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The Effect of Contrast Training Method on Agility Performance in Star Female Basketball Players

Kontrast Antrenman Metodunun Yıldız Kız Basketbolcularda Çeviklik Performansına Etkisi

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Abstract

The aim of this study is to examine the effect of the contrast training method on agility performance in star female basketball players. 24-star female basketball players participated in the research. Players were randomly divided into two groups: control group (CG, n=12) and contrast training group (CTG, n=12). While CG continues his routine basketball training; in addition to CTG, contrast training was applied as shown in Table 1. Illinois test and reactive agility test data for planned direction change were taken from the groups. In the statistical analysis of the data, "Paired t-test" was applied for the changes in the values in the pre- and post-test results, and "Independent t-Test" was applied for the differences between the groups. The significance level was accepted as "p<.05". According to the Illinois and Reactive Agility Paired t-Test results of the groups, there was no difference in CG (p>.05); A difference was found in CTG (p<.05). As a result of comparing Illinois and Reactive Agility pre- and post-test values with CG and CTG, the difference in Illinois and Reactive Agility post-test results was found to be significant (p<.05); There was no difference in pre-test values (p>.05). In conclusion, it is thought that applying contrast training methods with appropriate intensities are important in preparation and in-season training in basketball, where multi-directional movements are widely applied, to reach the optimum level of agility, which is defined as changes in direction involving physical, technical, perceptual and decision-making skills.

Keywords Contrast Training, Agility, Basketball.

Öz

Bu çalışmanın amacı, yıldız kadın basketbolcularda kontrast antrenman yönteminin çeviklik performansına etkisini incelemektir. Araştırmaya 24 yıldız kadın basketbolcu katılmıştır. Oyuncular rastgele iki gruba ayrılmıştır: kontrol grubu (KG, n=12) ve kontrast antrenman grubu (KTG, n=12). KTG rutin basketbol antrenmanlarına devam ederken; KTG'ye ek olarak Tablo 1'de gösterildiği gibi kontrast antrenman uygulanmıştır. Gruplardan, planlı yön değişikliği için Illinois testi ve reaktif çeviklik testi verileri alınmıştır. Verilerin istatistiksel analizinde, ön ve son test sonuçlarındaki değerlerdeki değişimler için "Eşleştirilmiş t-Testi", gruplar arasındaki farklar için ise "Bağımsız t-Testi" uygulanmıştır. Anlamlılık düzeyi "p<.05" olarak kabul edilmiştir. Grupların Illinois ve Reaktif Çeviklik Eşleştirilmiş t-Testi sonuçlarına göre, KT'de fark bulunmamıştır (p>.05); CTG'de fark bulundu (p<.05). Illinois ve Reaktif Çeviklik ön ve son test değerlerinin CG ve CTG ile karşılaştırılması sonucunda, Illinois ve Reaktif Çeviklik son test sonuçlarındaki farkın anlamlı olduğu (p<.05); ön test değerlerinde fark olmadığı görüldü (p>.05). Sonuç olarak, çok yönlü hareketlerin yaygın olarak uygulandığı basketbolda, fiziksel, teknik, algısal ve karar verme becerilerini içeren yön değişiklikleri olarak tanımlanan optimum çeviklik seviyesine ulaşmak için hazırlık ve sezon içi antrenmanlarda uygun yoğunluklarda kontrast antrenman yöntemlerinin uygulanmasının önemli olduğu düşünülmektedir.

Anahtar Kelimeler Kontrast Antrenman, Çeviklik, Basketbol.

Note: *This study was presented as Master Thesis at Süleyman Demirel University Institute of Health Scinces Exercise and Sport Sciences Department.*

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Introduction

Basketball, by its nature, is a game that is very fast-paced and changes quickly. Due to the dynamics of the game, players need to be active and ready as if they will pass, shoot, dribble, or jump for a rebound. Starting from childhood and adolescence, basketball develops physical strength characteristics such as endurance, power, speed, and agility through conscious training, bringing them to a high level with training even during maturity (Sevim, 1981).

