AD EDUXIAN JOURNAL
A Quarterly Multidisciplinary Blind Peer Reviewed & Refereed Online International Journal
Google Scholar Indexing PIF:1.048(I2OR) & 3.125 (IIFS)
Vol (2), Issue (3), Oct-Dec 2025 *ISSN: 3048-7951*

Sport-Specific Anthropometry and Body Mass Index in Young Male Football and Volleyball Players

Shaybal Chanda[1]; & Anik Biswas[2]

https://doi.org/10.5281/zenodo.18089180

Review:15/12/2025 **Acceptance: 15/12/2025** **Publication: 30/12/2025**

Abstract:

Background: BMI is commonly used to assess athletes, but its validity is limited by differences in lean mass. Football and volleyball impose distinct physical demands that shape sport-specific body traits, but evidence on BMI differences, especially among South Asian athletes, remains inconsistent.

Aim: To examine sport-specific differences in body mass index (BMI) and key anthropometric variables between young adult male football and volleyball players.

Material and Methods: This cross-sectional study compared 61 male athletes (30 football, 31 volleyball; 19–25 years) from southwestern Bangladesh. Height and weight were measured using standard procedures, and BMI was calculated per WHO criteria. All had ≥2 years of competitive experience and gave written consent. Group differences were analyzed using the Mann–Whitney U test ($p < 0.05$).

Result: Descriptive analysis of male athletes showed that football players had a mean age of 23.23 ± 1.86 years, height of 1.69 ± 0.02 m, weight of 63.76 ± 4.94 kg, and BMI of 22.28 ± 1.36, while volleyball players had a mean age of 21.87 ± 1.78 years, height of 1.78 ± 0.07 m, weight of 68.41 ± 8.73 kg, and BMI of 21.52 ± 2.21. Significant between-sport differences were observed for age ($p = 0.005$), height ($p = 0.018$), and weight ($p < 0.001$), whereas BMI did not differ significantly ($p = 0.104$).

Conclusion: The findings indicate that football players were generally older, shorter, and lighter than volleyball players, while BMI was similar between the two sports despite distinct body size profiles.

Keywords: **Athletic Profiling, Body Composition, Team Sports, Physical Characteristics, Height, Weight.**

Background: Anthropometric characteristics and body composition are fundamental determinants of athletic performance, health status, and sport specialization. Variables such as height, body mass, and body mass index (BMI) are widely used in sports science to describe physical profiles, monitor training adaptations, and support talent identification processes (Ackland et al., 2012). Among these indicators, BMI remains one of the most frequently applied measures because of its simplicity, cost-effectiveness, and standardized interpretation across populations. However, its application in athletic cohorts requires careful contextual interpretation due to sport-related variations in lean mass and fat mass distribution (De Lorenzo et al., 2013).

Different sports impose distinct physiological and biomechanical demands that shape athletes' morphological profiles over time. Football (soccer) is characterized by prolonged intermittent activity, high aerobic demands, frequent accelerations and decelerations, and repeated sprint efforts, which tend to promote lean body mass

[1]Associate Professor, Department of Physical Education and Sports Science, Faculty of Health Science, Jashore University of Science and Technology, Bangladesh. Email: shaybalchanda@yahoo.com, ORCID: https://orcid.org/0009-0001-1158-9688, (*Corresponding Author*)

[2]Student, Department of Physical Education and Sports Science, Faculty of Health Science, Jashore University of Science and Technology, Bangladesh. E-mail: anik171204bd@gmail.com, ORCID: https://orcid.org/ 0009-0006-9339-0088

development and lower relative fat accumulation (Reilly et al., 2000). In contrast, volleyball is a power-oriented team sport that emphasizes explosive jumping, rapid changes of direction, and upper- and lower-body power production, often favoring taller stature and greater musculoskeletal development (Duncan et al., 2006). These sport-specific demands, combined with training volume, positional roles, and selection mechanisms, contribute to measurable differences in anthropometric traits among athletes.

