

Exploring the Link Between Body Composition and Strength in Young Male Basketball Players

Genç Erkek Basketbolcularda Vücut Kompozisyonu ile Kuvvet Arasındaki İlişkinin İncelenmesi

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<https://doi.org/10.5281/zenodo.17448584>

Received / Gönderim: 10.04.2025

Accepted / Kabul: 01.09.2025

Published / Yayın: 24.10.2025

Volume 2, Issue 3, October, 2025

Cilt 2, Sayı 3, Ekim, 2025

Abstract

The objective of this study was to explore the link between body composition and strength in young male basketball players. 13 young male licensed basketball players voluntarily participated in the study. Body composition of young basketball players such as body weight, body fat weight, muscle weight, core muscle weight and basal metabolic rate values were measured by Tanita TBF-300 body composition analyser. In the determination of strength performances, hand grip, back-leg strength test data and Sayer's formula of anaerobic power data obtained from jump tests were used. SPSS 21.0 package program was used to analyse the data. Pearson correlation coefficient method was used as a statistical method. When body composition analyses and strength test data were compared, a significant relationship was observed between body mass index, muscle weights, basal metabolic rates and core muscle weights and hand grip, back-leg strength, and anaerobic power values of young basketball players ($p<0.05$). No significant relationship was observed between body fat weight and hand grip and back-leg strength values ($p>0.05$). The results showed that the elements of body composition such as muscle weight, core area and basal metabolic rate were highly correlated with the strength performances of young basketball players.

Keywords Basketball Players, Body Composition, Core Area, Strength.

Öz

Bu çalışmanın amacı, genç erkek basketbolcularda vücut kompozisyonunun ile kuvvet arasındaki ilişkisinin incelenmesidir. Çalışmaya lisanslı 13 genç erkek basketbolcu gönüllü olarak dahil edilmiştir. Genç basketbolcuların vücut ağırlığı, vücut yağ ağırlığı, kas ağırlığı, core bölge kas ağırlığı ve bazal metabolizma hızı gibi vücut kompozisyonu değerleri Tanita TBF-300 vücut kompozisyon analiz cihazı ile ölçülmüştür. Kuvvet performanslarının belirlenmesinde el pençe, sırt-bacak kuvveti test verileri ve sıçrama testlerinden elde edilen Sayer's formülü anaerobik güç verileri kullanılmıştır. Verilerin analizi için SPSS 21.0 paket programı kullanılmıştır. İstatistiksel yöntem olarak Pearson korelasyon katsayısı yöntemi kullanılmıştır. Yapılan vücut kompozisyon analizi ve kuvvet testlerine ait veriler karşılaştırıldığında; genç basketbolcuların beden kitle indeksi, kas ağırlıkları, bazal metabolizma hızları ve core bölge kas ağırlıkları ile el pençe, sırt-bacak kuvveti ve anaerobik güç değerleri arasında anlamlı bir ilişki gözlenmiştir. ($p<0.05$). Vücut yağ ağırlığı, el pençe ve sırt-bacak kuvveti değerleri arasında anlamlı bir ilişki gözlenmemiştir ($p>0.05$). Çalışma sonunda vücut kompozisyonunu oluşturan kas ağırlığı, core bölge ve bazal metabolizma hızı gibi unsurların genç basketbolcuların kuvvet performansları ile yüksek düzeyde ilişkide olduğu ortaya konmuştur.

Anahtar kelimeler: Basketbolcular, Core Bölge, Kuvvet, Vücut Kompozisyonu

<https://www.ijoss.org/Archive/issue2-volume3/ijoss-Volume2-issue3-26.pdf>

Introduction

Basketball ranks among the most widely played sports around the world and it is thought that elite basketball players should be tall and have high anaerobic power. Studies on the performance determinants of basketball players have mostly focused on physiological parameters (Attene et al., 2015; Ostojic et al., 2006). It has been reported that there are a limited number of studies examining the effect of body composition on motor performance, especially in young basketball players (Akkoç et al., 2018; Shaun et al., 2022; Nikolaidis et al., 2015).

