Available online at : http://journal.unj.ac.id/unj/index.php/gjik
Gladi : Jurnal Ilmu Keolahragaan, 17 (03) 2026, 495-504
Permalink/DOI: https://doi.org/10.21009/GJIK.173.13

The Effect of Cone Hops Plyometric Training on Running Speed in the University Basketball Players

Wijianto[1*], Hilmi Ega Muktabar[1], Hana Nuha Kurnia[1], Hafid Erli Nurdin Pratama[1]

[1]Physiotherapy Study Program, Faculty of Health Sciences, Universitas Muhammadiyah Surakarta, Surakarta, Indonesia

Correspondiing author. Email : wij165@ums.ac.id

(Submission Track: Received: 01-05-2026, Final Revision: 01-09-2026, Available Online: 30-09-2026)

Abstract. Sprint performance is an essential component of basketball, enabling players to execute rapid movements during offensive and defensive situations. This study aimed to examine changes in sprint performance following a four-week plyometric cone hops training program among university basketball players. A quantitative pre-experimental study employing a one-group pretest–posttest design was conducted. Twenty male basketball players aged 18–23 years were initially recruited through total sampling, of whom 17 completed the intervention and were included in the final analysis. The training program consisted of 12 sessions conducted three times per week over four weeks, incorporating cone hops with 180° turns and change-of-direction movements. Sprint performance was assessed using the 20-meter sprint test before and after the intervention. Data were analyzed using a paired-samples t-test. The results demonstrated a statistically significant reduction in sprint time from 3.432 ± 0.334 seconds at pretest to 3.185 ± 0.227 seconds at posttest ($p = 0.001$), representing an average improvement of 0.247 seconds (7.2%). These findings suggest that a four-week plyometric cone hops training program may improve short-distance sprint performance in university basketball players. However, controlled studies are needed to establish its effectiveness.

Keywords: Plyometric training; Cone hops; Sprint performance; Basketball players; Running speed.

Copyright © 2026 Wijianto, Hilmi Ega Muktabar, Hana Nuha Kurnia, Hafid Erli Nurdin Pratama
This work is licensed under a Creative Commons Attribution-ShareAlike 4.0 International License

INTRODUCTION

Research carried out by indicates that physical activity has the potential to improve physical fitness, quality of life and individual performance. Basketball is one of the sports with the highest levels of participation worldwide. (Fikri, Danardani, & Budi Darmawan, 2022) report that the number of players worldwide stands at 450 million, across both professional and recreational levels. Basketball in Indonesia is popular amongst various sections of society, including teenagers, young adults and university students (Fatoni, N., Supriyadi, S., Widiawati, 2022). The high level of interest in this sport has led to increasingly fierce competition amongst players. Consequently, each individual requires strong skills to succeed in this competitive environment. The primary objective of basketball is to score points by shooting the ball into the hoop; to achieve this, effective and efficient movements are essential. These movements are achieved by mastering the techniques of throwing and catching, dribbling, shooting, lay-ups, pivoting, and rebounding(Febrianti, 2019). Most sporting activities require a combination of strength, speed, endurance, and complex movements involving a wide range of joint motion. Therefore, mastering the basic techniques in sport is influenced by a good level of physical fitness, such as speed, power, agility, coordination and balance (Putri & Jatmiko, 2022).

The ability to run fast is a key component of basketball, particularly when moving quickly between positions on the court. This ability has a significant impact on a player's performance during a match, such as when chasing the ball, making a lay-up or blocking an opponent (Gou & Li, 2025; Jinan, Ashadi, Wulandari, & Purnomo, n.d.). The strength of the lower-limb muscles including the quadriceps, hamstrings, glutes and calf muscles also determines the effectiveness of acceleration and sprinting over short distances (Sudarna, Rusdiana, Imanudin, Umaran, & Kurniawan, 2021). Although basketball is played on a relatively small court and features a fast-paced game, data indicates that a player can cover a total distance of 4,500–5,000 metres over the course of a 40-minute match (Paes et al., 2022). These findings underscore the importance of designing training programmes that specifically accommodate the physical demands and movement characteristics of the game of basketball.

Improvements in a basketball team's performance are largely determined by the players' overall physical condition. However, these physical demands are not yet fully

met through specifically designed and structured training program. This situation highlights the importance of strengthening physical components in line with the characteristics of the game; consequently, training interventions are required that can optimally develop these physical aspects. One approach that can be adopted is the implementation of plyometric training.