Previous studies have consistently demonstrated that athletes from different sports exhibit distinct anthropometric and body composition profiles. Comparative research involving football and volleyball players has reported significant differences in height, body mass, limb length, and somatotype, particularly at elite and sub-elite levels (Bandyopadhyay, 2007; Masanovic et al., n.d.). Volleyball players are generally taller and heavier, while football players often display lower body fat percentages and greater aerobic efficiency (González-Ravé et al., 2011). These findings support the concept of sport-specific morphological adaptation and selection.

Despite extensive research on anthropometry and body composition, evidence regarding BMI differences between team sport athletes remains inconsistent. Some studies report statistically significant differences in BMI between athletes from various sports, while others observe minimal or non-significant variation, even when other anthropometric measures differ (Norton & Olds, 2001; Sánchez-Muñoz et al., 2007). This inconsistency may be attributed to the inherent limitation of BMI, which does not distinguish between fat mass and fat-free mass and may therefore obscure meaningful physiological differences in athletic populations (Ackland et al., 2012).

The validity of BMI as a health and performance indicator in athletes has been widely debated. While BMI is strongly associated with cardiometabolic risk in general populations, its predictive value diminishes among individuals with high muscularity, such as trained athletes (De Lorenzo et al., 2013). Athletes with greater lean mass may be classified as overweight according to BMI criteria despite having optimal body fat levels and metabolic health. Nevertheless, BMI continues to be widely used in sports research, particularly in field-based studies and developing contexts, due to limited access to advanced body composition assessment tools (R. M. Malina et al., 2015).

Another limitation of existing literature is the disproportionate focus on elite Western athletes, with comparatively fewer studies conducted in South Asian or developing country settings. Genetic background, nutritional status, socioeconomic conditions, and training infrastructure differ substantially across regions and may influence anthropometric outcomes (Rodríguez-Rodríguez et al., 2011). Consequently, findings from European or North American cohorts may not be directly generalizable to athletes from countries such as Bangladesh, where systematic data on sport-specific anthropometry remain scarce.

Furthermore, many comparative studies emphasize multiple body composition variables, such as skinfold thickness, fat percentage, or somatotype, without isolating BMI as a primary outcome variable. This approach, while comprehensive, limits the ability to interpret whether BMI alone differs meaningfully between athletes participating in different team sports under similar age and training conditions. There is therefore a clear literature gap regarding focused, sport-specific comparisons of BMI between football and volleyball players, particularly among young adult male athletes from underrepresented regions.

Addressing this gap is important for both scientific and practical reasons. From a research perspective, determining whether body mass index differs significantly between athletes engaged in endurance-dominant and power-dominant team sports can clarify the utility and limitations of BMI in athletic assessment. From an applied perspective, coaches, trainers, and sports medicine professionals frequently rely on BMI for routine monitoring despite its known constraints, and sport-specific evidence can improve interpretation and prevent misclassification of athletes' physical status. Accordingly, the research question guiding this study is: Do body mass index and selected anthropometric variables differ significantly between young male football and volleyball players? This study adds evidence on sport-specific anthropometry in South Asian athletes, provides practical BMI reference values for athlete monitoring, and clarifies the utility of BMI in athletic assessment.

MATERIAL AND METHODS

Study Design: This research employed a cross-sectional, comparative study design to examine sport-specific anthropometry and Body Mass Index (BMI) among young male football (soccer) and volleyball players. The cross-sectional approach enabled the collection of anthropometric and BMI data at a single time point to compare differences between the two sport groups.

Participants: A total of 61 male athletes, comprising 30 football and 31 volleyball players, were recruited from various sports academies located in Khulna, Jashore, Satkhira, and the surrounding suburban and rural areas of Bangladesh. Participants' ages ranged from 19 to 25 years. The sample size was determined through an a priori power analysis using G*Power software, targeting a moderate effect size (Cohen's $d = 0.5$), an alpha level of 0.05, and a power of 0.80, which confirmed that 61 participants were sufficient to detect statistically meaningful differences between groups.

