ORİJİNAL ARAŞTIRMA ORIGINAL RESEARCH

DOI: 10.5336/sportsci.2020-80118

Relationship between Body Composition, Agility and Vertical Jump Performance in Young Female Volleyball Players

Genç Kadın Voleybol Oyuncularında Vücut Kompozisyonu, Çeviklik ve Dikey Sıçrama Performansı Arasındaki İlişki

Erkan AKDOĞAN[a], Beyza GÜVEN[a]

[a]Department of Coaching Training, Eskişehir Technical University Faculty of Sport Sciences, Eskişehir, TURKEY

This study was presented as an oral presentation at International Sport Sciences Congress 18, 7-9 November 2020, Online.

ABSTRACT Objective: The purpose of this study was to investigate the relationship between body composition, agility and vertical jump performance in young female volleyball players. **Material and Methods:** For this purpose, 23 healthy young female volleyball players (Age: 14.79±0.58 years, height: 169.70±5.62 cm, body weight: 61.44±7.92 kg.) voluntarily participated in this study. The volleyball team was assessed for total body and regional estimates of body composition by using dual-energy X-ray absorptiometry. Vertical jump performance was analyzed by using the Squat Jump (SJ) and Counter Movement Jump (CMJ) tests and agility performance was measured using the T-agility test. The normality of the data was tested with the Shapiro-Wilk test. The relationship between body composition, agility and vertical jump performance was analyzed with Pearson correlation coefficient. Significance level was ≤0.05. **Results:** According to the statistical analyses, there was a significant negative correlation between SJ and CMJ percentage of body fat (BF%) leg fat (LF%) arm fat (AF%), trunk fat (TF%) and fat mass (kg) ($p<0.05$). There was also a significant correlation between agility test percentage of BF, LF and TF. No significant correlation was found among agility, SJ and CMJ with total/regional body composition. **Conclusion:** The results indicated that increased total/regional BF might be a detriment to the SJ, CMJ and agility performance in young female volleyball players. It is recommended that coaches should not allow female volleyball players to increase their BF so that physical performance loss can be avoided.

Keywords: Volleyball; body composition; squat jump; counter movement jump; agility

ÖZET Amaç: Bu çalışmanın amacı, genç kadın voleybol oyuncularında vücut kompozisyonu, çeviklik ve dikey sıçrama performansı arasındaki ilişkiyi araştırmaktır. **Gereç ve Yöntemler:** Bu amaçla, 23 kadın voleybol oyuncusu (yaş: 14,79±0,58 yıl, boy: 169,70±5,62 cm, kilo: 61,44±7,92 kg.) araştırmaya gönüllü olarak katılmıştır. Dual enerji X-ışını absorptiometrisi yöntemi ile tüm ve bölgesel vücut kompozisyonu belirlenmiştir. Dikey sıçrama performans testleri squat sıçrama (SS) ve aktif sıçrama (AS) ve çeviklik performansı T-çeviklik testi kullanılarak ölçülmüştür. Verilerin normallik sınaması, Shapiro-Wilk testi ile test edilmiştir. Tüm vücut ve bölgesel vücut kompozisyonu, çeviklik testi yeteneği ve sıçrama parametreleri arasında ilişki olup olmadığı Pearson korelasyon analizi ile belirlenmiştir. Anlamlılık düzeyi ≤0,05 alınmıştır. **Bulgular:** İstatiksel analizler sonucunda kadın voleybol oyuncularında SS ve AS testi ile vücut, bacak, kol ve gövde yağ yüzdesi ve kütlesi (kg) arasında negatif ilişki bulunmuştur ($p<0,05$). Aynı zamanda çeviklik test ile vücut, bacak ve gövde yağ yüzdesi arasında ilişki bulunmuştur. Çeviklik, SS ve AS ile diğer toplam/bölgesel vücut kompozisyonu arasında önemli bir ilişki görülmemiştir. **Sonuç:** Bu araştırma sonuçlarına göre artan tüm/bölgesel vücut yağının genç kadın voleybol oyuncularında SS, AS ve çeviklik performansını olumsuz etkileyebileceğini göstermiştir. Antrenörlerin yıllık periyot planlamasında fiziksel performans kaybını önlemek için bayan voleybolcuların vücut yağlanma artışına izin vermemesi önerilir.

