DOI 10.26773/jaspe.241005

Journal of Anthropology of Sport and Physical Education

ORIGINAL SCIENTIFIC PAPER

Comparative Analysis of Motor Skills and Morphological Characteristic of the Young Female Athletes

Marija Terzic[1]

[1]University of Montenegro, Faculty for Sport and Physical Education, Niksic, Montenegro

Abstract

Handball and volleyball are quite different sports. Thus, this research was inspired by these differences, by similar previous research, and the aspire to see if there are differences between the performances of young female athletes that play handball and volleyball. The aim of this research is to perform a comparative analysis of motor skills and morphological characteristics of young female athletes, handball and volleyball players. The complete sample consisted of 50 female athletes. One study group is composed of 25 female handball players, who are members of the women's handball club „Niksic". And the second study group is composed of 25 female volleyball players, who are members of the women's volleyball club „Volley Star". All female athletes are aged 12 to 14 and they have been training handball or volleyball for at least 2 years. In order to assess morphological characteristics and motor abilities, fourteen measures were applied to the sample. A t-test was used to determine statistically significant differences between study groups. In conclusion, there are statistically significant differences in terms of motor skills and morphological characteristics between young female handball and volleyball players.

Keywords: *handball, volleyball, motor skills, morphological characteristics*

Introduction

A tendency for improvement and measurement of their own abilities and characteristics, which can be developed under the influence of the training process is one of the basic motives that makes people to play sports (Bjelica, 2005). Research highlights the differences between athletes who play different sports. For instance, a study by Masanovic, Gardasevic, and Bjelica (2021) showed that volleyball players had significantly greater body height compared to handball players, while handball players had significantly higher body weight and a greater percentage of muscle mass compared to volleyball players. Similar results were obtained by Masanovic, Milosevic, and Corluka (2018), who also tested volleyball and handball players. Another study by Simonek, Horicka, and Hianik (2017) found that handball players performed better in the 30m sprint test compared to volleyball players. Research by Pena, Moreno-Doutres, Coma, Cook, and Busca (2016) showed that handball players had better agility compared to volleyball players. The study by Zekic, Robert, Vucetic, Vlatko, Pejcic, and Tena (2017) demonstrated that female handball players had greater aerobic endurance compared to female volleyball players, considering the sport's demands and training processes.

Volleyball is a linear interval game requiring players to perform short, high-intensity actions followed by periods of low-intensity activities (Gabbett, Georgieff, and Domrow, 2007; Majstorovic, Nesic, Grbic, Savic, and Dopsaj, 2019). It is considered a sport where power, strength, and explosiveness dominate, often demonstrated through various types of jumps and the ability to spike and serve the ball at high speeds. Over time, volleyball has evolved from a refined technical game to a strong and aggressive one (Selinger, 1987), putting the opposing team at a disadvantage.

Handball is a sport that falls under polystructural sports activities, as it includes all natural movement forms along with cyclic and acyclic movement structures. Players' movements, which manifest in different rhythms, methods, and intensities, relate to cyclic movements often interrupted by acyclic movements (jumps,

Correspondence:

M. Terzic
University of Montenegro, Faculty for Sport and Physical Education, Narodne omladine bb, 81400 Niksic, Montenegro
E-mail: terzicmarija11@gmail.com

throws, etc.). Such characteristics make handball one of the most complex sports (Foretic and Rogulj, 2007). This sport provides opportunities for the coordinated development of all muscle groups, activating various functional potentials that enhance all motor skills (Foretic and Rogulj, 2007). Morphological characteristics are significant for achieving top results in this game (Sibila and Pori, 2009). Marvic (2006) considers that a top handball player must possess the characteristics of a modern decathlete.

The primary goal of this research is to determine whether there are statistically significant differences between the motor skills and morphological characteristics of young female handball and volleyball players.

Methodology

The total sample of respondents comprises 50 girls, divided into two sub-samples. The first sub-sample consists of 25 handball players aged 12 to 14, who have been in continuous training for at least two years in the women's handball club "Niksic." The second sub-sample includes 25 volleyball players aged 12 to 14, who have also been in continuous training for at least two years in the women's volleyball club "Volley Star."