When the studies were conducted, it was found that while the focus was on creating a physical fitness profile in basketball (Delextrat and Cohen, 2008), achieving an optimal body mass index has become the main purpose of basketball training (Ziv and Lidor, 2009). Another issue that should be monitored for this purpose is body fat percentage (Ode et al., 2007). Studies have revealed the negative relationship between body fat percentage and performance (Artero et al., 2009; Mak et al., 2010; Nikolaidis and Ingebrigtsen, 2013; Nikolaidis, 2013). One of the main research topics for sport education specialists is anthropometric measurements and somatic profiles (Dezman et al., 2001; Montgomery et al., 2008; Ostojic et al., 2006; Sampaio et al., 2006). Somatic profiles of basketball players play an important role in the athlete selection process and help to predict players' performances (Bayios et al., 2006; Berri et al., 2011; Hoare, 2000). Along with this prediction, technical, tactical physiological, psychological, and motor characteristics of basketball players also appear as factors affecting sportive performance (Popowczak et al., 2022; Rinaldo et al., 2020; Yel et al., 2023).

It is seen that studies on anthropometric characteristics and motor characteristics (agility, speed, vertical jump) have been carried out (Akkoç et al., 2018; Nikolaidis et al., 2015; Popowczak et al., 2022). It is reported that high levels of muscular strength (Guimarães et al. 2021) and explosive power (Guimarães et al., 2019) are needed to demonstrate these motor characteristics at the desired level. An effective core muscle stabilises the kinetic chain during functional exercises and transfers force between the lower and upper extremities (Başkaya et al., 2023). Therefore, it is thought that revealing the relationship of body composition and strength performance will guide coaches in athlete selection and training programming.

According to the information, the main objective of this study is to explore the link between body composition and strength in young male basketball players.

Material and Methods

Research Model

This study examined the relationship between body composition and strength performance in young male basketball players using a cross-sectional correlational approach.

Research Group

A total of 13 male basketball players participated in the research on a voluntary basis. The participants had a mean age of 17.32 ± 0.46 years, with a height of 184.65 ± 5.39 cm and a body weight of 79.62 ± 16.15 kg. The inclusion criteria: being in the 17–18 age category, minimum 5 years of continuous basketball training, not reported any musculoskeletal injuries, chronic illnesses, to be engaged actively in basketball training during the study. The exclusion criteria: reported chronic medical conditions such as cardiovascular or neurological disorders, current or recent musculoskeletal injuries

within the last six months. The study was conducted with the principles in Declaration of Helsinki to ensure the rights, safety, and well-being of the participants.

Data Collection Tools

The measurement of height was taken to the nearest 1cm unit with using a portable stadiometer (Holtain Ltd, UK). During the measurement process, participants were required to maintain a stable posture, ensuring their hands and feet remained in contact with the designated measurement points. Body composition assessment was performed using Tanita TBF-300 body composition analyser. Body weight, body mass index (BMI), body fat weight, muscle weight, core muscle weight and basal metabolic rate were determined. Participants were instructed to remove metal objects and shoes before stepping into the analyser. Takei (T.K.K.5401 model-Japan) brand hand dynamometer was used to measure the hand grip strength of the participants. The participants were asked to spread their arms 45° to the side and squeeze the hand dynamometer using their maximum force. The participants were asked to squeeze the dynamometer with maximal effort for two trials. A one-minute rest period was given between each trial. The highest value was recorded. Takei (T.K.K.5402 model-Japan) brand back-leg dynamometer was used for back-leg strength of the participants. The feet were placed on the dynamometer stand with both knees in the stretched position. The dynamometer bar held with the hands was pulled vertically upwards while both arms were tense, the back was in a straight position and the trunk was slightly tilted forward. The highest value of the two trials was recorded with a one-minute rest period between each trial. Anaerobic power was assessed through jump tests. The jump height was determined with the Opto-jump (Microgate, Bolzano, Italy) device. Jump height was calculated as anaerobic power peak data using Sayers equation formula. Anaerobic power data were analysed using Sayers equation peak power: $[60.7 \times \text{jump height (cm)}] + [45.3 \times \text{body weight (kg)}] - 2055$ (Sayers et al., 1999).

Data Analysis

The data of the participants in the study were analysed using IBM SPSS 21.0 package program. Kolmogorov-Smirnov and Shapiro-wilk tests were used for normality assumption. Pearson correlation test was applied to determine the relationship between the variables according to the distribution of the data. The significance level was accepted as ($p < 0.05$) (Özdamar, 2002). All analyses were performed following established statistical procedures.

Findings

Table 1: Descriptive statistics on body composition of the participants.