Anahtar Kelimeler: Voleybol; vücut kompozisyonu; squat sıçrama; aktif sıçrama; çeviklik

The fact that body composition has a strong relevance to performance in sports has been studied in relation to total and regional fat and muscle ratio. It is acknowledged that body composition plays an important role in player's physiology and performance.[1] Similarly, excess fat tissue negatively affects the activities that require players to lift up their body against gravity several times during certain activities

Correspondence: Erkan AKDOĞAN
Department of Coaching Training, Eskişehir Technical University Faculty of Sport Sciences, Eskişehir, TURKEY/TÜRKİYE
E-mail: eakdogan@eskisehir.edu.tr

Peer review under responsibility of Turkiye Klinikleri Journal of Sports Sciences.

Received: 30 Nov 2020 ***Received in revised form:*** 03 Mar 2021 ***Accepted:*** 22 Mar 2021 ***Available online:*** 25 Mar 2021

such as jumping by creating extra weight, which leads to a decrease in performance while causing higher levels of energy demands depending on the activity.[2] In addition, lean muscle mass is another important contributor to power generation during activities that require intense performance by increasing levels of strength and power performance.[3]

Volleyball is often characterized with a strong competition among players during short but high intensity exercises which is generally followed by low intensity activities.[4] It is necessary for players to take part in defensive and offensive jumping activities throughout these high-intensity activities, during which strength, power, agility and speed are necessary.[5] Anthropometric and physical performance variables have stronger correlations with the successful performance of such movement structures.[6]

Body composition is generally believed to have a major impact on athletic performance.[4,5] To illustrate, Lidor and Ziv reported a relationship between game performance and the level of volleyball skills, especially for female players, when anthropometric data is concerned.[7] In addition, Martín-Matillas et al., found that elite volleyball players were relatively taller, their muscle mass and ectomorphy were more immense, and their adiposity marker levels were relatively lower when compared to lower level players.[8] Moreover, Gabbett and Georgiev showed that the higher the level of play is, the taller and the leaner young volleyball players are, which clearly depicts the importance of anthropometric characteristics for young volleyball players.[4]

There are many studies focusing on female volleyball players' body composition. However, most of these studies deal with the following variables: age, morphologic structure, playing position and different performance levels of players, how their body compositions change throughout the season, or comparing female players from other fields of sports according to these parameters.[3,9-12]

Indeed, many studies have been conducted to examine how body composition affects elite female and male volleyball players' performance. However, few studies have focused on the relationships between ability to jump, body composition and agility performance for young female volleyball players. The aim of the current study is to explore how body composition is related to agility and vertical jump performance when young female volleyball players are concerned.

MATERIAL AND METHODS

SUBJECTS

Twenty three healthy voluntary young female volleyball players (Age: 14.79±0.58 years, height: 169.70±5.62 cm, body weight: 61.44±7.92 kg,) participated in this study. After informing the players about the study verbally, their legal guardians were asked to sign a written informed consent for their participation because all the participants were younger than 18 years. This study conformed to the principles of Helsinki Declaration. As for the ethical issues, it was approved by Anadolu University Health Sciences Institute Scientific Research and Publication Ethics Committee on 30.05.2018 (protocol number: 56751).

PROCEDURE

All measurements and tests were carried out during the pre-season period. Anthropometry and body composition measurements were carried out at the Kinanthropometry Laboratory located at Eskişehir Technical University, Faculty of Sport Sciences. All tests [Squat Jump (SJ), Counter Movement Jump (CMJ), and T-agility] were performed indoors on a hardwood floors at the multipurpose sport hall of the university. The test sessions were completed in one day during morning hours between 9:00 and 12:00 a.m. Similar to the previous studies, all the participants rested for 1 minute between each try and for 5 minutes between test sessions so that they could be ready well enough for the next attempt.[13,14] During the test session, each subject first performed the anthropometric and body composition measurements, followed by the vertical jump test and T-agility test. Subjects were allowed to practise all the tests before the actual test session. Prior to the test, subjects completed a 15-minute warm-up activities, including jogging, lateral displacements, dynamic stretching, and jumping. Subjects were told that they should not do the followings for at least 24 hours before the test

day: not taking any drugs; not drinking coffee; and not getting involved in physical activities.