Basketball is a sport where athletes can showcase their personal attributes. After learning the technical aspects of basketball, athletes are required to combine these with their personal traits and integrate them with the game's tactics (Wissel, 2004).

Agility is a highly important feature in basketball and gives athletes a competitive edge. This skill is crucial for overcoming a defending player during an offensive play. For the defending player, it is important to respond to the opponent's agility equally or more effectively (Öz, 2018; Yel et al., 2023).

Players performing in basketball need to quickly reach the opponent's basket and finalize their positions within the shortest time frame. Athletes can maximize their performance during a match, demonstrate the correct technique, and show accurate timing, with a well-developed speed characteristic (Usgu, 2015).

Basketball inherently includes movement types like acceleration and deceleration, change of planes, and jumping abilities. An athlete involved in basketball must perform these movements without any change in their speed (Kizilet et al., 2010).

Detailed research indicates that training with low weights followed by high-speed movements in the upper and lower extremities can enhance power levels. Contrast training has been shown to increase performance in high and average anaerobic power, speed, jumping, and throwing, and to significantly improve dynamic strength in young males (Ebben & Watts, 1998; Ingle et al., 2006; Polat et al., 2019).

It's possible to say that agility is the synthesis of many physical and cognitive features. One of these training methods is contrast training. Contrast training, an example of strength training, has been shown to positively affect power development. It also enhances skills like jumping performance, agility, sudden change of direction, and has been proven effective in power-demanding team sports (Ebben, 1998).

A study conducted in 2014 on football players found that the contrast training method positively affected the performance of football-specific skills like speed, vertical jump, striking the ball, and agility (García-Pinillos et al., 2014).

Based on information, this study aims to examine the effect of the contrast training method on the agility performance of junior female basketball players2020).

METHOD

In Study Model

This research was carried out using the experimental method, one of the quantitative research methods.

Participants

Twenty-four junior female basketball players from the Isparta Municipality Sports Club voluntarily participated in the study. An explanation regarding the confidentiality of the obtained data and personal information was provided to the athletes and their parents, and a "Parental Information and Consent Form" was obtained from each athlete's parents. The study was conducted in accordance with the Declaration of Helsinki and its later amendments and was also approved by the Erzincan Binali Yıldırım University Health and Sports Sciences Ethics Committee with decision number 01/03.

The basketball players were randomly divided into two groups: a control group (CG, n=12) and a contrast training group (CTG, n=12). While the CG continued with routine basketball training, the contrast training specified in Table 3.3.1 was additionally applied to the CTG. Data from the groups were collected as pre-test data in the 1st week and post-test data in the 8th week. The players had an average age of 15.33±0.49 years for the CG and 15.41±0.51 years for the CTG; height of 156.91±4.60 cm for the CG and 156.66±5.51 cm for the CTG; average body weight of 58.64±2.86 kg for the CG and 57.45±2.98 kg for the CTG; and basketball experience of 7.83±0.83 years for the CG and 7.75±0.96 years for the CTG.

Procedures

The measurements of the basketball players were conducted at Süleyman Demirel University Faculty of Sport Sciences' Performance Test Laboratory.

Height Measurement

The height of the athletes was measured using a SECA brand stadiometer with a precision of 0.1 mm. The athletes were positioned in an anatomical posture with arms hanging down, and the head horizontal, and measurements were recorded in "cm".

Body Weight Measurement

Body weight measurements were taken using a SECA brand electronic scale with a precision of 0.5 kg, with the athletes barefoot wearing only shorts and T-shirts, and were recorded in "kg".