The sample of measuring instruments for assessing morphological dimensions was conducted according to the standardized ISAK manual (Marfell-Jones, Olds, Stew, and Carter, 2006). The selected variables are: body height (ATV), body weight (ATT), arm span (ARR), hand length (ADS), waist circumference (AOS), hip circumference (AOK), and Body Mass Index (BMI). The sample of measuring instruments for assessing motor skills was conducted according to the model by Bala et al. (2007), including: 20m run (MT2), high jump (MSV), standing long jump (MSD), standing on one leg test (MSN), sit and reach test (MTP), trunk lift test (MPT), and push-ups (MTS). This battery of measuring instruments was constructed to meet the research's needs and objectives.

The obtained results in this research were processed using descriptive and comparative statistical methods. The statistical significance of differences in selected variables was determined using a t-test for independent samples with a statistical significance level set at $p<0.05$.

Results

Tables 1, 2, 3, and 4 present the basic descriptive statistical parameters of the morphological characteristics and motor skills of handball and volleyball players, including calculated values of central and dispersion tendencies: arithmetic mean (Mean), standard deviation (Sd), minimum (Min) and maximum (Max) values, range (R), skewness coefficient (Sk), and kurtosis coefficient (Ku).

Tabela 1. Descriptive Statistics of Morphological Characteristics of Female Handball Players

Variables	N	Min	Max	Mean	Sd	R	Sk	Ku
ATV	25	154.00	179.00	167.42	6.39	25.00	-0.25	-0.17
ATT	25	40.60	73.60	56.06	10.22	33.00	0.29	-1.18
ARR	25	154.00	183.00	168.00	7.29	29.00	-0.02	-0.17
ADS	25	16.00	20.00	18.20	1.00	4.00	-0.28	0.15
AOS	25	59.00	88.00	67.28	7.58	29.00	1.20	0.93
AOK	25	78.00	105.00	90.20	8.26	27.00	0.40	-1.11
BMI	25	15.80	25.65	19.79	3.20	9.85	0.46	-1.30

Legend: N - number of entities; Min - minimum results; Max - maximum results; Sd - standard deviation; R - range; Sk - skewness measure; Ku - kurtosis measure; ATV - body height; ATT - body weight; ARR - arm span; ADS - hand length; AOS - waist circumference; AOK - hip circumference; BMI - Body Mass Index

Table 1 shows the processed results obtained by measuring the morphological characteristics of handball players. The analysis begins with parameters describing the Gaussian curve. Skewness (Sk) represents a measure of symmetry. According to the results in Table 1, the results are close to zero, with the hip circumference (AOK) standing out with Sk = 1.20. However, we can conclude that the skewness results are not statistically significant as they do not exceed ±2, ranging from -0.28 to 1.20. For an ideally symmetrical curve, skewness is zero, indicating no skewness, which is not the case for the results in this table. Kurtosis represents the Gaussian curve's peak curvature. The kurtosis column shows values ranging from -1.30 to 0.93, with parameters such as BMI = -1.30, body weight (ATT) = -1.18, and hip circumference (AOK) = -1.11 being most distant from zero but still statistically insignificant. Based on the skewness and kurtosis values, we can conclude that all results indicate a normal distribution. The Gaussian curve's shift is minimal, so each variable is slightly flattened or elongated but statistically insignificant. Analyzing the standard deviation (Sd) and its relationship with the arithmetic mean (Mean), we can conclude that there are no statistically significant results. In Table 1, one variable with the smallest range is hand length (ADS = 4.00), while the variable with the largest range is body weight (ATT = 33.00). Other variables have optimal values between the minimum and maximum.

Table 2 describes the descriptive statistics of the motor skills of handball players. The skewness values range from -0.25 to

Tabela 2. Descriptive Statistics of Motor Skills of Female Handball Players

Variables	N	Min	Max	Mean	Sd	R	Sk	Ku
MT2	25	2.95	4.50	3.65	0.28	1.55	0.31	3.08
MSV	25	15.00	44.00	29.20	8.37	29.00	-0.25	-0.83
MSD	25	140.00	230.00	178.60	21.15	90.00	0.36	0.25
MSN	25	1	2	1.28	0.45	1	1.04	-0.99
MTP	25	1	14	6.72	4.19	13	-0.05	-1.37
MPT	25	13	22	16.96	2.28	9	0.19	-0.31
MTS	25	2	35	15.84	10.69	33	0.42	-0.91

1.04, indicating no statistically significant results. Kurtosis represents the measure of homogeneity and is related to empirical result variability in a statistical series. The table shows that the 20m run variable (MT2) stands out with MT2 = 3.08, while other kurtosis values are close to zero, with the smallest value being trunk flexion (MTP) at MTP = 1.37, which is statistically insignificant. The 20m run (MT2) is statistically significant and shows that the Gaussian curve is mesokurtic. Analyzing skewness and kurtosis, we can conclude that the Gaussian curve's shift is minimal and statistically insignificant in all variables except for MT2, where the curve is ideally mesokurtic. Analyzing the standard deviation (Sd) column and its relationship with the arithmetic mean (Mean), we can conclude that there are no statistically significant results.