ANTHROPOMETRIC AND BODY COMPOSITION ANALYSIS

A scale (SECA, Hamburg Scale) with a precision of 01. kg was used to measure participants' body weight (kg). Measured barefoot, the players' heads were placed in the Frankfurt plane, and a stadiometer (SECA, Hamburg) with an accuracy of 0.1 cm was used to determine how tall they were. As for the evaluation of body composition (fat percentage, muscle mass, and fat mass) through DXA at total and regional levels, the researchers preferred a total body scanner called the Dual-energy X-ray absorptiometry (Lunar Prodigy Pro; GE, Healthcare, Madison, WI, USA). In addition, they used phantoms in order to calibrate the scanner in the morning before the actual measurements by following the manufacturer's standard guidelines. The consistency was realized by performing all the scans and analyses with the same operator. Before the measurements, the researchers asked the participants not to wear any jewelry or have any metal objects in their bodies while being screened. A standard supine position was achieved during the scans by tying the subjects' knees and ankles with a Velcro strap and their arms were extended by their sides. Typical duration of the examinations was from 6 to 8 min, depending on the height of the subject.

VERTICAL JUMP MEASUREMENTS

The participants were asked to perform jump tests Squat Jump (SJ) and Counter Movement Jump (CMJ) in order to measure the explosive power of the lower limbs by using a Smartspeed, (Fusion Sport Pty Queensland, Australia). Also, the participants were instructed to keep their hands on their hips while jumping so that the effects of arm swing could be avoided. According to instructions provided for the SJ, the subjects began to jump as high as possible when their knee has approximately 90° angle. When it comes to CMJ from the standing position, the researchers asked the participants to do a maximal vertical thrust (stretch-shortening cycle) by bending their knees to a 90° angle. Finally, the participants were told to keep their bodies straight and descend with their knees fully extended during the jump. Any jump that was incorrectly performed was repeated. The measurements from the best performance of two trials were recorded and expressed in "cm".

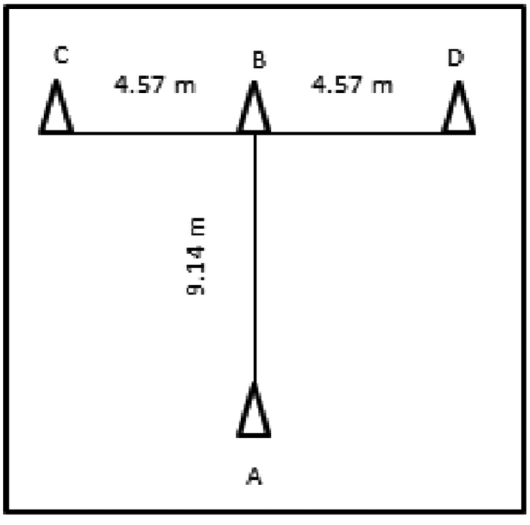

FIGURE 1: Agility t-test.

T-AGILITY TEST

The aim of using the Agility-T-test was to determine forward sprinting, left and right shuffling, and backpedaling as "speed" involving directional changes (Figure 1). The procedure for T-agility test was defined by Sassi et al. as follows: First, the participants stand on their both feet behind the start line A. Then, they move ahead towards cone B and use their right hand to touch the base when they want. Later, they drag their feet to the left towards cone C and touch the base with their left hand by facing forward and without crossing feet and drag their feet to the right to cone D and touch its base with the right hand. This action is followed by returning to the left towards cone B and touch its base. Finally, they quickly run backward and take their position on line A. If a participant crosses his feet, fails to touch the cone base, and/or does not face forward, he must do the test again. The score is calculated for their better performance out of two trials.[13]

STATISTICAL ANALYSIS

The researchers used SPSS 18 software (SPSS Inc., Chicago, IL, USA) to analyze the data statistically. The obtained data were presented as means and stan-

dard deviations, and degree of confidence was chosen as 0.05. Since the sample of the research was smaller than 50, the assumption of normal distribution was checked with the Shapiro Wilk test.[15] The data that has the normal distribution (p>0.05) were analyzed with Pearson correlation, which is a parametric test.[16]

RESULTS

Table 1 below displays the descriptive statistics of physical and total/regional body composition. The results of agility and vertical jump performance tests are presented in Table 2. In addition, the correlation coefficients between body composition, agility and vertical jump are shown in Table 3. According to the results of the study, SJ significantly and negatively correlates with the CMJ percentage of body fat, body fat mass, percentage of leg fat, leg fat mass, arm fat percentage, arm fat mass, trunk fat percentage and trunk fat mass. There was also a significant correlation between t-agility test percentage of body fat**,** leg fat (LF) and trunk fat (TF). No significant correlation was found between agility**,** SJ and CMJ with other total/regional body compositions.

TABLE 1: The descriptive statistics of physical and total/regional body composition.