Agility Tests

Planned Change of Direction Test

The Illinois Test was applied to athletes for the planned change of direction test. The Illinois agility test course was 10 m long and 5 m wide, with cones placed at intervals of 3.3 m on a straight line down the middle. The test consisted of a 40 m speed run with 180° turns every 10 m and a 20 m shuttle run. After preparing the test course, a two-gate electronic timing system with a precision of 0.01 sec was set up at the start and finish lines. Participants needed to be informed about the test and its procedures before execution and were allowed to attempt at a slow pace 3-4 times. Participants performed warm-up and stretching exercises at their determined slow pace for 5-6 minutes. They were then asked to sprint from a front-facing prone position (lying face down) with elbows bent and hands beside the chest, palms on the ground, from the start line of the test course. Results were recorded in "sec/min" (Hazır et al., 2010).

Reactive Agility Test

The test was conducted with a SmartSpeed (Fusion Sport, Australia) brand wireless photocell system with accuracy set to 0.01 seconds. A total of 4 timing gates were set up for the test: 1 starting, 1 middle, and 2 exit gates. The timing gates were arranged in the "1-1-2" format, which is considered the optimal model for reactive agility tests. The athlete started the test at a high exit position 30 cm behind the starting gate and ran straight to the middle gate. After passing the middle gate, the athlete ran another straight sprint by making a 45° change of direction toward the gate where visual and auditory stimuli appeared. To prevent athletes from predicting the direction of visual and auditory stimuli beforehand, the device was set to select the direction randomly for each test. Results were recorded in "sec/min" (Inglis &Bird, 2016; di Mascio et al, 2020).

Contrast Training Program

While the CG continued with routine basketball training, the CTG followed the contrast training program specified in Table 1, in addition to basketball training, two days a week.

Table 1. Contrast Training Program

Exercises	Set x Reps
Squat	3 x 3 (85%)
Depth Jump	3 x 4
Weighted Jump	3 x 4 (30%)
Dumbbell Chest Press	3 x 3 (85%)
Depth Push-Up	3 x 4
Medicine Ball Throw	3 x 4 (30%)

Statistical Analysis

Statistical Package for Social Sciences (SPSS) version 24.0 was used to analyze the data. Descriptive statistics were applied for the demographic information of the basketball players, and the "Shapiro-Wilk" normality test was utilized to determine if the data conformed to a normal distribution. After establishing that the data exhibited normal distribution, the "Paired t-Test" was applied to assess changes in pre- and post-test results within groups, and the "Independent Samples t-Test" was used to determine differences between groups. The significance level was set at "p <.05".

FINDINGS

The Paired t-Test results of CG are presented in Table 2.

Table 2. Paired t-Test results of the CG

Agility test (sec/m)	Pre	Post	*t*-Value	*p*-Value
Illinois	20.82 ± 1.59	20.11 ± 1.15	1.22	.256
Reactive Agility	2.89 ± 0.67	2.66 ± 0.54	0.35	.102

Values are expressed as means ± standard deviations. CG= control group; Note. ** p<.001; * p<.05

When examining Table 2, the comparison of the pre and post-test averages of Illinois and Reactive Agility tests in CG shows that the difference was not statistically significant (p>.05).

The Paired t-Test results of CTG are presented in Table 3.

Table 3. Paired t-Test results of the CTG

Agility test (sec/m)	**Pre**	**Post**	***t*-Value**	***p*-Value**
Illinois	20.67 ± 1.57	18.87 ± 1.02	1.89	**.000**
Reactive Agility	2.76 ± 0.89	2.12 ± 0.34	0.24	**.000**

Values are expressed as means ± standard deviations. CTG= contrast training group; Note. ** p<.001; * p<.05

According to Table 3, the comparison of the pre and post-test averages of Illinois and Reactive Agility tests in CTG shows that the difference was statistically significant (p<.05).

The Independent t-Test results of CTG are presented in Table 4.

