

INFLUENCE OF BASIC ANTHROPOMETRIC INDICATORS ON HAND GRIP STRENGTH IN STUDENTS FROM BASKETBALL TRAINING GROUPS

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Abstract: The study aimed to determine the relationships between handgrip strength values and basic anthropometric indicators - height, body mass, and BMI in male and female university students. The research contingent is 52 students from the basketball study groups of the Technical University (Sofia) and 21 students from the basketball groups of the Sofia University "St. Kliment Ohridski". Height, body mass, and right- and left-hand grip strength were measured in 38 male students and 35 female students. BMI was additionally calculated with the formula kg/m^2 . The maximum grip strength of the right and left hands was measured with a hand dynamometer. The reliability of the test is ensured by the use of a repeated test (Test-retest), using the average value of two attempts. Results: The analysis of variance showed that the average grip strength of the right hand in men was 45.74 ± 7.86 kg, and that of the left hand was 43.05 ± 7.32 kg. In women, the average grip strength of the right hand is 25.89 ± 4.36 kg, and of the left hand is 23.40 ± 4.09 kg. Of the persons examined by us, it was found that 97.81% of them are right-handed dominant. The results of this study revealed that in terms of baseline anthropometric indicators (height, body mass, and BMI) and handgrip strength, there was a weak correlation. Conclusion: The study of grip strength can be useful in two directions, namely: in sports training - to establish the muscle strength of the hands, as a basis for improving the technical elements of the basketball game, as a predictive indicator for the selection of young basketball players and to prevent serious injuries in the practice of basketball; in medicine - to establish a person's general state of health.

Keywords: sport, muscle strength, dominant and non-dominant hand

1. INTRODUCTION

Hand grip strength is an often overlooked quality in the physical training of basketball players. There are no specialized training programs for its development, but good grip strength is a key factor in the successful execution of many basketball technical skills such as catching and passing the ball, dribbling, and shooting at the basket. By improving grip strength, basketball players can better control the ball while dribbling and improve the accuracy of long-range and bounce passes.

Apart from the purely sporting aspect, developing grip strength can also be used for injury prevention during training and competition.

Several authors often use grip strength as an additional indicator that can serve to determine overall muscle strength (Leong, DP, Teo KK, Rangarajan S., et al., 2016).

Most often, a dynamometer is used to determine grip strength. The use of a dynamometer to determine grip strength is applied both in sports and medicine. With its help, both pupils and students who play sports and those who do not play sports can be measured. These facts are confirmed in a study by Gąsior, Jakub S., Mariusz Pawłowski, Piotr J. (2020), which proves that the use of a dynamometer is a reliable tool for assessing grip in children between 7-13 years of age who are not athletes. Other studies in medicine have identified the level of grip strength as a very useful indicator of a person's overall health and the presence of cardiovascular disease at very low grip strength. (Soysal P, Hurst C, Demurtas J, et al, 2021).

For some researchers, it is important to determine what factors influence the development of grip strength. According to Alahmari, K. A., Silvian, S. P., Reddy, R. et al, S., (2017), these factors in men are arm's length, age, and forearm circumference. In a study of women, it was found that the main factor influencing the development of grip strength was the size of the forearm muscle (Abe, T., & Loenneke, J.P., 2015).

It is a well-known fact that there is a difference in grip strength between right and left hands. Therefore, it is recommended that when measuring, they determine which hand is dominant and which is non-dominant. According to research by Abe, T., & Loenneke, J.P. (2015) used the values achieved with the dominant hand when determining grip strength values. The same authors found that the measured grip strength with the dominant hand was 10% higher than that of the non-dominant hand. However, this trend has been refuted by other researchers, who report that in their study, 20% of participants in the measurement achieved results with the non-dominant hand equal to or greater than the dominant hand. Cornwell A, Khodiguan N, Yoo EJ., (2012) & Bechtol Co (1954), Petersen et al.,

(1989). The reason for the results obtained is not established and can be interpreted more broadly in search of assumptions rather than based on facts.

Evaluation and scientific research are essential components of the development of physical education and sports, contributing to all forms of sports, improving the health and safety of participants, training methods and organization of the learning process (Tsvetkova, 2021:138).

2. MATERIALS AND METHODS

The study aimed to establish the relationships between hand grip strength values and basic anthropometric indicators – height, body mass, and BMI in male and female students.