Inclusion Criteria: Participants were required to be actively engaged in competitive football or volleyball for at least two years. They had to be free from any musculoskeletal injuries and medically cleared for physical activity, ensuring that all participants could safely undergo anthropometric assessment and participate fully in the study.

Exclusion Criteria: Participants were excluded if they had a history of chronic illness, recent surgery, or any condition that could affect normal growth, body composition, or performance. These criteria ensured that only healthy individuals capable of safely participating in the study were included.

Informed Consent: All participants were fully informed about the study objectives, procedures, potential risks, and benefits. Written informed consent was obtained from each participant prior to data collection in accordance with established ethical guidelines for human research, ensuring voluntary participation and the protection of confidentiality.

Anthropometric Criteria: The primary variables measured were height and body weight, which were subsequently used to calculate BMI. Height was recorded in meters (m) and weight in kilograms (kg) following standardized anthropometric protocols. Body Mass Index was calculated by dividing weight in kilograms by the square of height in meters. The BMI values were then categorized according to World Health Organization guidelines, with values below 18.50 considered underweight, 18.50 to 24.99 considered normal, 25.00 and above considered overweight, and values of 30.00 or higher classified as obese.

Instruments and Tools: Measurements were taken using a calibrated digital weighing scale for body weight (kg) and a stadiometer for height (m). Standardized data sheets and writing instruments were used to record all measurements.

Test Protocol: All measurements were conducted following standardized procedures to ensure accuracy and reliability. Participants were instructed to remove shoes and heavy clothing before measurement. Height was measured while participants stood upright against a stadiometer, and weight was measured on a calibrated digital scale with minimal clothing. Each measurement was taken twice, and the average value was recorded. All personnel conducting the measurements were trained to follow the same procedures to minimize measurement error and ensure consistency across participants.

Data Collection: Data collection was conducted at the respective sports academies according to the established test protocol. Trained personnel visited each academy to implement the measurements, ensuring that all procedures were carried out uniformly. Ethical considerations were strictly maintained, including privacy, confidentiality, and voluntary participation. The collected data provided a reliable basis for calculating BMI and analyzing sport-specific anthropometric patterns.

Statistical Analysis: Descriptive statistics, including mean and standard deviation, were calculated for all measured variables. The normality of the data distribution was assessed using Kolmogorov-Smirnov and Shapi-Wilk tests, and homogeneity of variance was evaluated with Levene's test. In cases of violation of normality or homogeneity assumptions, non-parametric statistical methods were planned for group comparisons. Differences between football and volleyball players were to be assessed using the Mann-Whitney U test, with the level of significance set at $p < 0.05$. All analyses were conducted using SPSS software (version 23) to ensure accurate and reliable statistical inference.

RESULTS:

Table 1. Assessment of Normality in Anthropometric Variables among Young Male Football and Volleyball Players

Variable	Sports	Kolmogorov-Smirnov			Shapiro-Wilk		
		Statistic	*df*	Sig.	Statistic	*df*	Sig.
Age	Football	.217	30	.001	.835	30	.000
	Volleyball	.171	31	.021	.940	31	.083
Weight	Football	.121	30	.200	.956	30	.244
	Volleyball	.152	31	.064	.965	31	.387
Height	Football	.204	30	.003	.904	30	.011
	Volleyball	.149	31	.076	.867	31	.001
BMI	Football	.136	30	.163	.929	30	.045
	Volleyball	.136	31	.154	.978	31	.743