Analyzing Table 3, we see that the skewness column shows that the waist circumference (AOS) variable is statistically significant

Tabela 3. Descriptive Statistics of Morphological Characteristics of Female Volleyball Players

Variables	N	Min	Max	Mean	Sd	R	Sk	Ku
ATV	25	156.00	178.00	167.44	5.59	22.00	-0.13	-0.41
ATT	25	48.10	67.50	56.61	5.63	19.40	0.42	-0.85
ARR	25	157.00	178.50	168.31	6.07	21.50	-0.08	-0.53
ADS	25	17.00	20.00	18.51	0.93	3.00	-0.24	-0.69
AOS	25	60.00	80.00	65.32	3.97	20.00	2.17	7.18
AOK	25	85.00	98.00	92.04	3.94	13.00	-0.22	-1.19
BMI	25	17.21	22.10	20.07	1.42	4.89	-0.33	-1.09

(AOS = 2.17). This indicates that the waist circumference measurements in this group are below average, with the Gaussian curve showing positive asymmetry. The smallest value is BMI (-0.33), which is statistically insignificant. Other variable values are close to zero with no significant deviations. The kurtosis column shows that the waist circumference (AOS) variable is statistically significant (AOS = 7.18). Since the kurtosis value is greater than 3, the Gaussian curve is leptokurtic, indicating result homogeneity for this variable and a higher Gaussian curve peak. The lowest kurtosis value is hip circumference (AOK) at -1.19, which is statistically insignificant. The results show that the waist circumference (AOS) values (Sk = 2.17, Ku = 7.18) indicate positive asymmetry and greater curvature, indicating result homogeneity. Other variable results are statistically insignificant, with minimal Gaussian curve deviations from normality. When analyzing the standard deviation (Sd) and its relationship with the arithmetic mean (Mean), we find no statistically significant results. The range (R) column shows that hand length (ADS) has the smallest value (ADS = 3.00), while body height (ATV) has the largest range (ATV = 22.00). Other variables have approximately similar ranges.

Tabela 4. Descriptive Statistics of Motor Skills of Female Volleyball Players

Variables	N	Min	Max	Mean	Sd	R	Sk	Ku
MT20	25	3.40	4.26	3.80	0.19	0.86	-0.07	0.43
MSV	25	10.00	45.00	32.04	10.02	35.00	-0.81	-0.46
MSD	25	130.00	203.00	174.72	16.68	73.00	-0.73	0.82
MSN	25	1	2	1.28	0.45	1	1.04	-0.99
MTP	25	1	23	15.00	5.56	22	-0.97	1.10
MPT	25	10	19	15.20	2.21	9	-0.12	-0.13
MTS	25	1	14	6.40	3.67	13	0.37	-0.54

Analysis Table 4, we see that the skewness values range from -0.97 to 1.04 and the kurtosis values ranging from -0.99 to 1.10. Analyzing skewness and kurtosis, we conclude that the Gaussian curve shows no significant deviations from normality. The range (R) column shows that the standing long jump (MSD) variable has the largest range (MSD = 73.00), while the standing on one leg (MSN) variable has the smallest range (MSN = 1). Analyzing the standard deviation (Sd) and its relationship with the arithmetic mean (Mean), we find no statistically significant results.

Tabela 5. Differences in Morphological Characteristics between Handball and Volleyball Female Players

Variables	Mean Handball Females	Mean Volleyball Females	t - value	Mean Difference	p
ATV	167.42	167.44	-0.01	-0.02	0.625
ATT	56.06	56.61	-0.23	-0.55	0.003
ARR	168.00	168.31	-0.16	-0.31	0.485
ADS	18.20	18.51	-1.12	-0.30	0.852
AOS	67.28	65.32	1.14	1.96	0.005
AOK	90.20	92.04	-1.00	-1.84	0.001
BMI	19.79	20.07	-0.39	-0.27	0.001

Legend: Mean - arithmetic mean; t - t-test value; Mean Difference - mean difference values; p - significance coefficient of mean differences

Table 5 shows the results describing the average values of the morphological characteristics of handball and volleyball players, including the t-test value for each variable, the difference in means, and the p-value, representing the significance of the differences. The t-test results indicate statistically significant differences in four variables: body weight (ATT) $p = 0.003$, waist circumference (AOS) $p = 0.005$, hip circumference (AOK) $p < 0.001$, and BMI ($p < 0.001$). Other variable values are statistically insignificant. Based on the mean values, we conclude that volleyball players had higher body weight, hip circumference, and BMI, while handball players had higher waist circumference values.