Variables	Mean±SD (n=23)
Age (years)	14.79±0.58
Height (cm)	169.70±5.62
Weight (kg)	61.44±7.92
Body fat percentages (%)	31.68±4.94
Body fat mass (kg)	19.02±5.03
Lean body mass (kg)	40.19±3.82
Arm fat percentages (%)	34.45±5.13
Arm fat mass (kg)	2.17±0.56
Lean arm mass (kg)	4.04±0.50
Leg fat percentages (%)	36.22±4.09
Leg fat mass (kg)	7.99±1.69
Lean leg mass (kg)	13.90±1.47
Trunk fat percentages (%)	28.75±6.57
Trunk fat mass (kg)	8.06±2.89
Trunk lean mass (kg)	19.28±2.06

SD: Standard deviation.

TABLE 2: The results of agility and vertical jump performance tests.

Performance tests	Mean±SD (n=23)
Squat jump (cm)	26.55±4.57
Countermovement jump (cm)	27.22±4.87
T-agility test (sec)	11.30±0.59

SD: Standard deviation.

DISCUSSION

This study aims to determine to what extent body composition is related to agility and vertical jump performance in young female volleyball players. According to the results, SJ significantly and negatively correlates with CMJ percentage of body fat (BF%), LF%, arm fat (AF%), TF% and fat mass (kg). Simi-

TABLE 3: Relationship between total/regional body composition, agility and vertical jump performance on female volleyball players.

Variables	SJ _cm		CMJ _cm		T-agility (sec)	
	r value	p value	r value	p value	r value	p value
Body fat (%)	-0.857**	000	-0.807**	0	0.451*	0.027
Body fat (kg)	-0.801**	000	-0.763**	0	0.339	0.105
Lean body mass (kg)	-0.185	0.386	-0.197	0.356	-0.233	0.272
Arm fat percentages (%)	-0.714**	000	-0.636**	0.001	0.382	0.066
Arm fat mass (kg)	-0.746**	0	-0.698**	0	0.348	0.096
Lean arm mass (kg)	-0.335	0.109	-0.372	0.073	-0.011	0.958
Leg fat percentages (%)	-0.829**	0	-0.779**	0	0.481*	0.017
Leg fat (kg)	-0.739**	0	-0.697**	0	0.279	0.186
Lean leg mass (kg)	-0.129	0.549	-0.125	0.559	-0.289	0.171
Trunk fat percentages (%)	-0.854**	0	-0.813**	0	0.428*	0.037
Trunk fat mass (kg)	-0.799**	0	-0.767**	0	0.35	0.094
Trunk lean mass (kg)	-0.095	0.659	-0.111	0.604	-0.271	0.2

SJ; Squat jump; CMJ: Counter movement jump; *p<0.05; **p<0.01.

larly, the study found a significant correlation between t-agility test percentage of BF, LF and TF. No significant correlation was found between agility, SJ and CMJ with other total/regional body composition.

It is believed that successful volleyball players have lean body mass as a significant anthropometric characteristics.[4] In other words, being less heavier due to lower BF is more advantageous when compared to players with similar skills but heavier due to more body fat.[15] The body mass and height of the volleyball players in the current study were consistent with those reported in the previous studies.[6,9,18] In addition, the percentage BF 31.6% was similar to that reported in other studies but higher when compared to other studies.[11,18,19] The reason of this disparity might be different methods used to obtain data about percent body fat, different data collection times (pre or during season), and differences in training programs.

The study found that SJ significantly and negative correlates with CMJ percentage of %BF, LF%, AF%, TF% and fat mass (kg). These findings are similar to those of several studies. For example, Nikolaidis found a negative correlation between BF and CMJ (r=-0.24) for young volleyball players.[19] Similarly, Acar and Eler found negative correlations between vertical jump and percentage of %BF and %TF (r=-0,27, r=-0,19) in Turkish young female volleyball players.[22] In addition, Özkan et al., reported that relative CMJ significantly and negatively correlates with percentage of BF (r=0.-533) in Turkish young female volleyball players.[23] Similar to this study, Kushkestani et al., showed a significant negative correlation between explosive power (vertical jump) and fat percentage in female volleyball players.[24] Also, Copic et al. reported significant relationships between the jumping performance and body composition in elite female players.[14] Contrary to our study, Boldt et al. found that there was no significant relationship between BF(%) and vertical jump (r=-0,35) in female volleyball players.[25] The current results show that increase in total/regional BF percentage and weight negatively affects SJ and CMJ performances.