The Kolmogorov-Smirnov and Shapiro-Wilk tests (Table 1) were used to assess the normality of age, weight, height, and BMI for both football and volleyball players. For age, both tests indicated that football players' data

significantly deviated from normality (Kolmogorov-Smirnov $p = 0.001$; Shapiro-Wilk $p = 0.000$), while volleyball players' age was non-normal according to Kolmogorov-Smirnov ($p = 0.021$) but normal according to Shapiro-Wilk ($p = 0.083$), suggesting a borderline case. Weight distributions were normally distributed for both sports, as all p-values exceeded 0.05. Height showed deviations from normality in football players (Kolmogorov-Smirnov $p = 0.003$; Shapiro-Wilk $p = 0.011$) and in volleyball players according to Shapiro-Wilk ($p = 0.001$), although Kolmogorov-Smirnov indicated marginal normality ($p = 0.076$). BMI was normally distributed for volleyball players ($p > 0.05$ in both tests), but for football players, Shapiro-Wilk indicated a slight deviation from normality ($p = 0.045$) despite Kolmogorov-Smirnov showing non-significance ($p = 0.163$). Overall, weight and volleyball players' BMI appear normally distributed, while age, height, and football players' BMI deviate from normality, supporting the need for non-parametric statistical analyses for certain variables.

Table 2. Levene's Test for Homogeneity of Variance (Based on Mean)

Variable	Levene Statistic (F)	df_1	df_2	p-value	Method
Age	0.021	1	59	0.885	Based on Mean
Weight	10.473	1	59	0.002	Based on Mean
Height	9.555	1	59	0.003	Based on Mean
BMI	5.563	1	59	0.022	Based on Mean

Levene's test (Table 2) was conducted to assess the homogeneity of variance for age, weight, height, and BMI between football and volleyball players. The results indicate that the variances for age ($F = 0.021$, $p = 0.885$) were equal across the two sports groups, confirming homogeneity. In contrast, weight ($F = 10.473$, $p = 0.002$), height ($F = 9.555$, $p = 0.003$), and BMI ($F = 5.563$, $p = 0.022$) showed significant differences in variance, indicating a violation of the homogeneity assumption. These findings suggest that non-parametric statistical methods should be employed for variables where homogeneity is not met, while parametric tests may be appropriate for age.

Considering the violations of normality and heterogeneity of variance in age, height, weight, and BMI, non-parametric statistical analysis using the **Mann-Whitney U test** was employed to compare these variables between football and volleyball players.

Table 3. Descriptive Statistics of Age, Weight, Height, and BMI among Football and Volleyball Players

Variable	Sports	N	Mean	Std. Deviation
Age	Football	30	23.23	1.86
	Volleyball	31	21.87	1.78
	Total	61	22.54	1.93
Weight	Football	30	63.76	4.94
	Volleyball	31	68.41	8.73
	Total	61	66.13	7.45
Height	Football	30	1.69	.02
	Volleyball	31	1.78	.07
	Total	61	1.73	.07
BMI	Football	30	22.28	1.36
	Volleyball	31	21.52	2.21
	Total	61	21.89	1.86

Table 3 presents descriptive statistics for age, weight, height, and BMI of football and volleyball players. Football players had a mean age of 23.23 ± 1.86 years, mean weight of 63.76 ± 4.94 kg, mean height of 1.69 ± 0.02 m, and mean BMI of 22.28 ± 1.36. Volleyball players had a mean age of 21.87 ± 1.78 years, mean weight of 68.41 ± 8.73 kg, mean height of 1.78 ± 0.07 m, and mean BMI of 21.52 ± 2.21. Overall, the combined sample of 61 participants showed a mean age of 22.54 ± 1.93 years, mean weight of 66.13 ± 7.45 kg, mean height of 1.73 ± 0.07 m, and mean BMI of 21.89 ± 1.86.