Plyometric exercise is a training method widely used to improve explosive performance, such as speed or sprinting (Kusminto, Kusnanik, & Mintarto, 2019). This training method utilises the Stretch-Shortening Cycle (SSC), which is a rapid sequence of muscle and tendon stretching and contraction. This mechanism helps to improve muscle performance and generate force, thereby influencing speed (Matthew J Jordan et al., 2023). Somruthai Poomsalood & Sasima Pakulanon (2016) demonstrated in their study that a 4-week plyometric training programme can improve the running speed of basketball players, as measured by a 20-metre sprint test. These findings suggest that incorporating plyometric training over a short period has the potential to improve basketball players' running speed. However, previous research has not specifically analysed the effectiveness of plyometric cone hops on running speed. Therefore, this study was conducted to analyse the effectiveness of plyometric cone hops in improving the running speed of basketball players.

METHOD

This study employed a quantitative approach with a pre-experimental, one-group pre-test post-test design to measure changes in running speed before and after a plyometric cone hop training intervention. The study was conducted in November–December 2025 at the UMS Sports Hall (GOR). The study population comprised 20 participants, all of whom were selected as the sample through total sampling based on inclusion and exclusion criteria.

The inclusion criteria for this study were: male members of the UMS Basketball Club, aged 18–23 years, who were actively attending training sessions and willing to participate as respondents until the study was completed. Exclusion criteria included subjects with lower limb injuries, those with vestibular disorders such as vertigo, or those still undergoing recovery from injury. Meanwhile, subjects were classified as dropouts if they missed three training sessions or withdrew during the course of the study. Based on these criteria, 20 subjects were identified as meeting the study requirements. This study

has obtained ethical approval from the Health Research Ethics Committee (KEPK) of the Faculty of Health Sciences, Muhammadiyah University of Surakarta, under No. 1750/KEPK-FIK/XI/2025, issued on 27 November 2025.

The independent variable in this study was plyometric cone hops, whilst the basketball players' running speed served as the dependent variable. Before the intervention began, the participants undertook a 15-minute stretching session aimed at reducing the risk of injury and facilitating neuromuscular preparation. This was followed by plyometric cone hops with a 180° turn and cone hops with a change of direction (COD) sprint. The intervention lasted for 4 weeks, with training sessions held three times a week and a one-day rest interval between sessions (Pechlivanos et al., 2024) . This study implemented a progressively increasing training programme each week to allow the muscles to adapt to and respond to the training load. The exercises consisted of 3 sets of 8 repetitions (Brini et al., 2023), with a 10-second rest between each set. Each training session was tailored to the number and level of complexity of the movements, as shown in Table 1.

Tabel 1. Training load for plyometric cone hops

Week	Plyometric drill	Set x repetition	Rest set (second)	Time (minute)	Intensity
Ke-1	Front cone hops	3 x 8	10 s	4 m	Low
	Lateral cone hops	3 x 8	10 s	4 m	Low
	Diagonal cone hops	3 x 8	10 s	2 m	Low
Ke-2	Front cone hops	3 x 8	10 s	4 m	Low
	Lateral cone hops	3 x 8	10 s	4 m	Low
	Diagonal cone hops	3 x 8	10 s	2 m	Low
Ke-3	Front cone hops	3 x 8	10 s	4 m	Low
	Lateral cone hops	3 x 8	10 s	4 m	Low
	Diagonal cone hops	3 x 8	10 s	2 m	Low
	Cone hops with change of direction (COD) sprint	3 x 8	10 s	8 m	Moderate
Ke-4	Front cone hops	3 x 8	10 s	4 m	Low
	Lateral cone hops	3 x 8	10 s	4 m	Low
	Diagonal cone hops	3 x 8	10 s	2 m	Low
	Cone hops with change of direction (COD) sprint	3 x 8	10 s	8 m	Moderate
	Cone hops with 180^{o} turn	3 x 8	10 s	3 m	Moderate

Running speed was measured before (pre-test) and after (post-test) the intervention using a 20-metre sprint test. The categories in the 20-metre sprint test are as follows: 2.58–2.91 (very good), 2.92–3.34 (good), 3.35–3.72 (average), 3.73–4.11

(poor), and 4.12–4.50 (very poor)(Sudarna et al., 2021) (Abdul Narlan & Dicky Tri Juniar, 2020). The instrument has been validated with a coefficient of 0.95 and has been found to be reliable with a reliability coefficient of 0.82. This indicates that the measurements are consistent and valid for use.