Table 4. Independent t-Test results between groups

Agility test (sec/m)	**Pre**		***F*-Value**	***p*-Value**	**Post**		***F*-Value**	***p*-Value**
	CG	**CTG**			**CG**	**CTG**		
Illionis	20.82±1.59	20.67±1.57	4.04	0.362	20.11±1.15	18.87±1.02	3.78	**.000**
Reactive Agility	2.89±0.67	2.76±0.89	1.54	0.442	2.66±0.54	2.12±0.34	1.12	**.000**

Values are expressed as means ± standard deviations. CG= control group, CTG= contrast training group; Note. ** p<.001; * p<.05

When examining Table 4, the comparison of the Illinois and Reactive Agility pre and post-test values between CG and CTG indicates that the differences in the post-test results for Illinois and Reactive Agility were significant (p<.05), whereas no significant difference was found in the pre-test values (p>.05).

Discussion

The game of basketball requires multidimensional speed in both offense and defense. An offensive player can gain an advantage by getting past a defender to secure an open shot, basket, or passing lane. Agility is especially valuable in point guards who frequently handle the ball on the court. The ability to create space between the ball handler and the defender facilitates advantageous offensive options. Players capable of producing explosive movements during offense are more likely to evade defenders (Conrad, 2014).

Twenty-four junior female basketball players licensed with the Isparta Municipality Sports Club voluntarily participated in our study. The basketball players were randomly divided into two groups: control group (CG, n=12) and contrast training group (CTG, n=12). While the CG continued their routine basketball training, the CTG underwent

additional contrast training as indicated in Table 1. The average age of the athletes was 15.33±0.49 years for the CG and 15.41±0.51 years for the CTG; with heights of 156.91±4.60 cm for the CG and 156.66±5.51 cm for the CTG; and average body weight of 58.64±2.86 kg for the CG and 57.45±2.98 kg for the CTG; with basketball experience of 7.83±0.83 years for the CG and 7.75±0.96 years for the CTG.

In our study, the effect of the contrast training method on agility in junior female basketball players was examined. According to the results of our study, while no difference was found in the control group ($p>.05$) in the Illionis and Reactive agility pre-test and post-test comparison, a significant difference was found in the contrast training group. In addition, in the comparison of Illionis and Reactive agility tests between the groups, no difference was found in the pre-tests, while the difference was statistically significant in the post-tests ($p<.05$). It is considered that the significant positive differences in results stemmed from the group-appropriate loading-rest principle, the content of the training program, and the involvement of strength exercises within the contrast training applied over eight weeks.

García-Pinillos et al, (2014) found similar results, showing that a 12-week contrast training period positively affected shooting speed, vertical jump, sprint, and agility performance in young football players. They found improvements in shooting speed and vertical jump, as well as reductions in sprint scores over 5, 10, 20, and 30 meters and agility test times following the contrast training program. They noted that their study was the first to examine the effects of a contrast training method combining isometric and plyometric regimes without external load on young football players [9].

Latorre Román et al, (2018) aimed to investigate the effects of a 10-week contrast training program (isometric + plyometric) on speed, jump skills, and agility performance in preadolescent basketball players. According to researchers, it was the first study examining the effects of a 10-week contrast training method combining plyometric and isometric regimes without external load in preadolescent basketball athletes. The main finding was that the 10-week contrast training program led to positive adaptations in sprint and vertical jump agility performance in preadolescent basketball players. Following the contrast training, they observed increased squat jump, countermovement jump, vertical jump, drop jump 20, drop jump 40, agility, and sprint values in the control group. No injuries were reported during the application of the contrast training method to preadolescent basketball players.

In addition, Cormier et al, (2020) aimed to analyze the effects of complex training and contrast training on 1RM, vertical jump, direction change, and sprint time in the leg area and to determine which method could better explain neuromuscular adaptations following usage. They also aimed to identify training characteristics with potentially larger moderator effects. The study found no statistically significant differences between complex and contrast training; both types positively affected 1RM, contrast training had moderate effects on direction change and sprint time ability, and complex training was effective and produced meaningful improvements in sprint performance.