Variable	n	$\bar{X}$	$\pm$	SD	Min	Max
Age (years)	13	17.32	$\pm$	0.46	17	18
Height (cm)	13	184.65	$\pm$	5.39	175	196.5
Body Weight (kg)	13	79.62	$\pm$	16.15	62.7	120.4
BMI (kg/m ²)	13	23.22	$\pm$	3.77	19	32.2
Muscle Weight (kg)	13	38.6	$\pm$	5.42	30.5	46.6
Body Fat Weight (kg)	13	11.77	$\pm$	8.98	5.8	39.6
Basal Metabolic Rate (kcal)	13	1835	$\pm$	196.11	1555	2121
Core Muscle Weight (kg)	13	29.25	$\pm$	3.96	24	35.9

According to descriptive statistics in Table 1. participants' mean age was 17.32 ± 0.46 years, mean height was 184.65 ± 5.39 cm, mean weight was 79.62 ± 16.15 kg and mean BMI was 23.22 ± 3.77 kg/m². Participants' mean muscle weight was 38.6 ± 5.42 kg, mean body fat weight was 11.77 ± 8.98 kg, mean basal metabolic rate was 1835 ± 196.11 kcal, the mean core muscle weight was 29.25 ± 3.96 kg.

Table 2: Descriptive statistics on strength performance of the participants.

Variable	n	$\bar{X}$	$\pm$	SD	Min	Max
Hand Grip Strength (kg)	13	40.12	$\pm$	5.44	32	49.3
Back-Leg Strength (kg)	13	129.23	$\pm$	23.10	101.5	170.5
Anaerobic Power (w/kg)	13	3555.49	$\pm$	585.76	2818.76	4813.43

Table 2. presents mean hand grip strength score was 40.12 kg $\pm$ 5.44 kg, mean back-leg strength score was 129.23 kg $\pm$ 23.10 kg, mean anaerobic power score was 3555.49 w/kg $\pm$ 585.76 w/kg of the participants.

Table 3: The relationship of body composition and strength performance of participants.

Variable		BMI Weight (kg/m ²)	Muscle Weight (kg)	Body Fat Weight (kg)	Basal Metabolic Rate (kcal)	Core Area Muscle
Hand Grip Strength (kg)	r=	0.405	0.637*	0.223	0.638*	0.595*
	p=	0.170	0.019	0.465	0.019	0.032
Back-Leg Strength (kg)	r=	0.589*	0.656*	0.411	0.659*	0.656*
	p=	0.034	0.015	0.163	0.014	0.015
Anaerobic Power (w/kg)	r=	0.926**	0.932**	0.771**	0.939**	0.940**
	p=	0.000	0.000	0.002	0.000	0.000

*p<0.05, **p<0.01

According to Table 3. a significant relationship was observed between BMI and back-leg strength ($r=0.589$) at medium level and between anaerobic power ($r=0.926$) at high level ($p<0.05$). Also, a significant relationship was observed between muscle weight and hand grip strength ($r=0.637$) and back-leg strength ($r=0.656$) at medium level, and between anaerobic power ($r=0.932$) at high level ($p<0.05$). On the other hand, no significant correlation was observed between body fat weight and hand grip strength ($r=0.120$) and back-leg strength ($r=0.325$) ($p>0.05$), while a highly significant correlation was observed with body fat weight and anaerobic power ($r=0.686$) ($p<0.05$). A significant relationship was observed between basal metabolic rate and hand grip strength ($r=0.638$) and back-leg strength ($r=0.659$) at medium level, and a significant relationship was observed between basal metabolic rate and anaerobic power ($r=0.939$) at high level ($p<0.05$). Similarly, a significant relationship was observed between core muscle weight and hand grip strength ($r=0.595$) and back-leg strength ($r=0.656$) at a moderate level and between anaerobic power ($r=0.940$) at a high level ($p<0.05$).

Discussion and Conclusion

To sum up; medium level significant relationship was observed between BMI and back-leg strength and a high-level significant relationship between back-leg strength and anaerobic power in young basketball players. A medium-level significant relationship was observed between muscle weight and hand grip strength, as well as between muscle weight and back-leg strength. A high-level significant relationship was also found between anaerobic power and all body component variables. A highly significant relationship was observed between body fat weight and anaerobic power. A moderate significant relationship was observed between basal metabolic rate and hand grip strength and back-leg strength, while a high significant relationship was found between basal metabolic rate and anaerobic power. A moderate significant relationship was observed between core muscle weight and hand grip strength and back-leg strength, as well as between anaerobic power.