RESULT AND DISCUSSION

Result

Data collection for the study took place during November–December 2025 at the UMS Sports Hall. A total of 20 respondents were selected for this study based on inclusion and exclusion criteria; however, only 17 were analyzed at the end of the study, as the other three met the criteria for withdrawal.

Tabel 2. Distribusi karakteristik responden

Variable	n	%	min	median	max	mean	SD
Age							
18	5	29,4	18	19	21	19,117	0,992
19	7	41,2					
20	3	17,6					
21	2	11,8					
Body Weight							
54-64	6	35,3	54	68	94	70,411	12,535
65-74	4	23,5					
75-84	5	29,4					
85-94	2	11,8					
Height							
161-170	7	41,2	161	173	185	173,823	6,673
171-180	7	41,2					
181-190	3	17,6					
Body Mass Index (BMI)							
<18,5	0	0	18,50	22,80	30,90	23,26	3,60
18,5 - 22,9	9	52,9					
23 - 24,9	1	5,9					
25 - 29,9	6	35,3					
>30	1	5,9					
Pre test running speed (20-metre sprint test (seconds))							
2,58 - 2,91	1	5,9	2,58	3,14	4,03	3,432	0,334
2,92 - 3,34	4	23,5					
3,35 - 3,72	9	52,9					
3,73 - 4,11	3	17,6					
4,12 - 4,50	0	0					

Table 2 shows that this study involved 17 respondents (n=17). The 19-year-old age group constituted the largest proportion of respondents, at 41.2% (7 respondents), with an average age of 19.117 ± 0.992. Regarding height, the 161–170 cm and 171–180 cm groups were the most numerous, each comprising 7 respondents (41.2 per cent), with a mean of 173.823 ± 6.673. This distribution indicates a relatively homogeneous distribution of height.

The majority of respondents fell within the 54–64 kg weight range, namely 6 respondents (35.3%), with an average of 70.411 ± 12.535. Variation in body weight appeared to be greater than that in age and height. Based on body mass index (BMI), the majority of respondents fell into the normal category (18.5–22.9), comprising 9 respondents (52.9%), with a mean of 23.25 ± 3.60 kg/m². In general, the distribution of respondents' BMI was within the normal range. Prior to the intervention, the measurement results showed that the majority of respondents fell into the 3.35–3.72 seconds (moderate) category, comprising 9 people (52.9%). The 20-metre sprint test results prior to the intervention (pre-test) showed a minimum time of 2.58 seconds, a maximum time of 4.03 seconds, and a mean of 3.432 ± 0.334 seconds. This indicates that the distribution of the respondents' sprint times was still varied prior to the intervention.

Table 3. Running speed results from the 20-metre sprint test after the intervention

Variable **Post test (20 metre sprint test (seconds))**	**n**	**%**
2,58 - 2,91	3	17,6
2,92 - 3,34	9	52,9
3,35 - 3,72	5	29,4
3,73 - 4,11	0	0
4,12 - 4,50	0	0
Min		2,71
Max		3,50
Mean		3,185
Standard Deviation		0,227

Based on Table 3, the plyometric cone hops intervention resulted in a shorter 20-metre sprint time, thereby indicating an increase in running speed. Generally, 9 participants (52.9 per cent) fell into the 2.92–3.34-second category (good), with a minimum time of 2.71 seconds and a maximum of 3.50 seconds, and a mean of 3.185 ±

0.227. A smaller standard deviation indicates that speed variation became more homogeneous following the plyometric cone hop intervention.

Table 4. Test of normality of the data

Normality Test	P-value	Description
Pretest	0,411	Normally distributed
Posttest	0,545	Normally distributed

Note: P>0,05 Normally distributed data

Table 4 shows the results of the normality test carried out using the Shapiro-Wilk test, with p-values for both the pre-test and post-test greater than 0.05, indicating that the data are normally distributed.

Table 5. Results of the data analysis

Variable	Pre	Post	Paired T-test
	Mean (SD)	Mean (SD)	Sig,
Speed	3,432 (0,334)	3,185 (0,227)	0,001

Note: Significance p<0,05

Referring to Table 5, data analysis using a paired t-test revealed a positive effect on running speed following the plyometric cone hops intervention, with a p-value of 0.001 ($p < 0.05$). Based on the results of the analysis, it can be concluded that the plyometric cone hops intervention is statistically effective in improving running speed among players in the UMS University Basketball Club.