Alves et al., (2010) aimed to investigate the short-term effects of complex and contrast training on vertical jump and countermovement jump, sprint (5 and 15 m), and agility skills in young elite football players from Portugal. The experimental group participated in complex and contrast training, and power training programs for six weeks, with an additional 1 and 2 training sessions per week on predetermined days, while the control group continued regular football training. Each complex and contrast training was coordinated in three stations: general training, team training, and training focused on specific attributes. Weight increased by 5% of 1 repetition maximum (1RM)

every two weeks. Results indicated a reduction in sprint times of 5 and 15 m for the training group and an improvement in squat and jump scores, suggesting that contrast and complex training enhance 5 and 15 m sprint and squat jump performance.

Pagaduan et al., (2019) systematically reviewed and meta-analyzed the effects of contrast training, a mixed training plan combining high-speed exercises following resistance exercise, on vertical jump performance. The counter movement jump was used as a measure of lower body strength compared to heavy resistance training, plyometric training, and a control group in this study. Thirteen studies were included in the systematic review, incorporating a range of healthy and untrained individuals to elite-level participants in different age groups applying contrast training methods. Protocols varied, employing traditional mixed pairing methods or triple combinations, applied two or three times per week over 4–12 weeks. The meta-analysis included 10 studies, showing that counter movement jump outcomes significantly increased following contrast training and heavy resistance training.

Koçbay (2022) investigated the impact of a 6-week contrast training program on amateur boxers' left-right direct punch speed performance, bench press maximal strength, and squat performance. Results show that the contrast training program effectively improved punch speed performance. In the thesis study, while no statistically significant difference was found in the control group, a positive differentiation was observed in the right direct punch speed in the contrast training group, and an improvement was noted in left direct punch speed. Differences in the Left-Right Punch Peak Speed evaluation, tested at two different times and in two separate stations in the contrast training group, statistically increased positively with time. Analysis of the interaction of different exercise program applications on Left and Right Punch Peak Speed test measurement revealed different effects of the applied methods. Variations among means indicated that the observed differences originated from the contrast training method, with both left and right punch speeds showing improvement based on pre-test results. The progress observed in the contrast training group is linked to the intensity of ballistic exercises and the application of exercises biomechanically similar to punching techniques.

Uzunhasan (2023) aimed to investigate the effects of the contrast training method and plyometric training methods applied over eight weeks on neuromuscular and metabolic factors. He used the 30-15 IFT to determine metabolic characteristics and examined agility, speed, jump, and electromechanical delay criteria to assess neuromuscular properties. It was further aimed to evaluate the effects of eight weeks of strength and power training on anaerobic speed reserves reflecting the dual-sided nature of football on players' locomotor profiles and match performances. Findings showed that both groups provided meaningful developments in agility tests across the study groups. It was further contemplated that irregular developments in agility capability following contrast and plyometric training might stem from these practices not focusing specifically on enhancing agility.

Tokgöz (2022) investigated the effect of the French Contrast Method on speed performance in football players. The study applied 10-meter and 20-meter speed tests before and after training to both the training and control groups, evaluating statistical differences. In pre-test measurements, the training group's 10 m average was 2.27 and 20 m was 3.57, while post-tests showed 2.22 for 10 m and 3.49 for 20 m, identifying a significant positive difference; the control group showed no significant differences. This study suggests the French Contrast Method effectively contributes to improved speed performance.

Additionally, Ceyhan et al., (2022) examined the effects of traditional strength training versus contrast training on body composition, active jump, spike jump, and squat performance in young male volleyball athletes. The study results highlighted significant improvements in jump performance due to contrast training, concluding it as an effective training method for young male volleyball players because it combines a set of exercises within a single time frame. Prolonging contrast training for more than three weeks and conducting it twice weekly in sports branches heavily relying on vertical jumping can aid in enhancing lower body strength in athletes. A typical contrast training exercise program for the leg area includes a multi-joint exercise (e.g., squat or leg press) followed by a vertical jump exercise (e.g., active jumps). Coaches can also incorporate various contrast training methods by adding other speed exercises or plyometric training after vertical jumping exercises.