Agility and speed are important components of defensive and offensive actions by volleyball players. There are many agility and speed testing protocols in the literature. Since it might be difficult to choose the best one for academic studies, considering specificity is suggested one way to decide on the best test protocol.[26] Few studies have been conducted to find correlations among anthropometric variables and change in direction speed performance. In theory, factors such as BF and body segment lengths can affect agility performance. When two athletes with almost equal total body mass are compared, the fatter athlete will have less lean mass to affect the speed requirements of agility performance.[27]

In this study, there was a significant correlation between t-agility test percentage of BF, LF, and TF. However, to our knowledge, there are very few studies to correlate body composition variables and, t-agility performance. The author accessed only one study that involved correlations of BF and t-agility performance in female volleyball players. The results of this study by Boldt et al., showed a significant relationship between BF(%) and t-test (r=0,54) in female volleyball players.[25] The current study' results showed that increase in total/regional BF percentage and weight negatively affect t-agility performances. Based on these results, we conclude that the body composition variables could be valid predictors of vertical jumping and agility performance.

CONCLUSION

In conclusion, high levels of total/regional BF might be a factor that negatively affects SJ, CMJ and agility performance. It is recommended that coaches should not allow female volleyball players to increase in BF to avoid physical performance loss in the annual periodization. Additionally, since the body composition and the performance variables were only measured before the season, the study might be repeated collecting the data during the season in future research to describe trends in body composition and performance variables among young volleyball players.

Source of Finance

During this study, no financial or spiritual support was received neither from any pharmaceutical company that has a direct connection with the research subject, nor from a company that pro-

vides or produces medical instruments and materials which may negatively affect the evaluation process of this study.

Conflict of Interest

No conflicts of interest between the authors and / or family members of the scientific and medical committee members or members of the potential conflicts of interest, counseling, expertise, working conditions, share holding and similar situations in any firm.

Authorship Contributions

Idea/Concept: *Erkan Akdoğan, Beyza Güven;* ***Design:*** *Erkan Akdoğan;* ***Control/Supervision:*** *Erkan Akdoğan;* ***Data Collection and/or Processing:*** *Erkan Akdoğan, Beyza Güven;* ***Analysis and/or Interpretation:*** *Erkan Akdoğan, Beyza Güven;* ***Literature Review:*** *Erkan Akdoğan, Beyza Güven;* ***Writing the Article:*** *Erkan Akdoğan, Beyza Güven;* ***Critical Review:*** *Erkan Akdoğan.*

