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Original Article

Impact of a Specific Physical Training Program on Physical Performance in U15 Female Basketball Players

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Abstract

The aim of this study was to examine changes in selected physical performance indicators following a sport-specific training program in 12 U´15 female basketball players. Testing was conducted before and after the intervention using a 20-m sprint, countermovement jump, adapted T-test, and multistage 20-m shuttle run. The intervention was integrated into the team's regular training and was implemented between the first and second test periods preceding the U´15 national final tournament. Paired-samples t-tests were used to compare pre- and post-intervention values. Significant improvements were found in countermovement jump, adapted T-test, and shuttle-run performance, whereas the improvement in 20-m sprint time did not reach statistical significance. The findings indicate that a structured, basketball-specific conditioning program may contribute to improvements in explosive power, change-of-direction performance, and aerobic capacity in adolescent female players.

1. Introduction

Basketball is an intermittent team sport that requires repeated accelerations, decelerations, jumps, changes of direction, and high-intensity running actions. Consequently, speed, explosive lower-limb power, change-of-direction ability, and aerobic capacity are important components of physical preparation in youth basketball. For adolescent female players, these qualities should be developed progressively and in close connection with the technical and tactical requirements of the sport.

Recent research indicates that plyometric and functional training can improve several physical performance outcomes in female basketball players, although the

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magnitude of the response varies according to the population, intervention duration, exercise selection, and outcome measure (Bouteraa et al., 2020; Cao et al., 2024a, 2024b). Meta-analytic evidence has also reported improvements in countermovement jump and change-of-direction performance following plyometric training in female athletes, with adolescent players showing meaningful responses to sufficient training exposure (Lin et al., 2025).

Youth basketball research further suggests that basketball-specific high-intensity conditioning and small-sided games can improve aerobic performance and selected physical capacities while maintaining a close relationship with the sport's movement demands (Aschendorf et al., 2019; Li et al., 2024). Training approaches that combine sport-specific movements with plyometric, speed, agility, and conditioning exercises may therefore be useful when the objective is to develop several physical qualities simultaneously.

The present study was conducted with a competitive U15 girls' basketball team. At the end of the previous U14 national championship, the team finished in second place. Following the subsequent break, the players resumed training in the U15 category. The first assessment (T1) was conducted at the beginning of the U15 preparation period, followed by a structured physical preparation program integrated into regular basketball training. The second assessment (T2) was conducted before the U15 final tournament, which the team subsequently won. This chronology is important because the U14 result represents the previous competitive season, whereas the intervention and T1–T2 comparison refer to the U15 season.

The purpose of the study was to examine the changes in speed, explosive lower-limb power, change-of-direction performance, and aerobic endurance between T1 and T2. It was hypothesized that the specific training program would be associated with improvements in all four physical performance indicators

2. Material and methods

2.1. Participants

The study included 12 female basketball players competing in the U15 category. The players belonged to the same competitive team and had previous experience in organized basketball training. The athletes participated in the team's normal training program throughout the study period. Informed consent for participation was obtained from the athletes and their guardians, and the procedures were conducted in accordance with applicable ethical requirements.

The competitive chronology was as follows: the team finished second at the U14 National Championship final tournament; after the subsequent vacation period, the team entered the U15 National Championship; T1 was performed after resumption of training; the specific preparation program was then implemented; T2 was conducted before the U15 final tournament; and the team subsequently won the U15 National Championship. Thus, the T1–T2 comparison represents the period of the U15 preparation program and should not be interpreted as a comparison between U14 and U15 age categories.

2.2. Testing Battery

Four tests were used at T1 and T2: the 20-m sprint, countermovement jump, adapted T-test, and multistage 20-m shuttle run (Beep Test). The same testing procedures were used at both time points.

20-m sprint. The test was performed indoors from a standing start. Each player completed two attempts, and the best time was retained for analysis. Lower completion time represented better performance.

Countermovement jump. Explosive lower-limb performance was assessed using a countermovement jump. Each player completed two attempts and the best jump height was retained for analysis. Higher values represented better performance.

Adapted T-test. Change-of-direction performance was assessed using the adapted T-test. The course consisted of four markers: A–B = 5 m and B–C = 2.5 m, with corresponding lateral movements between B, C, and D. The player sprinted forward from A to B, touched B with the right hand, side-stepped to C and touched C with the left hand, side-stepped to D and touched D with the right hand, side-stepped back to B and touched B with the left hand, and finally ran from B to A. The timing started with the initial movement and stopped when the player crossed the A marker. A trial was invalid if the legs were crossed during side-stepping or if the required marker was not touched. One attempt was performed.