Atasever and Sevindik Aktaş (2023) sought to explore the efficient utilization of the contrast training method to enhance athletes' reactive strength in their research. Study data was discussed in comparison with existing research. Evaluation of the study indicated that the training program positively impacted the athletes, notably enhancing the reactive strength index, a crucial factor in improving competitive prowess in winter sports.

Elbadry et al., (2019) investigated the effects of the French contrast method on explosive strength and jump parameters in athletic sports. The evaluation of study data showed that the French contrast training method fostered positive improvements in explosive power, vertical jumps, and squat jump metrics in the training group.

Conclusion

To conclude, the contrast training method positively impacts agility performance of star female basketball players. To optimize the agility feature, inclusive of physical, technical, perceptual, and decision-making skills characterized by directional changes, it's considered crucial to implement contrast training methods at appropriate intensities during both preparatory and in-season basketball training, where multidirectional movements are extensively practiced.

Based on research outcomes, it is suggested that the contrast training method:

- Be incorporated by basketball coaches during preparation and in-season training.
- Be explored through research applying contrast training methods with various movements.
- Be investigated in research concerning different ages and gender categories of basketball players

Beyanlar / Declarations

Etik Onay ve Katılım Onayı / Ethics approval and consent to participate

Bu çalışmanın hazırlanma ve yazım sürecinde "Yükseköğretim Kurumları Bilimsel Araştırma ve Yayın Etiği Yönergesi" kapsamında bilimsel, etik ve alıntı kurallarına uyulmuş olup; toplanan veriler üzerinde herhangi bir tahrifat yapılmamış ve bu çalışma herhangi başka bir akademik yayın ortamına değerlendirme için gönderilmemiştir. Makale ile ilgili doğabilecek her türlü ihlallerde sorumluluk yazara aittir. Çalışmanın yürütülebilmesi için Erzincan Binali Yıldırım Üniversitesi İnsan Araştırmaları Sağlık ve Spor Bilimleri Etik Kurul Başkanlığından 31 Ocak 2025 tarihli ve 01/03 sayılı kararı ile gerekli izinler alınmıştır.

During the preparation and writing of this study, the principles of scientific integrity, ethics, and citation, as stipulated in the "Higher Education Institutions Scientific Research and Publication Ethics Directive," were fully observed; no

falsification was made on the collected data, and this study has not been submitted to any other academic publication platform for evaluation. The author bears full responsibility for any potential violations regarding the article. To conduct the study, the necessary approvals were obtained from the Erzincan Binali Yıldırım University Ethics Committee for Health and Sports Sciences Research Involving Humans, with the decision dated January 31, 2025, and numbered 01/03.

Veri Ve Materyal Erişilebilirliği / Availability of data and material

Bu çalışmanın bulgularını destekleyen veriler, makul talepler üzerine sorumlu yazardan temin edilebilir. Veri seti yalnızca akademik amaçlar için erişilebilir olacak ve verilerin herhangi bir kullanımı, orijinal çalışmayı referans gösterecek ve katılımcıların gizliliğini koruyacaktır.

The data that support the findings of this study are available from the corresponding author upon reasonable request. The dataset will be accessible only for academic purposes, and any use of the data will recognize the original study and maintain the confdentiality of the participants.

Çıkar Çatışması / Competing interests

Yazarlar, bu makalede sunulan çalışmayı etkileyebilecek herhangi bir çıkar çatışması veya kişisel ilişkiye sahip olmadıklarını beyan etmektedirler.

The authors declare that they have no known competing financial interests or personal relationships that could have appeared to influence the work reported in this paper.

Yazar Katkıları / Authors' Contribution Statement

Bu çalışmada birinci yazarın katkısı %30, ikinci yazarın katkısı %40 ve üçüncü yazarın katkısı %30'dur.
The contribution of the first author in this study is 30%, the contribution of the second author is 40%, and the contribution of the third author is 30%.

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This Bu çalışma, kamu, özel veya kar amacı gütmeyen sektörlerdeki fon sağlayıcı kurumlardan herhangi bir özel destek almamıştır.
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