REFERENCES

1. Milanese C, Piscitelli F, Lampis C, Zancanaro C. Anthropometry and body composition of female handball players according to competitive level or the playing position. J Sports Sci. 2011;29(12):1301-9. [Crossref] [Pubmed]
2. Reilly T. Fitness assessment. In: Reilly T, ed. Science and Soccer. 1st ed. London: EF Spon; 1996. p.25-50. [Link]
3. Mala L, Maly T, Zahalka F, Bunc V, Kaplan A, Jebavy R, et al. Body composition of elite female players in five different sports games. J Hum Kinet. 2015;45:207-15. [Crossref] [Pubmed] [PMC]
4. Gabbett T, Georgieff B. Physiological and anthropometric characteristics of Australian junior national, state, and novice volleyball players. J Strength Cond Res. 2007; 21(3):902-8. [Crossref] [Pubmed]
5. González-Ravé JM, Arija A, Clemente-Suarez V. Seasonal changes in jump performance and body composition in women volleyball players. J Strength Cond Res. 2011;25(6): 1492-501. [Crossref] [Pubmed]
6. Milić M, Grgantov Z, Chamari K, Ardigò LP, Bianco A, Padulo J. Anthropometric and physical characteristics allow differentiation of young female volleyball players according to playing position and level of expertise. Biol Sport. 2017;34(1):19-26. [Crossref] [Pubmed] [PMC]
7. Lidor R, Ziv G. Physical characteristics and physiological attributes of adolescent volleyball players-a review. Pediatr Exerc Sci. 2010; 22(1):114-34. [Crossref] [Pubmed]
8. Martín-Matillas M, Valadés D, Hernández-Hernández E, Olea-Serrano F, Sjöström M, Delgado-Fernández M, et al. Anthropometric, body composition and somatotype characteristics of elite female volleyball players from the highest Spanish league. J Sports Sci. 2014;32(2):137-48. [Crossref] [Pubmed]
9. Paz GA, Gabbett TJ, Maia MF, Santana H, Miranda H, Lima V. Physical performance and positional differences among young female volleyball players. J Sports Med Phys Fitness. 2017;57(10):1282-9. [Crossref] [Pubmed]
10. Malousaris GG, Bergeles NK, Barzouka KG, Bayios IA, Nassis GP, Koskolou MD. Somatotype, size and body composition of competitive female volleyball players. J Sci Med Sport. 2008;11(3):337-44. [Crossref] [Pubmed]
11. Tessutti LS, Aguiar SD, Costa GD, Clemente FM, Lima RF, Neves RV, et al. Body composition and performance variables differences in female volleyball players by agegroup and playing position. Braz J Kinanthrop Hum Perform. 2019;21:60-131. [Crossref]
12. Kutáč P, Sigmund M. Assessment of body composition of female volleyball players of various performance levels. J Phys Educ Sport. 2017;17(2):556-62. [Link]
13. Sassi RH, Dardouri W, Yahmed MH, Gmada N, Mahfoudhi ME, Gharbi Z. Relative and absolute reliability of a modified agility T-test and its relationship with vertical jump and straight sprint. J Strength Cond Res. 2009;23(6):1644-51. [Crossref] [Pubmed]
14. Ćopić N, Dopsaj M, Ivanović J, Nešić G, Jarić S. Body composition and muscle strength predictors of jumping performance: differences between elite female volleyball competitors and nontrained individuals. J Strength Cond Res. 2014;28(10): 2709-16. [Crossref] [Pubmed]
15. Büyüköztürk Ş. Sosyal Bilimler İçin Veri Analizi El Kitabı. 28. Baskı. Ankara: Pegem Akademi; 2020. [Link]
16. Pallant J. SPSS Survival Manual: A Step by Step Guide to Data Analysis Using SPSS. 4th ed. Crows Nest New South Wales Australia: Allen and Unwin; 2011. [Link]
17. Tsoukos A, Drikos S, Brown LE, Sotiropoulos K, Veligekas P, Bogdanis GC. Anthropometric and motor performance variables are decisive factors for the selection of junior national female volleyball players. J Hum Kinet. 2019;67:163-73. [Crossref] [Pubmed] [PMC]
18. Ayan V, Bektas Y, Erol AE. Anthropometric a performance characteristics of Turkey National U-14 volleyball players. Afr J Phys Health Educ Recr Dance. 2012;18(2):395-403. [Link]
19. Nikolaidis PT. Body mass index and body fat percentage are associated with decreased physical fitness in adolescent and adult female volleyball players. J Res Med Sci. 2013;18(1):22-6. [Pubmed] [PMC]
20. Grgantov Z, Milić M, Katić R. Identification af explosive power factors as predictors of player quality in young female volleyball players. Coll Antropol. 2013;37 Suppl 2:61-8. [Pubmed]
21. Valente-Dos-Santos J, Tavares ÓM, Duarte JP, Sousa-E-Silva PM, Rama LM, Casanova JM, et al. Total and regional bone mineral and tissue composition in female adolescent athletes: comparison between volleyball players and swimmers. BMC Pediatr. 2018;18(1):212. [Crossref] [Pubmed] [PMC]
22. Acar H, Eler N. The Relationship between body composition and jumping performance of volleyball players. J Educ Train Stud. 2019;7(3):192-6. [Crossref]
23. Özkan A, Köklü Y, Eyuboğlu E, Akça F, Koz M, Ersöz G. Kadın voleybolcularda vücut kompozisyonu, somatotip özellikler, anaerobic performans, bacak ve sırt kuvveti arasındaki ilişkinin belirlenmesi [The determination of relationship between body composition, somatotype, anaerobic performance, leg and back strength in female volleyball players]. Gazi Beden Eğitimi ve Spor Bilimleri Dergisi. 2010;15(4):23-34. [Link]
24. Kushkestani M, Nosrani ES. Parvani M, Rezaei S, Nazar NK. Evaluation of the relationship between explosive power and anthropometric and body composition indices in female volleyball players. New Approaches in Sport Sciences (NASS). 2019;1(1):157-68. [Link]
25. Boldt M, Gregory D, Jaffe D, Dodge TM, Jones MT. Relationship between body composition and performance measures in NCAA division III women's volleyball players. J Strength Cond Res. 2011;25(3):79-80. https:// journals. [Crossref]
26. Lidor R, Ziv G. Physical and physiological attributes of female volleyball players--a review. J Strength Cond Res. 2010;24(7):1963-73. [Crossref] [Pubmed]
27. Sheppard JM, Young WB. Agility literature review: classifications, training and testing. J Sports Sci. 2006;24(9):919-32. [Crossref] [Pubmed]