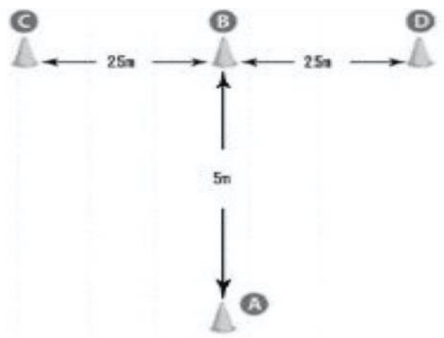

Figure 1. *Adapted T-test route used in the study*

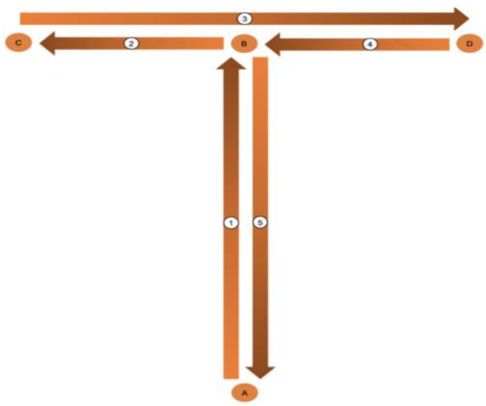

Figure 2. *Schematic sequence of movements in the adapted T-test.*

Beep Test. Aerobic endurance was assessed using the multistage 20-m shuttle run. The players ran continuously between two lines separated by 20 m, following audio signals that progressively increased running speed. The highest completed level was recorded as the performance score.

2.3. Training Intervention

The physical preparation program was integrated into the team's regular training schedule. Training was performed three times per week within 90-minute basketball sessions. The program included sprint exercises, plyometric jumps, agility and ladder drills, multidirectional movements, and sport-specific conditioning activities. Training load was progressively adjusted according to the players' adaptation and the competitive calendar. The intervention was intended to develop several physical qualities simultaneously while preserving the technical and tactical specificity of basketball.

The intervention was conducted between T1 and T2. T2 was deliberately scheduled before the U15 final tournament, allowing the post-intervention assessment to be performed under conditions closely related to the competitive period.

2.4. Statistical Analysis

Descriptive statistics are presented as mean ± standard deviation (SD). Because the same 12 players were assessed at T1 and T2, paired-samples t-tests were used to compare pre- and post-intervention values. Statistical significance was set at $p < .05$. The analysis was based on the individual T1 and T2 values recorded in the study dataset. The standardized paired effect size (Cohen's dz) was also calculated as the mean paired difference divided by the standard deviation of the paired differences.

3. Results and Discussions

The T1 and T2 results are presented in Table 1. Mean 20-m sprint time decreased from 3.46 ± 0.19 s to 3.40 ± 0.23 s, representing an average improvement of 0.06 s; however, the paired-samples t-test did not reach statistical significance ($t(11) = 1.715$, $p = .114$, dz = 0.50).

Countermovement jump performance increased from 32.64 ± 3.54 cm at T1 to 36.48 ± 3.62 cm at T2. This improvement of 3.84 cm was statistically significant ($t(11) = −5.526$, $p < .001$, dz = 1.60). Adapted T-test time decreased from 6.58 ± 0.21 s to 6.48 ± 0.21 s, corresponding to a statistically significant improvement ($t(11) = 3.743$, $p = .003$, dz = 1.08). Beep Test performance increased from 7.45 ± 0.55 to 8.40 ± 0.97 levels, also showing a statistically significant improvement ($t(11) = −4.737$, $p < .001$, dz = 1.37).

Table 1. *Pre- and post-intervention physical performance results.*

Variable	T1 Mean ± SD	T2 Mean ± SD	Mean change	t(11)	p	Cohen's dz
20-m sprint (s)	3.46 ± 310.19	3.40 ± 0.23	−0.06	1.715	.114	0.50
Countermovement jump (cm)	32.64 ± 3.54	36.48 ± 3.62	+3.84	−5.526	<.001	1.60
Adapted T-test (s)	6.58 ± 0.21	6.48 ± 0.21	−0.09	3.743	.003	1.08
Beep Test (level)	7.45 ± 0.55	8.40 ± 0.97	+0.95	−4.737	<.001	1.37

Discussions

The main finding of the present study was that the period of specific physical preparation was associated with significant improvements in countermovement jump, adapted T-test, and Beep Test performance, whereas the change in 20-m sprint time was not statistically significant. The pattern of results is therefore more nuanced than the original statement that all variables improved significantly. This distinction is important when interpreting the effect of the intervention in a small, uncontrolled sample.