Discussion

The plyometric cone hop exercise used in this study involves jumping, landing and rapid changes of direction, thereby stimulating the major muscles of the lower limbs (Sudarna et al., 2021). These movements can also improve neuromuscular coordination and the efficient utilisation of elastic energy through the stretch-shortening cycle mechanism (Groeber, Stafilidis, & Baca, 2021; Ramírez-Campillo et al., 2016). These findings are consistent with previous research showing that plyometric training can improve sprint speed and the ability to change direction in basketball players (Poomsalood & Pakulanon, 2016). This is due to neuromuscular adaptations and more efficient utilization of the stretch-shortening cycle (SSC), enabling the muscles to generate force rapidly and support increased running speed (Ahmadabadi, S., Rjabi, H.,

Gharakhanlou, R., Talebian, S., Basereh, 2023). A several study, support the findings of this research, which show that jump-based plyometric exercises can improve running speed and explosive power (Chandra, S., Sharma, A., Malhotra, N., Rizvi, M. R., Kumari, 2023). The explosive nature of these movements, which involve changes of direction, is consistent with the patterns seen in plyometric cone hops and the movement patterns in basketball, thereby improving players' running speed.

Furthermore, beyond physiological mechanisms, the respondents' body mass index (BMI) also influenced the interpretation of improvements in running speed. This is consistent with the findings of (Fernández-Galván, L. M., Boullosa, D., Jiménez-Reyes, P., Cuadrado-Peñafiel, V., Casado, 2021), who reported that players with a higher BMI were associated with lower sprinting ability. Overall, this study demonstrates that a four-week program of plyometric cone hop training has the potential to improve running speed in basketball players. For future research, it is recommended to utilize instruments that measure biomechanical parameters (such as RFD and foot-ground contact) and neuromuscular parameters (muscle activation patterns).

CONCLUSION

The plyometric cone hop training carried out in this study, comprising 12 sessions over 4 weeks, showed preliminary changes improved the running speed of players from the UMS Basketball Club; consequently, the research objectives and hypotheses put forward are supported. This training can be considered as one method of improving speed as it involves explosive and multidirectional movements that are in line with the demands of basketball. However, this study only evaluated running performance in functional terms and did not directly measure biomechanical or neuromuscular changes. Therefore, it is recommended that future research utilise instruments to analyse RFD, ground contact time, and muscle activation patterns in order to gain a more objective understanding of the mechanisms underlying speed improvement.

REFERENCES

Abdul Narlan, M. P., & Dicky Tri Juniar, M. P. (2020). *Pengukuran Dan Evaluasi Olahraga*. Deepublish.

Ahmadabadi, S., Rjabi, H., Gharakhanlou, R., Talebian, S., Basereh, A. (2023). Effects of a 4-week plyometric training on activity patterns during different phases of one-leg drop jump with focus on jump height. *Scientific Reports*, *13*(1). https://doi.org/https://doi.org/10.1038/s41598-023-36461-1

Brini, S., Boullosa, D., Calleja-González, J., Ramirez-Campillo, R., Nobari, H., Castagna, C., … Ardigò, L. P. (2023). Neuromuscular and balance adaptations

following basketball-specific training programs based on combined drop jump and multidirectional repeated sprint versus multidirectional plyometric training. *PLOS ONE*, *18*(3), e0283026. https://doi.org/10.1371/journal.pone.0283026

Chandra, S., Sharma, A., Malhotra, N., Rizvi, M. R., Kumari, S. (2023). Effects of Plyometric Training on the Agility, Speed, and Explosive Power of Male Collegiate Badminton Players. *Journal of Lifestyle Medicine*, *13*(1), 52–58. https://doi.org/https://doi.org/10.15280/jlm.2023.13.1.52

Fatoni, N., Supriyadi, S., Widiawati, P. (2022). Pengembangan Materi Bola Basket Tahap Fundamental Pada Klub Hutama Manggala Basketball Yang Dikemas Dalam E-Modul. *Sport Science and Health*, *4*(2), 103–111. https://doi.org/https://doi.org/10.17977/um062v4i22022p103-111

Febrianti, N. (2019). *Analisis Komponen Fisik Terhadap Kemampuan Teknik Dasar Permainan Bola Basket Siswa SMA Katolik Cendrawasih Makassar.*

Fernández-Galván, L. M., Boullosa, D., Jiménez-Reyes, P., Cuadrado-Peñafiel, V., Casado, A. (2021). Examination of the sprinting and jumping force-velocity profiles in young soccer players at different maturational stages. *International Journal of Environmental Research and Public Health*, *18*(9). https://doi.org/https://doi.org/10.3390/ijerph18094646