Table 4. Mann-Whitney U Test Results for Differences in Age, Height, Weight, and BMI between Football and Volleyball Players

SL	Null Hypothesis	Test	Sig.	Decision
1	The distribution of Age is the same across categories of Sports	Independent-Samples Mann-Whitney U Test	.005	Reject the null hypothesis.
2	The distribution of Height is the same across categories of Sports	Independent- Samples Mann-Whitney U Test	.018	Reject the null hypothesis.
3	The distribution of Weigh is the same across categories of Sports	Independent- Samples Mann-Whitney U Test	.000	Reject the null hypothesis.
4	The distribution of BMI is the same across categories of Sports	Independent- Samples Mann-Whitney U Test	.104	Retain the null hypothesis.

Level of significance $\alpha = .05$ and significant at $p = .05$

The Mann-Whitney U test (Table 4) was conducted to compare age, height, weight, and BMI between football and volleyball players. The results indicated significant differences in age ($p = 0.005$), height ($p = 0.018$), and weight ($p < 0.001$) across the two sports groups, leading to rejection of the null hypotheses for these variables. In contrast, no significant difference was found in BMI ($p = 0.104$), and the null hypothesis for BMI was retained. These findings suggest that while football and volleyball players differ in age, height, and weight, their BMI distributions are similar.

Overall, Descriptive analysis of 61 young male athletes revealed that football players ($n = 30$) had a mean age of 23.23 ± 1.86 years, mean weight of 63.76 ± 4.94 kg, mean height of 1.69 ± 0.02 m, and mean BMI of 22.28 ± 1.36. Volleyball players ($n = 31$) had a mean age of 21.87 ± 1.78 years, mean weight of 68.41 ± 8.73 kg, mean height of 1.78 ± 0.07 m, and mean BMI of 21.52 ± 2.21. The combined sample showed a mean age of 22.54 ± 1.93 years, mean weight of 66.13 ± 7.45 kg, mean height of 1.73 ± 0.07 m, and mean BMI of 21.89 ± 1.86. Non-parametric analysis using the Mann-Whitney U test indicated significant differences between sports for age ($p = 0.005$), height ($p = 0.018$), and weight ($p < 0.001$), whereas no significant difference was observed for BMI ($p = 0.104$). These results suggest that football and volleyball players differ significantly in age, height, and weight,

but have comparable BMI distributions, highlighting sport-specific anthropometric characteristics while overall body composition, as measured by BMI, remains similar.

Discussion: The present study's findings elucidate clear sport-specific anthropometric distinctions between young male football and volleyball players, underscoring the influence of sport demands on physical development. The results indicated that football players were generally older, shorter, and lighter than their volleyball counterparts, while BMI distributions did not differ significantly between the groups. These findings align with existing literature emphasizing the role of sport-specific requirements in shaping athletes' anthropometric profiles (Ackland et al., 2012; Norton & Olds, 2001).

The significant differences in height and weight between football and volleyball players reflect the unique physiological and biomechanical demands inherent to each sport. Volleyball, characterized by frequent jumping, reaching, and rapid directional changes, generally favors taller athletes with greater body mass to optimize reach and power (Gabbett & Georgieff, 2007; Sheppard et al., 2009). Conversely, football requires agility, speed, and endurance, often favoring athletes with a more compact stature and lower body mass, contributing to enhanced acceleration and maneuverability on the field (Reilly et al., 2000; Stølen et al., 2005). The observed anthropometric trends are consistent with these performance demands.

The absence of significant differences in BMI between football and volleyball players suggests that while absolute height and weight differ, the proportionality of body mass relative to height remains comparable. This may indicate that both groups maintain similar body composition profiles, balancing lean mass and fat mass to meet their sport-specific functional requirements (Mujika et al., 2004; Silva et al., 2014). BMI, however, is a limited measure in athletic populations as it does not differentiate between muscle and fat mass; thus, further body composition analysis would provide more nuanced insights (Peterson et al., 2011).