When similar studies in the literature were examined, a strong negative correlation was observed between jump and sprint values of young basketball players and skinfold thickness and fat percentage, while a positive correlation was found with lean body mass (Nedim et al., 2023; Tuna and Yalçinkaya, 2023). While the body fat percentage of basketball players was observed to be high before the season, it was observed that this ratio decreased during the season and remained low after the season (Nishisaka et al., 2022; Stanforth et al., 2014; Torres-McGehee et al., 2012). It is also observed that elite players are taller, have more lean mass, more strength, power, and agility, and are more technically skilful than non-elite players (Guimarães et al., 2020). In all branches involving anaerobic energy system, excess body fat percentage and low lean muscle mass negatively affect performance (Bilge and Tuncel, 2003). Similarly, in a study on basketball players, it was stated that changes in body fat percentage were related to hand grip strength and explosive strength (Rinaldo et al., 2020). In our study, there was a high positive correlation between the body fat percentage of young basketball players and their anaerobic capacity, which is consistent with previous research.

It was observed that high body mass index (BMI) negatively affects sprint and jumping performance, especially in young basketball players, and it was recommended that young basketball players should focus on exercise and nutrition programs targeting optimal body mass index (Nikolaidis et al., 2015). In addition, it is known that body mass index decreases in parallel with the duration in a regular training process (Shaun et al., 2022). It has been stated that the relationship between BMI and most motor performances follows an inverted 'U' model rather than linear (Bovet et al., 2007; Nikolaidis, 2013). This statement may explain the lack of statistically significant differences between normal and overweight groups, as well as the relatively weak correlations between BMI and motor performances (Nikolaidis et al., 2015). In the proportion between BMI body mass with fat and fat-free mass, the increase in fat will result in the decrease in power per kg (Öncen and Tanyeri, 2019). In our study, there was a moderate correlation between back strength and anaerobic power, and a highly significant correlation between back strength and anaerobic power. The results of our study are consistent with the findings in the relevant literature. In conclusion, muscle mass, basal metabolic rate, and core muscle mass values appear to be related to the strength and anaerobic power of young male basketball players. In addition, the results emphasize the importance of lean body mass and BMI for motor performance. The results support the implementation of conditioning programs to optimize body composition and support skill development. Finally, the significant correlations between body composition parameters and handgrip strength, hamstring strength, and anaerobic power measurements highlight their theoretical importance in understanding the physiological determinants of adolescent athletes' performance.

Kısaltmalar / Abbreviations

SD	Standart sapma (Standard deviation)
X	Ortalama (Mean)
SPSS	Sosyal bilimler için istatistik paketi (Statistical package for the social sciences)
p value	Anlamlılık değeri (Significant value)
r value	Korelasyon değeri (Correlation value)
N	Katılımcı sayısı (Number of participant)
Min	Minimum (Minimum)
Max	Maksimum (Maximum)
BMI	Vücut kütle indeksi (Body mass index)
Kg	Kilogram (Kilogram)
Cm	Centimeter
Kcal	Kilokalori (Kilocalorie)
W	Wat (Watt)

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. Çalışma için etik onay, Kütahya Dumlupınar Üniversitesi Sosyal ve Beşeri Bilimler Fakültesi Bilimsel Araştırma ve Yayın Etik Kurulu tarafından verilmiştir (belge no. 02/04/2024-2024/03). Katılımcılar için, etik kurallara uygun olarak katılımcıların ebeveynlerinden veya yasal vasilerinden bilgilendirilmiş onam alınmış ve tüm katılımcılar bu çalışmaya gönüllü olarak katılmıştır. /

During the preparation and writing of this study, scientific, ethical and citation rules were followed in accordance with the 'Higher Education Institutions Scientific Research and Publication Ethics Guidelines'; no alterations were made to the collected data, and this study has not been submitted for evaluation to any other academic publication medium. The author is solely responsible for any violations that may arise in connection with this article. The Ethical approval for the study was granted by the Ethical approval for the study was granted by the Scientific Research and Publication Ethics Committee of Kütahya Dumlupınar University, Faculty of Social and Human Sciences (document no. 02/04/2024-2024/03). For participants, informed consent was obtained from the participants' parents or legal guardians following ethical guidelines, and all participants voluntarily participated in this study

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 confidentiality 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

Çalışmanın tasarımı ve planlanması: S.A.; Veri toplama, analizi veya yorumlanması: S.A.; Makalenin yazımı: S.A.; Veri düzenleme, yöntem belirleme, yazım – özgün taslak, yazım – gözden geçirme ve düzenleme: S.A.; Tüm yazarlar, makalenin önemli noktalarını eleştirel bir şekilde gözden geçirmiştir. Tüm yazarlar makalenin son halini onaylamıştır.