The present study was conducted during the academic year 2023/2023 in two Bulgarian universities: Sofia University "St. Kliment Ohridski" and Technical University, Sofia. Students participate in basketball study groups and attend classes once a week. The grip strength indicator was taken at the end of the summer semester in May. The two universities were chosen because of the similarity in the curricula of the universities and the status of the sport in them, as well as the presence of basketball specialists who are trained to take the indicators correctly and identically. Students are invited to participate in the study voluntarily and the results obtained are not taken into account for obtaining the annual sports grades.

The researchers took the anthropometric indicators of height and weight, after which the body mass index (BMI) was calculated using the formula: kg/m^2 . The maximum grip strength of the right and left hands was measured with a hand dynamometer. A standard protocol was used to record the results. Each participant was asked to squeeze the device with maximum force by bending the arm at the elbow joint without touching the body. Two measurements were taken on both hands, the first measurement being on the right hand, followed by the left, and again right and left. The reliability of the test is guaranteed by the use of repeated Test-retest. The average value obtained from the two trials is used in the calculation of the results.

3. RESULTS AND DISCUSSIONS

Participant Characteristics

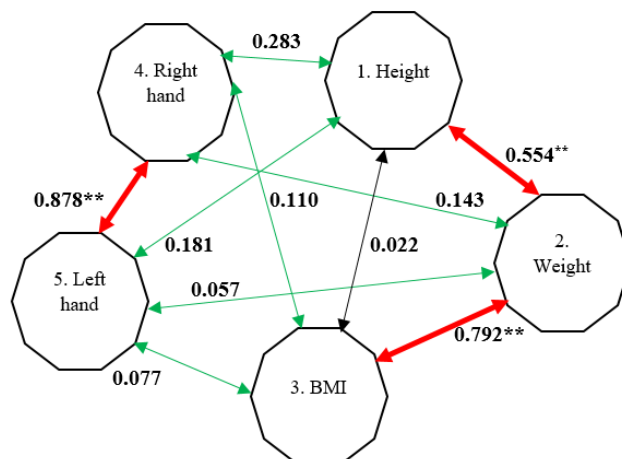
A total of 73 participants (38 men and 35 women) were students from two Bulgarian universities in the city of Sofia. None of the participants experienced injury, pain, or discomfort during the measurement. A total of 97.81% of the subjects were right-handed and 2.19% were left-handed. The average age of the students is 20.82 ± 3.44 years with an average height of 183.34 ± 8.15 cm for men and 167.09 ± 6.71 cm for women. Body weight in men is 81.61 ± 18.36 kg and in women 57.77 ± 7.75 kg. The body mass index in men showed average values of 23.93 ± 4.84 and in women 20.64 ± 2.17 . In the group of men, the grip strength of the right dominant hand was 45.74 ± 7.86 kg, and the left non-dominant hand was 43.05 ± 7.32 kg. In the female group, the grip strength of the right dominant hand was 25.89 ± 4.36 kg, and the left non-dominant hand was 23.40 ± 4.09 kg. The obtained values for the coefficient of variation (V) for the grip strength indicator define the male sample as *highly heterogeneous* - $V=61.77\%$ for the right hand and $V=53.57\%$ for the left hand. For women, the values obtained for this indicator define the sample as *approximately uniform* - $V=18.99\%$ for the right hand and $V=16.72\%$ for the left hand. The detailed characteristics of the two groups of men and women are presented in Table 1.

Table 1. Participant characteristics for height, weight, BMI, right and left-hand strength

		Descriptive Statistics										
Gender		N	Range	Min	Max	Mean	SD	Variance	Skewness		Kurtosis	
		Statistic	Statistic	Statistic	Statistic	Statistic	Statistic	Statistic	Statistic	Std. Error	Statistic	Std. Error
Men	Height (cm)	38	41	165	206	183.34	8.148	66.393	.455	.383	.962	.750
	Weight (kg)	38	85	55	140	81.61	18.362	337.162	.877	.383	1.359	.750
	BMI (index)	38	25.5	17.7	43.2	23.929	4.8420	23.445	1.748	.383	5.582	.750
	Right hand grip strength (kg)	38	41	30	71	45.74	7.859	61.767	.977	.383	2.318	.750
	Left hand grip strength (kg)	38	44	26	70	43.05	7.319	53.565	.969	.383	4.472	.750
	Valid N (listwise)	38										
Women	Height (cm)	35	31	150	181	167.09	6.714	45.081	-.017	.398	.140	.778
	Weight (kg)	35	34	46	80	57.77	7.746	60.005	1.046	.398	.982	.778
	BMI (index)	35	9.8	16.3	26.1	20.640	2.1739	4.726	.121	.398	-.054	.778
	Right hand grip strength (kg)	35	22	16	38	25.89	4.357	18.987	.442	.398	.855	.778
	Left hand grip strength (kg)	35	20	16	36	23.40	4.089	16.718	.535	.398	1.214	.778
	Valid N (listwise)	35										