Age differences, with football players being older, may reflect variations in training onset, maturation rates, or recruitment strategies within the sports. Football often involves structured youth academies with early specialization, potentially leading to older cohorts at competitive levels compared to volleyball (Ford et al., 2009; R. M. Malina et al., 2015). Additionally, biological maturation influences anthropometric characteristics, and age-related differences may partially account for the observed physical disparities (Cumming et al., 2017). Longitudinal tracking of maturation alongside anthropometry is recommended for a comprehensive understanding.

The findings contribute to the growing body of evidence supporting the necessity of sport-specific anthropometric profiling for talent identification and training prescription. Tailoring training regimens to the athlete's physical characteristics can enhance performance and reduce injury risk (Bangsbo et al., 2006; Gabbett & Georgieff, 2007). For example, volleyball players may benefit from strength and conditioning programs emphasizing explosive power and vertical jump capacity, whereas football players require training focused on speed, agility, and endurance (Chelly et al., 2010; Little & Williams, 2005).

Moreover, these anthropometric distinctions have practical implications for scouting and selection processes. Coaches and sport scientists can utilize such data to identify athletes whose physical profiles align with the

demands of the sport, thereby optimizing team composition and competitive advantage (Baker et al., 2018; Cobley et al., 2009). However, it is critical to integrate anthropometric data with technical, tactical, and psychological assessments to form a holistic evaluation of an athlete's potential (Vaeyens et al., 2008).

The study's use of the Mann-Whitney U test for non-parametric analysis was appropriate given the data distribution and sample characteristics, ensuring robust detection of group differences (Field, 2013). Future research could expand on these findings by including female athletes and examining additional anthropometric variables such as limb length, body segment proportions, and somatotype classifications (R. Malina et al., 2004). Such comprehensive profiling would deepen understanding of how morphology interacts with sport-specific performance.

Furthermore, integrating physiological and biomechanical assessments alongside anthropometry would clarify how physical characteristics translate into functional capabilities. For instance, exploring relationships between height, weight, and jumping ability in volleyball or sprint performance in football could link morphology to key performance indicators (Markovic et al., 2004; Stølen et al., 2005). This multidisciplinary approach would enhance the precision of training interventions and talent development pathways.

The similarity in BMI despite significant differences in height and weight also raises questions about the role of body composition in these sports. Given that BMI cannot distinguish between fat and lean mass, future studies employing tools such as dual-energy X-ray absorptiometry (DXA) or bioelectrical impedance analysis (BIA) would provide more detailed body composition data (Ackland et al., 2012). This would help clarify whether the similar BMI values mask differences in muscle mass or fat distribution, which are critical for performance and health.

The study confirms that young male football and volleyball players exhibit distinct anthropometric profiles aligned with the physical demands of their respective sports. Height and weight differences are significant, reflecting the contrasting performance requirements, while BMI remains similar, suggesting comparable body proportionality. These insights reinforce the importance of sport-specific physical profiling in athlete development and selection. Future research should incorporate longitudinal designs, broader anthropometric variables, and detailed body composition analyses to further elucidate the complex interactions between morphology and sport performance.

Limitations: The study included a relatively small sample of 61 participants, which may limit generalizability. Only basic measurements and BMI were assessed, without considering body composition or training history. The cross-sectional design also prevents conclusions about changes over time.

Concussion: To better understand the physical differences between athletes in different sports, this study examined key body measurements of young male football and volleyball players. The results showed that football players tend to be slightly older, shorter, and lighter, while volleyball players are generally taller and heavier. However, body mass index (BMI), which reflects overall body composition, was similar in both groups. This indicates that although the two sports favor different body shapes for optimal performance, the overall balance of weight relative to height is quite similar.