Design and planning of the study: S.A.; Data collection, analysis or interpretation: S.A.; Manuscript preparation: S.A.; Data organization, methodology development, writing - original draft, writing – review and editing: S.A.; All authors critically reviewed the key points of the manuscript and approved the final version.

Fon Desteği / Funding

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

This research received no external funding.

Teşekkür / Acknowledgements

None.

APA 7 Citation

Aydın, S. (2025). Exploring the Link Between Body Composition and Strength in Young Male Basketball Players. *International Journal of Health, Exercise, and Sport Sciences*, 3(2), 320–327.

<https://www.ijoss.org/Archive/issue2-volume3/ijoss-Volume2-issue3-25.pdf>
<https://doi.org/10.5281/zenodo.17440985>

References / Kaynaklar

- Akkoç, O., Caliskan, E., & Bayramoglu, Z. (2018). Effects of passive muscle stiffness measured by Shear Wave Elastography, muscle thickness, and body mass index on athletic performance in adolescent female basketball players. *Medical Ultrasonography*, 20(2), 170. <https://doi.org/10.11152/mu-1336>
- Artero, E. G., España-Romero, V., Ortega, F. B., Jiménez-Pavón, D., Ruiz, J. R., Vicente-Rodríguez, G., Bueno, M., Marcos, A., Gómez-Martínez, S., Urzanqui, A., González-Gross, M., Moreno, L. A., Gutiérrez, A., & Castillo, M. J. (2009). Health-related fitness in adolescents: underweight, and not only overweight, as an influencing