Fikri, A., Danardani, W., & Budi Darmawan, G. E. (2022). TINGKAT MOTIVASI ATLET REMAJA MENGIKUTI GLADIATOR BASKETBALL ACADEMY CLUB. *Jurnal Pendidikan Kepelatihan Olahraga Undiksha*, *13*(3), 89–94. https://doi.org/10.23887/jjpko.v13i3.53862

Gou, Q., & Li, S. (2025). The influence of basketball players' tracking speed ability on sports decision performance. *PeerJ*, *13*, e20266. https://doi.org/10.7717/peerj.20266

Groeber, M., Stafilidis, S., & Baca, A. (2021). The effect of stretch–shortening magnitude and muscle–tendon unit length on performance enhancement in a stretch–shortening cycle. *Scientific Reports*, *11*(1), 14605. https://doi.org/10.1038/s41598-021-94046-2

Jinan, U., Ashadi, K., Wulandari, F. Y., & Purnomo, M. (n.d.). IMPLEMENTASI PROGRAM LATIHAN FISIK SPESIFIK POSISI UNTUK MENINGKATKAN PERFORMA STRIKER SEPAK BOLA. In *Indonesia Strength Conditioning and Coaching Journal* (Vol. 2).

Kusminto, P. T., Kusnanik, N. W., & Mintarto, E. (2019). Pengaruh Latihan Box Drill Dan Jump Drill Terhadap Kelincahan Dan Kecepatan. *Journal Mandala Nusa*, *7*(1). https://doi.org/http://ejournal.mandalanursa.org/index.php/JIME/indexterakreditasiPeringkat4

Matthew J Jordan, Per Aagaard, Chris Bishop, Zachary McClean, Nathaniel Morris, Nathan Boon-van Mossel, … Walter Herzog. (2023). EXPLOSIVE STRENGTH AND STRETCH-SHORTENING-CYCLE CAPACITY DURING ACL REHABILITATION. *ASPETAR SPORT MEDICINE JOURNAL*, *12*.

Paes, P. P., Correia, G. A. F., Damasceno, V. D. O., Lucena, E. V. R., Alexandre, I. G., Da Silva, L. R., Dos Santos, W. R., & De Freitas Júnior, C. G. (2022). Effect of plyometric training on sprint and change of direction speed in young basketball athletes. *Journal of Physical Education and Sport*, *22*(2), 305–310. https://doi.org/https://doi.org/10.7752/jpes.2022.02039

Pechlivanos, R. G., Amiridis, I. G., Anastasiadis, N., Kannas, T., Sahinis, C., Duchateau, J., & Enoka, R. M. (2024). Effects of plyometric training techniques on vertical jump performance of basketball players. *European Journal of Sport Science*, *24*(6), 682–692. https://doi.org/10.1002/ejsc.12097

Poomsalood, S., & Pakulanon, S. (2016). Effects of 4-week Plyometric Training on Speed, Agility, and Leg Muscle Power in Male University Basketball Players: A Pilot Study. *Kasetsart Journal - Social Sciences.*

Putri, T. C., & Jatmiko, T. (2022). Analisis Kondisi Fisik Atlet Basket Putri Universitas Ciputra Tahun 2022. *JPO: Jurnal Prestasi Olahraga*.

Ramírez-Campillo, R., Vergara-Pedreros, M., Henríquez-Olguín, C., Martínez-Salazar, C., Alvarez, C., Nakamura, F. Y., … Izquierdo, M. (2016). Effects of plyometric training on maximal-intensity exercise and endurance in male and female soccer players. *Journal of Sports Sciences*, *34*(8), 687–693. https://doi.org/10.1080/02640414.2015.1068439

Somruthai Poomsalood, & Sasima Pakulanon. (2016). Effects of 4-week Plyometric Training on Speed, Agility, and Leg Muscle Power in Male University Basketball Players: A Pilot Study. *Kasetsart Journal - Social Sciences*, *36*, 598–606.

Sudarna, N. S., Rusdiana, A., Imanudin, I., Umaran, U., & Kurniawan, T. (2021). Analisis Volume Permainan Berdasarkan Posisi Pemain di UKM Bola Basket Putra. *UPI JTIKOR (Jurnal Terapan Ilmu Keolahragaan*. https://doi.org/. https://doi.org/10.17509/jtikor.v8i2