Table 6 shows the t-test results indicating differences in the motor abilities of handball and volleyball players. The analysis reveals a statistically significant difference in one variable: push-ups (MTS) with $p < 0.001$. Other variables are statistically insignificant. Based on the mean values, handball players performed better in the push-up test, indicating stronger arm and shoulder muscles compared to volleyball players. Additionally, mean values show that volleyball players performed better in the high jump test, while handball players performed better in the standing long jump, sit and reach test, and trunk lift test. However, these differences are statistically insignificant with $p > 0.05$.

Tabela 6. Differences in Motor Skills between Handball and Volleyball Female Players

Variables	Mean Handball Females	Mean Volleyball Females	t - value	Mean Difference	p
MT2	3.65	3.80	-2.09	-0.14	0.262
MSV	29.20	32.04	-1.08	-2.84	0.297
MSD	178.60	174.72	0.72	3.88	0.349
MSN	1.28	1.28	0.00	0.00	1.000
MTP	6.72	15.00	-5.94	-8.28	0.511
MPT	16.96	15.20	2.76	1.76	0.958
MTS	15.84	6.40	4.17	9.44	0.001

Analyzing Tables 5 and 6, representing the t-test results of morphological characteristics and motor skills, respectively, we see statistically significant differences between the groups in the following variables: body weight (ATT), waist circumference (AOS), hip circumference (AOK), BMI, and push-ups (MTS).

Based on the mean values, handball players performed better in the standing long jump (MSD), trunk lift test (MPT), and push-ups (MTS). Additionally, handball players had lower mean values in the 20m run test compared to volleyball players, indicating that they were faster. Regarding morphological characteristics, handball players had higher waist circumference values, while volleyball players had higher values in other variables such as body height (ATV), body weight (ATT), hand length (ADS), hip circumference (AOK), arm span (ARR), and BMI. Based on the mean BMI values, both groups had optimal body weight within the range of 18.5 to 24.9 kg/m2.

Discussion

The main findings of this study indicate that there are statistically significant differences between the motor skills and morphological characteristics of young female handball and volleyball players. More precisely, handball players dominate in the standing long jump, indicating stronger leg muscles and better explosive power, which is expected given the frequent explosive changes in direction, jumping into space during goal fights and strong defensive play primarily using the legs. Volleyball players perform better in the high jump test, a movement often present in volleyball during blocking or spiking. They have learned and improved this movement well, while handball players rarely jump with both legs except occasionally when blocking a shot on goal.

Considering the findings drawn from the research and data analysis, we can observe that differences in game rules between handball and volleyball lead to differences in player performance. The young athletes in this study are still in their growth phase, and their motor skills and morphological characteristics will change over time due to training plans, programs, and other factors such as genetics, society, and lifestyle habits. These young athletes are already showing performance trends aligned with the demands of their sports. This is evident from the mean values of variables shown in Table 6, highlighting the differences in motor skills between handball and volleyball players. In this line, previous studies have also shown that handball players showed better values than volleyball players in agility tests, volleyball players showed better performances in the CMJ (counter movement jump) and CMJas (counter movement jump with arm swing) jump than handball players (Pena et al., 2016). Also, studies of Simonek et al. (2016) have shown that handball players were more successful than volleyball player in the test of maximum running speed Flying 30m sprint. In the test assessing jumping explosiveness (triple jump) the highest level of explosiveness was recorded in volleyball players.

Analyzing balance as a motor skill, tested through the standing on one leg test, both handball and volleyball players performed well, showing good balance. Regarding upper body strength, handball players demonstrated stronger arms and shoulder muscles compared to volleyball players. Conversely, volleyball players showed better flexibility in the lumbar and pelvic regions. Previous studies have shown that in the test for flexibility there was no significant difference between volleyball and handball players (Kumar, 2019). And in the test for arm strength (pull ups) there was no significant difference among the players (Dar, 2017) which is different compared to the results we obtained with this research.