- factor. The AVENA study. *Scandinavian Journal of Medicine & Science in Sports*, 20(3), 418–427. <https://doi.org/10.1111/j.1600-0838.2009.00959.x>
- Attene, G., Iuliano, E., Di Cagno, A., Calcagno, G., Moalla, W., Aquino, G., & Padulo, J. (2015). Improving neuromuscular performance in young basketball players: plyometric vs. technique training. *The Journal of sports medicine and physical fitness*, 55(1-2), 1–8.
- Başkaya, G., Ünveren, A., & Karavelioğlu, M. B. (2023). The Effect of Static and Dynamic Core Exercises on Motor Performance and Football-Specific Skills of Football Players Aged 10-12. *Gazi Beden Eğitimi ve Spor Bilimleri Dergisi*. <https://doi.org/10.53434/gbesbd.1148408>
- Bayios, I. A., Bergeles, N. K., Apostolidis, N. G., Noutsos, K. S., & Koskolou, M. D. (2006). Anthropometric, body composition and somatotype differences of Greek elite female basketball, volleyball and handball players. *The Journal of sports medicine and physical fitness*, 46(2), 271–280.
- Berri, D. J., Brook, S. L., & Fenn, A. J. (2010). From college to the pros: predicting the NBA amateur player draft. *Journal of Productivity Analysis*, 35(1), 25–35. <https://doi.org/10.1007/s11123-010-0187-x>
- Bilge, M., & Tuncel, F. (2003). Hentbolcularda Anaerobik Güç ve Kapasite İle Vücut Kompozisyonu Arasındaki İlişkinin İncelenmesi. *Gazi Beden Eğitimi Ve Spor Bilimleri Dergisi*, 8(4), 67-76.
- Bovet, P., Auguste, R., & Burdette, H. (2007). Strong inverse association between physical fitness and overweight in adolescents: a large school-based survey. *International Journal of Behavioral Nutrition and Physical Activity*, 4(1), 24. <https://doi.org/10.1186/1479-5868-4-24>
- Delextrat, A., & Cohen, D. (2008). Physiological Testing of Basketball Players: Toward a Standard Evaluation of Anaerobic Fitness. *Journal of Strength and Conditioning Research*, 22(4), 1066–1072. <https://doi.org/10.1519/jsc.0b013e3181739d9b>
- Dezman, B., Trninić, S., & Dizdar, D. (2001). Expert model of decision-making system for efficient orientation of basketball players to positions and roles in the game—empirical verification. *Collegium antropologicum*, 25(1), 141–152.
- Guimarães, E., Baxter-Jones, A., Maia, J., Fonseca, P., Santos, A., Santos, E., Tavares, F., & Janeira, M. (2019). The Roles of Growth, Maturation, Physical Fitness, and Technical Skills on Selection for a Portuguese Under-14 Years Basketball Team. *Sports*, 7(3), 61. <https://doi.org/10.3390/sports7030061>
- Guimarães, E., Maia, J. A. R., Williams, M., Sousa, F., Santos, E., Tavares, F., Janeira, M. A., & Baxter-Jones, A. D. G. (2021). Muscular Strength Spurts in Adolescent Male Basketball Players: The INEX Study. *International Journal of Environmental Research and Public Health*, 18(2), 776. <https://doi.org/10.3390/ijerph18020776>
- Guimarães, E., Adam, Pereira, S., Garbeloto, F., Freitas, D., Janeira, M. A., Tani, G., Katzmarzyk, P. T., Silva, S., Bailey, D. A., Mirwald, R. L., & Maia, J. (2020). Patterns of physical performance spurts during adolescence: a cross-cultural study of Canadian, Brazilian and Portuguese boys. *Annals of Human Biology*, 47(4), 346–354. <https://doi.org/10.1080/03014460.2020.1781928>
- Hoare, D. G. (2000). Predicting success in junior elite basketball players — the contribution of anthropometric and physiological attributes. *Journal of Science and Medicine in Sport*, 3(4), 391–405. [https://doi.org/10.1016/s1440-2440\(00\)80006-7](https://doi.org/10.1016/s1440-2440(00)80006-7)
- Mak, K.-K., Ho, S.-Y., Lo, W.-S., Thomas, G. N., McManus, A. M., Day, J. R., & Lam, T.-H. (2010). Health-related physical fitness and weight status in Hong Kong adolescents. *BMC Public Health*, 10(1). <https://doi.org/10.1186/1471-2458-10-88>
- Montgomery, P. G., Pyne, D. B., Hopkins, W. G., Dorman, J. C., Cook, K., & Minahan, C. L. (2008). The effect of recovery strategies on physical performance and cumulative fatigue in competitive basketball. *Journal of Sports Sciences*, 26(11), 1135–1145. <https://doi.org/10.1080/02640410802104912>
- Nedim Č., Čaušević D., Cristina I. A., Rani, B., Corina R. D., Ensar A., Lupu, G., & Dan I. A. (2023). Relations between specific athleticism and morphology in young basketball players. *Frontiers in Sports and Active Living*, 5. <https://doi.org/10.3389/fspor.2023.1276953>
- Nikolaidis, P. T., Asadi, A., Santos, E. J., Calleja-González, J., Padulo, J., Chtourou, H., & Zemkova, E. (2015). Relationship of body mass status with running and jumping performances in young basketball players. *Muscles, ligaments and tendons journal*, 5(3), 187–194. <https://doi.org/10.11138/mltj/2015.5.3.187>
- Nikolaidis P. T., Ingebrigtsen J. (2013). The relationship between body mass index and physical fitness in adolescent and adult male team handball players. *Indian J Physiol Pharmacol*, 57(4):361–371. PMID: 24968574
- Nikolaidis, P. T. (2013). Prévalence du surpoids, et rapport entre l'indice de masse corporelle, le pourcentage de graisse corporelle et la condition physique chez les footballeurs masculins âgés de 14 à 16ans. *Science & Sports*, 28(3), 125–132. <https://doi.org/10.1016/j.scispo.2012.12.002>
- Nishisaka, M. M., Zorn, S. P., Kristo, A. S., Sikilidis, A. K., & Reaves, S. K. (2022). Assessing Dietary Nutrient Adequacy and the Effect of Season—Long Training on Body Composition and Metabolic Rate in Collegiate Male Basketball Players. *Sports*, 10(9), 127. <https://doi.org/10.3390/sports10090127>
- Ode, J. J., Pivarnik, J. M., Reeves, M. J., & Knous, J. L. (2007). Body mass index as a predictor of percent fat in college athletes and nonathletes. *Medicine and Science in Sports and Exercise*, 39(3), 403–409. <https://doi.org/10.1249/01.mss.0000247008.19127.3e>

