. Mean differences are reported as absolute improvements; *t* values are reported as absolute values.

Discussion

The findings of this study showed that eight weeks of plyometric training significantly improved explosive power, agility, and speed among male basketball project players in Bonga Town. These results are in line with previous research and exercise physiology theory, which generally suggest that progressive plyometric training can enhance athletes' explosive power, agility, and sprint performance (Markovic & Mikulic, 2010; Slimani et al., 2016). The improvements observed in all three fitness components can be interpreted as adaptations to frequent, high-velocity, explosive actions.

The improvement in standing long jump performance indicates that plyometric training enhanced the participants' explosive power. Plyometric exercises may improve the efficiency of the stretch-shortening cycle, the rapid recruitment and activation of motor units, and the coordination of muscle activation (Markovic & Mikulic, 2010). This finding is consistent with meta-analytic evidence that plyometric training improves jumping performance, particularly when training frequency, duration, and volume are appropriately planned (de Villarreal et al., 2009).

The reduction in Illinois agility test time supports the findings of Asadi et al. (2016), who reported that plyometric training enhances change-of-direction ability, while the improvement in sprint time agrees with the meta-analysis of de Villarreal et al. (2012) on the effects of plyometric training on sprint performance. These adaptations are especially important in basketball, where effective play depends on jumping, accelerating, stopping, and changing direction quickly (Stojanović et al., 2018). Practically, the results suggest that a structured and progressive plyometric program can be implemented with simple equipment in a local basketball development project.

This study has several limitations. It used a single group without a control group, involved a relatively small sample drawn from one town project, and the participants continued their regular basketball training during the intervention. Consequently, part of the observed improvement may be attributable to regular training or maturation. Future studies should include a control group, larger samples from several projects, and longer follow-up periods to confirm these findings.

CONCLUSION

Based on the findings, it can be concluded that an eight-week plyometric training program significantly improves the motor skill fitness of male basketball project players in Bonga Town, specifically explosive power in the standing long jump, agility, and sprint speed. Plyometric training therefore has a positive effect on physical performance components that are essential for basketball. Coaches should be guided and educated on the importance and value of plyometric training programs and encouraged to include them in regular training sessions in order to develop physically fit and skillful male basketball players. Efforts should also be made to popularize the benefits of plyometric training among basketball players and coaches, which in turn would help the nation produce skillful and physically fit players.

ACKNOWLEDGEMENT

The authors thank God for all His blessings. We also express our sincere gratitude to the players of the Bonga Town basketball project and to Dessalegn Wase Mola (Assistant Professor) for his genuine, constructive, and valuable criticism and comments, which were crucial in writing this work.

Authors' contributions. Yonas Mebrat Dagnaw, Amrot Gizaw Gibo, Asfaw Bahiru Mitiku, Bizuayehu Abebe, and Seare Hailekiross Belay collaborated on the design of the study, data analysis, and writing of the manuscript. All authors were actively involved in the interpretation of the findings, critically reviewed the manuscript for important intellectual content, approved the final version of the manuscript, and agreed to the order of authorship.

Funding. No funding was received for this research. The authors declare that no financial support, grants, or other funding were obtained from any public, commercial, or not-for-profit organization for the conduct of this study.

Data availability. The data generated and analyzed during the current study are not publicly available because they contain confidential information about the participants; however, they are available from the corresponding author upon reasonable request.

Ethics approval. Ethical approval for this study was obtained from the Institutional Review Board (IRB)/Research Ethics Committee of Bonga University, Ethiopia. The study was conducted in accordance with the ethical principles of the Declaration of Helsinki and relevant institutional guidelines. All participants were informed about the purpose and procedures of the study, and written informed consent was obtained from each participant prior to data collection.

Competing interests. The authors declare no conflicts of interest.

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