Acknowledgement: The authors thank all participating athletes and the respective sports academies for their support. AI tools were used solely for language editing; all study design, data collection, and analysis were conducted by the authors.**Funding**: Nil **Conflict of interest**: The authors declare that there is no conflict of interest

REFERENCES

- Ackland, T. R., Lohman, T. G., Sundgot-Borgen, J., Maughan, R. J., Meyer, N. L., Stewart, A. D., & Müller, W. (2012). Current status of body composition assessment in sport: Review and position statement on behalf of the ad hoc research working group on body composition health and performance, under the auspices of the I.O.C. Medical Commission. *Sports Medicine (Auckland, N.Z.)*, *42*(3), 227–249. https://doi.org/10.2165/11597140-000000000-00000
- Baker, J., Schorer, J., & Wattie, N. (2018). Compromising Talent: Issues in Identifying and Selecting Talent in Sport. *Quest*, *70*(1), 48–63. https://doi.org/10.1080/00336297.2017.1333438
- Bandyopadhyay, A. (2007). Anthropometry and Body Composition in Soccer and Volleyball Players in West Bengal, India. *Journal of PHYSIOLOGICAL ANTHROPOLOGY*, *26*(4), 501–505. https://doi.org/10.2114/jpa2.26.501
- Bangsbo, J., Mohr, M., & Krustrup, P. (2006). Physical and metabolic demands of training and match-play in the elite football player. *Journal of Sports Sciences*, *24*(7), 665–674. https://doi.org/10.1080/02640410500482529
- Chelly, M. S., Hermassi, S., & Shephard, R. J. (2010). Relationships between power and strength of the upper and lower limb muscles and throwing velocity in male handball players. *Journal of Strength and Conditioning Research*, *24*(6), 1480–1487. https://doi.org/10.1519/JSC.0b013e3181d32fbf
- Cobley, S., Baker, J., Wattie, N., & McKenna, J. (2009). Annual Age-Grouping and Athlete Development. *Sports Medicine*, *39*(3), 235–256. https://doi.org/10.2165/00007256-200939030-00005
- Cumming, S. P., Lloyd, R. S., Oliver, J. L., Eisenmann, J. C., & Malina, R. M. (2017). Bio-banding in Sport: Applications to Competition, Talent Identification, and Strength and Conditioning of Youth Athletes. *Strength & Conditioning Journal*, *39*(2), 34–47. https://doi.org/10.1519/SSC.0000000000000281
- De Lorenzo, A., Bianchi, A., Maroni, P., Iannarelli, A., Di Daniele, N., Iacopino, L., & Di Renzo, L. (2013). Adiposity rather than BMI determines metabolic risk. *International Journal of Cardiology*, *166*(1), 111–117. https://doi.org/10.1016/j.ijcard.2011.10.006
- Duncan, M. J., Woodfield, L., & al-Nakeeb, Y. (2006). Anthropometric and physiological characteristics of junior elite volleyball players. *British Journal of Sports Medicine*, *40*, 649-651. https://doi.org/10.1136/bjsm.2005.021998
- Field, A. (2013). *Discovering statistics using IBM SPSS statistics* (4th ed.). Saga.
- Ford, P. R., Ward, P., Hodges, N. J., & Williams, A. M. (2009). The role of deliberate practice and play in career progression in sport: The early engagement hypothesis. *High Ability Studies*, *20*(1), 65–75. https://doi.org/10.1080/13598130902860721