In terms of morphological characteristics, differences from previous studies of older age categories are noted, which is expected since girls achieve their maximum growth rate annually between 11 and 14 years, after which growth slows down to an average of 8 cm per year. This period involves accelerated growth of limbs and hand length. Previous research (Musaiger, Ragheb, & Al-Marzooq, 1994; Bayios et al., 2006; Pena et al., 2016; Masanovic et al., 2018; Masanovic et al., 2021) showed that handball players have higher body weight while volleyball players have higher body height. In this study, the respondents had similar body height, while volleyball players had higher body weight compared to handball players.

Conclusion

This research shows that girls, even at this age, are guided by training plans and programs to develop motor skills required by their sport. Proper training helps them to progress towards the ideal model of a successful athlete. It is crucial for coaches and

sports professionals working with younger categories to prioritize the proper psychophysical development of athletes over competitive results, which will naturally follow with proper and disciplined work.

Received: 22 July 2024 | **Accepted:** 19 September 2024 | **Published:** 15 October 2024

References

Bjelica, D. (2005). *Sistematizacija sportskih disciplina i sportski trening*. Podgorica: Crnogorska sportska akademija.

Bala, G., Stojanović, V. M., i Stojanović, M. (2007). *Mjerenje i definisanje motoričkih sposobnosti dece*. Novi Sad: Fakultet sporta i fizičkog vaspitanja.

Bayios, A., I., Bergeles, K., N., Apostolidis, G., N., Noutsos, S., K., & Koskolou D., M. (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), 271-80.

Dar, S., A. (2017). A comparative study of arm strength, leg strength and cardio respiratory endurance of volleyball and handball players. *International Journal of Physical Education, Sports and Health, 4*(3), 11-14

Foretić, N., i Rogulj, N. (2007). Škola rukometa. *Znanstveno-sportsko društvo Grifon*. Split.

Gabbett, T., Georgieff, B., & Domrow, N. (2007). The use of physiological, anthropometric, and skill data to predict selection in a talent-identified junior volleyball squad. *The Jurnal of Sports Medicine and Physical Fitness,25*(12), 1337-1344.

Kumar, S. (2019). Comparison of physical fitness between handball and volleyball players of Jammu and Kashmir. *International Journal of Physiology, Nutrition and Physical Education, 4*(1), 624-625.

Majstorović, N., Nešić, G., Grbić, V., Savić, Z., & Dopsaj, M. (2019). Proceedings of the 4th International Conference on Innovations in Sports, Tourism and Instructional Science. *Atlantis Press*, 143-146.

Marvić, F. (2006). Uticaj antropometrijskih karakteristika i funkcionalnih sposobnosti na bočnu i dubinsku pokretljivost rukometaša. *Sport Mont, IV*(10-11), 256-260.

Marfell-Jones, M., Olds, T., Stew, A. D., & Carter, J. E. L. (2006). *International standards for anthropometric assessment.* Potchefstroom: International Society for the Advancement of Kinanthropometry**.**

Mašanović, B., Gardašević, J., & Bjelica, D. (2021). Comparative Study of Anthropometric Measurement and Body Composition Between Elite Handball and Volleyball Players from the Serbian National League. *International Journal Morphology*, *39*(1), 287-293.

Mašanović, B., Milošević, Z., & Ćorluka, M. (2018). Comparative Study of Anthropometric Measurement and Body Composition between Junior Handbal and Volleyball Players from Serbian National League. *International Journal of Applied Excercise Physiology, 7*(4), 2322-3537.

Musaiger, A.O., Ragheb, M.A., & Al-Marzooq, G. (1994). Body composition of athletes in Bahrain. *British Journal of Sports Medicine, 28*(3), 157–159.

Pena, J., Moreno-Doutres, D., Coma, J., Cook, M., & Busca, B. (2016). Anthropometric and fitness profile of high-level basketball, handball and volleyball players. *Revista Andaluza de Medicina del Deporte,* 30-35.

Selinger, A. (1987). *Arie Selinger's power volleyball*. New York, St. Martin's Griffin.

Šibila, M., & Pori, P. (2009). Morphological characteristic of handball players. *Collegium Antropologicum, 33*(4), 1079-86.

Šimonek, J., Horička, P., & Hianik, J. (2017). The differences in acceleration, maximal speed and agility between soccer, basketball, volleyball and handball players. *Journal of Human Sport and Exercise 12*(1), 73-82.

Zekic, R., Vucetic, V., & Pejcic, T. (2017). Differences in testing the assessment of maximum oxygen of young volleyball and handball players: *Proceedings of the 11th InternationalConference on Kinanthropology, 984-993.*