- Ostojic, S. M., Mazic, S., & Dikic, N. (2006). Profiling in Basketball: Physical and Physiological Characteristics of Elite Players. *The Journal of Strength and Conditioning Research*, 20(4), 740. <https://doi.org/10.1519/r-15944.1>
- Öncen, S., & Tanyeri, L. (2019). Comparison of Anaerobic Performance and Agility Characteristics Between American Football and Indoor Soccer Players. *Journal of Education and Training Studies*, 7(4), 224. <https://doi.org/10.11114/jets.v7i4.4103>
- Özdamar, K. (2002). Paket programlar ile istatistiksel veri analizi: SPSS-MINITAB. Kaan Kitabevi.
- Popowczak, M., Horička, P., Šimonek, J., & Domaradzki, J. (2022). The Functional Form of the Relationship between Body Height, Body Mass Index and Change of Direction Speed, Agility in Elite Female Basketball and Handball Players. *International Journal of Environmental Research and Public Health*, 19(22), 15038. <https://doi.org/10.3390/ijerph192215038>
- Rinaldo, N., Toselli, S., Gualdi-Russo, E., Zedda, N., & Zaccagni, L. (2020). Effects of Anthropometric Growth and Basketball Experience on Physical Performance in Pre-Adolescent Male Players. *International Journal of Environmental Research and Public Health*, 17(7), 2196. <https://doi.org/10.3390/ijerph17072196>
- Sampaio, J., Janeira, M., Ibáñez, S., & Lorenzo, A. (2006). Discriminant analysis of game-related statistics between basketball guards, forwards and centres in three professional leagues. *European Journal of Sport Science*, 6(3), 173–178. <https://doi.org/10.1080/17461390600676200>
- Sayers, S. P., Harackiewicz, D. V., Harman, E. A., Frykman, P. N., & Rosenstein, M. T. (1999). Cross-validation of three jump power equations. *Medicine and science in sports and exercise*, 31(4), 572–577. <https://doi.org/10.1097/00005768-199904000-00013>
- Shaun, K., Aston, D., & R Drew, S. (2022). Body Composition Changes in College Basketball Players Over Summer Training. *International Journal of Sports and Exercise Medicine*, 8(5). <https://doi.org/10.23937/2469-5718/1510232>
- Stanforth, P. R., Crim, B. N., Stanforth, D., & Stults-Kolehmainen, M. A. (2014). Body Composition Changes Among Female NCAA Division 1 Athletes Across the Competitive Season and Over a Multiyear Time Frame. *Journal of Strength and Conditioning Research*, 28(2), 300–307. <https://doi.org/10.1519/jsc.0b013e3182a20f06>
- Torres-McGehee, T. M., Pritchett, K. L., Zippel, D., Minton, D. M., Cellamare, A., & Sibilia, M. (2012). Sports Nutrition Knowledge Among Collegiate Athletes, Coaches, Athletic Trainers, and Strength and Conditioning Specialists. *Journal of Athletic Training*, 47(2), 205–211. <https://doi.org/10.4085/1062-6050-47.2.205>
- Tuna, G., & Yalçinkaya, A. E. (2023). Kadın Voleybolcularda Farklı Isınma Protokollerinin Sprint Performansına Akut Etkisinin İncelenmesi. *The Online Journal of Recreation and Sports*, 12(4), 797–804. <https://doi.org/10.22282/tojras.1349683>
- Yel, K., & Güzel, S., Kurcan, K., Aydemir, U. (2023). Spor Performansı v Denge. Spor Araştırmalarında Farklı Perspektifler 2, Editör: Prof.Dr. Erdal Zorba, Doç.Dr. Mevlüt Gönen, Dr. Zekai ÇAKIR, Aralık. Bölüm-8, ISBN: 978-625-6643-01-7, Syf:120-137. Duvar Yayınları. İzmir
- Ziv, G., & Lidor, R. (2009). Physical Attributes, Physiological Characteristics, On-Court Performances and Nutritional Strategies of Female and Male Basketball Players. *Sports Medicine*, 39(7), 547–568. <https://doi.org/10.2165/00007256-200939070-00003>

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