- Gabbett, T., & Georgieff, B. (2007). Physiological and anthropometric characteristics of Australian junior national, state, and novice volleyball players. *Journal of Strength and Conditioning Research*, *21*(3), 902–908. https://doi.org/10.1519/R-20616.1
- González-Ravé, J. M., Arija, A., & Clemente-Suarez, V. (2011). Seasonal Changes in Jump Performance and Body Composition in Women Volleyball Players. *The Journal of Strength & Conditioning Research*, *25*(6), 1492–1501. https://doi.org/10.1519/JSC.0b013e3181da77f6
- Little, T., & Williams, A. G. (2005). Specificity of acceleration, maximum speed, and agility in professional soccer players. *Journal of Strength and Conditioning Research*, *19*(1), 76–78. https://doi.org/10.1519/14253.1
- Malina, R., Bouchard, C., & Bar-Or, O. (2004). *Growth, Maturation, and Physical Activity*. https://doi.org/10.5040/9781492596837
- Malina, R. M., Rogol, A. D., Cumming, S. P., Silva, M. J. C. e, & Figueiredo, A. J. (2015). *Biological maturation of youth athletes: Assessment and implications*. https://doi.org/10.1136/bjsports-2015-094623
- Markovic, G., Dizdar, D., Jukic, I., & Cardinale, M. (2004). Reliability and factorial validity of squat and countermovement jump tests. *Journal of Strength and Conditioning Research*, *18*(3), 551–555. https://doi.org/10.1519/1533-4287(2004)18%253C551:RAFVOS%253E2.0.CO;2
- Masanovic, B., Bavcevic, T., & Bavcevic, I. (n.d.). Comparative Study of Anthropometric Measurement and Body Composition between Junior Soccer and Volleyball Players from the Serbian National League. *Sport Mont*, *17*(1), 9–14.
- Mujika, I., Padilla, S., Pyne, D., & Busso, T. (2004). Physiological changes associated with the pre-event taper in athletes. *Sports Medicine (Auckland, N.Z.)*, *34*(13), 891–927. https://doi.org/10.2165/00007256-200434130-00003
- Norton, K., & Olds, T. (2001). Morphological Evolution of Athletes Over the 20th Century. *Sports Medicine*, *31*(11), 763–783. https://doi.org/10.2165/00007256-200131110-00001
- Peterson, M. D., Sen, A., & Gordon, P. M. (2011). Influence of resistance exercise on lean body mass in aging adults: A meta-analysis. *Medicine and Science in Sports and Exercise*, *43*(2), 249–258. https://doi.org/10.1249/MSS.0b013e3181eb6265
- Reilly, T., Bangsbo, J., & Franks, A. (2000). Anthropometric and physiological predispositions for elite soccer. *Journal of Sports Sciences*, *18*(9), 669–683. https://doi.org/10.1080/02640410050120050
- Rodríguez-Rodríguez, E., López-Plaza, B., López-Sobaler, A. M., & Ortega, R. M. (2011). [Overweight and obesity among Spanish adults]. *Nutricion Hospitalaria*, *26*(2), 355–363. https://doi.org/10.1590/s0212-16112011000200017
- Sánchez-Muñoz, C., Sanz, D., & Zabala, M. (2007). *Anthropometric characteristics, body composition and somatotype of elite junior tennis players*. https://doi.org/10.1136/bjsm.2007.037119
- Sheppard, J. M., Gabbett, T. J., & Stanganelli, L.-C. R. (2009). An analysis of playing positions in elite men's volleyball: Considerations for competition demands and physiologic characteristics. *Journal of Strength and Conditioning Research*, *23*(6), 1858–1866. https://doi.org/10.1519/JSC.0b013e3181b45c6a
- Silva, J. R., Rebelo, A., Marques, F., Pereira, L., Seabra, A., Ascensão, A., & Magalhães, J. (2014). Biochemical impact of soccer: An analysis of hormonal, muscle damage, and redox markers during the

season. *Applied Physiology, Nutrition, and Metabolism = Physiologie Appliquee, Nutrition Et Metabolisme*, *39*(4), 432–438. https://doi.org/10.1139/apnm-2013-0180

- Stølen, T., Chamari, K., Castagna, C., & Wisløff, U. (2005). Physiology of soccer: An update. *Sports Medicine (Auckland, N.Z.)*, *35*(6), 501–536. https://doi.org/10.2165/00007256-200535060-00004
- Vaeyens, R., Lenoir, M., Williams, A. M., & Philippaerts, R. M. (2008). Talent identification and development programmes in sport: Current models and future directions. *Sports Medicine (Auckland, N.Z.)*, *38*(9), 703–714. https://doi.org/10.2165/00007256-200838090-00001