The improvement in countermovement jump is consistent with evidence from female basketball and youth team-sport populations. Meszler and Váczi (2019) reported changes in jump-related performance following additional plyometric training in adolescent female basketball players, while Bouteraa et al. (2020) found improvements in selected performance variables after combined balance and plyometric training. More recent evidence is also supportive: Cao et al. (2024a) reported that plyometric training can improve countermovement jump and other physical performance measures in female basketball players, and Zhou et al. (2024) found positive effects of plyometric training on jumping performance, sprinting, and change-of-direction ability in youth basketball players.

The magnitude of the change in the present CMJ result was substantial within this group (dz = 1.60). However, because the study has no control group, the result cannot establish that the training program alone caused the improvement. Growth, maturation, concurrent basketball training, accumulated competitive experience, and familiarity with testing may also have contributed to the observed change. This limitation should be considered when comparing the present findings with controlled intervention studies.

The adapted T-test improved significantly. Change-of-direction performance is highly relevant to basketball beca use players repeatedly accelerate, decelerate, brake, and redirect their movement. Reviews of youth and team-sport athletes indicate that resistance, plyometric, sprint, and combined training can all improve change-of-direction performance, although the optimal method depends on the task and training design (Falch et al., 2019; Chaabene et al., 2020; Chen et al., 2025). The present program incorporated multidirectional movement, agility drills, sprinting, and plyometric exercises, which provides a plausible training-specific explanation for the observed improvement.

The improvement in Beep Test performance is also compatible with the sport-specific conditioning literature. Basketball-specific high-intensity interval training has been shown to improve aerobic performance in youth female basketball players, and small-sided games may provide an additional sport-specific stimulus for aerobic and change-of-direction adaptations (Aschendorf et al., 2019; Li et al., 2024). The present intervention combined conditioning with basketball movements, which may have supported the observed increase in shuttle-run performance.

The 20-m sprint result requires a more cautious interpretation. Mean sprint time improved from 3.46 s to 3.40 s, but the paired comparison was not statistically significant ($p = .114$). This finding is not inconsistent with the literature, which reports variable sprint responses depending on the training method, duration, participant characteristics, and baseline performance.

For example, evidence from female basketball and youth populations indicates that plyometric or combined training can improve sprint performance in some settings, but not uniformly across all protocols (Bouteraa et al., 2020; Cao et al., 2024a; Lin et al., 2025). The present result therefore suggests a possible small improvement in linear speed, but the available data do not support describing it as statistically confirmed.

The training frequency and integration into regular basketball practice are also relevant. Recent research in adolescent female basketball players has shown that plyometric training performed during the season can improve change-of-direction and jumping performance, while different weekly frequencies may produce similar adaptations when training volume is controlled (Figueira et al., 2025).

Similarly, studies of young female basketball players emphasize the value of structured, progressive programs that are adapted to the competitive calendar (Komotska & Sushko, 2022). The present intervention followed this principle by integrating physical conditioning into the team's existing basketball sessions rather than treating conditioning as a separate program.

The competitive outcome provides useful contextual information but should not be interpreted as proof of causation. The team finished second in the U14 National Championship before the intervention period and subsequently won the U15 National Championship after the T1–T2 training period. The temporal association between the physical improvements and the later competitive result is noteworthy, but the championship outcome is influenced by many factors beyond physical conditioning, including technical skill, tactical performance, opponent characteristics, team cohesion, coaching, and match-specific circumstances. Therefore, the present study supports an association between the training period and changes in physical performance, not a direct causal attribution of the championship result to the program.

The principal methodological limitations are the small sample size ($n = 12$), the absence of a control group, and the use of players from a single team. These factors limit statistical power and the generalizability of the findings. In addition, adolescent athletes undergo growth and maturation, which can influence physical performance independently of training. Future research should include larger samples, control or comparison groups, longer follow-up periods, and, where possible, measures of biological maturation. Such designs would allow stronger conclusions regarding the independent contribution of sport-specific physical conditioning.

4. Conclusions

The specific physical preparation period was associated with significant improvements in countermovement jump, adapted T-test performance, and Beep Test performance in the U15 female basketball players studied. The 20-m sprint time also improved descriptively, but the change did not reach statistical significance. These findings indicate that an integrated program combining sprint, plyometric, agility, multidirectional, and conditioning exercises may be useful for developing several physical qualities in adolescent female basketball players. Nevertheless, the small sample and absence of a control group require cautious interpretation, and the findings should not be generalized beyond similar populations without further controlled research. The team's subsequent U15 national championship represents a competitive outcome occurring after the intervention period, but it cannot be attributed solely to the physical training program.

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Conflict of Interest

The authors declare no conflict of interest.

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