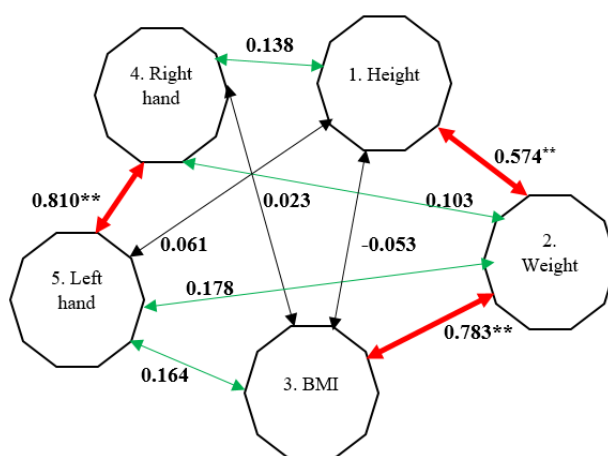
Through Pearson's correlation analysis (r), the strength of the relationship between anthropometric indicators - height, body mass, and BMI and the strength of the right and left-hand grip was determined. The results for men shown in Fig. 1 found a weak relationship between height and grip strength in the right hand ($r=0.283$) and in the left hand ($r=0.181$). The relationship between body mass and strength is right-handed ($r=0.143$) and left-handed ($r=0.057$), which is also in the category of weak correlation. The BMI indicator and the strength of the right and left hand are in a weak correlation relationship, respectively for the right ($r=0.110$) and for the left ($r=0.077$).

Figure 1. A structural model of established relationships between baseline anthropometric data and handgrip strength measured in male college students



The results for women shown in Fig. 2 found a weak relationship between height and grip strength in right-handed ($r=0.183$) and left-handed ($r=0.061$). The relationship between body mass and strength is right-handed ($r=0.103$) and left-handed ($r=0.178$), which is also in the category of weak correlation. The BMI indicator and the strength of the right and left hand are in a weak correlation relationship, respectively for the right ($r=0.023$) and for the left ($r=0.164$).

Figure 2. A structural model of established relationships between baseline anthropometric data and handgrip strength measured in female college students



Both in men and in women with a strong relationship, the indicators between the grip strength for the right and left hand stand out: for men ($r=0.878$) and women ($r=0.810$). Body mass and BMI also have a strong relationship, respectively for men it is ($r=0.792$) and for women ($r=0.783$). A significant correlation was found between height and body mass, respectively, in men ($r=0.554$) and women ($r=0.574$).

The results of this study revealed that there was a weak correlation between baseline anthropometric measures (height, body mass, and BMI) and handgrip strength. For example, height and weight have the highest correlations with grip strength in men, while in women the highest correlations are body mass and grip strength combined with BMI and the third strongest association with height.

The results obtained in our study are not consistent with the statement that body height, as a rule, in combination with BMI, is the strongest indicator of handgrip strength. But our results are in full accordance with the established results of a study of teenage basketball players (U14, U15, U19, U20) from the Italian national team. These results show low correlations between grip strength, height, and BMI, but positive associations with arm length. Researchers suggest that years of basketball practice may be a prerequisite for increased grip strength. These facts show that selecting female basketball players by arm length means selecting by grip strength. Thus, it is possible to suggest that, in addition to height, arm length can also be considered a useful parameter in the identification of talented female basketball players" (Pizzigalli, L., Micheletti Cremasco, M., LA Torre, A., et al., 2017)

As an opportunity to further investigate the arm strength of college basketball students, our research team will also measure arm length to determine the relationship. Also, it may be recommended that grip strength be measured as total hand strength when compared with other indicators to have clearer and more convincing statistical results.

4. CONCLUSIONS

The results of this study revealed that in terms of basic anthropometric indicators (height, body mass, and BMI) and hand grip strength, there is a weak correlation, which suggests working purposefully to develop grip strength, with all basketball players, regardless of the game post.

There is a lack of data on the grip strength of the population in the Republic of Bulgaria by age, which is an obstacle to making comparison tables both by age and gender and between sports and non-sporting students and students.

The grip strength of the dominant hand in male students was twice that of female students (45.74 kg vs. 25.89 kg). The non-dominant hand also preserves this tendency (43.05 kg vs. 23.40 kg). This unequivocally shows that when forming basketball study groups, it is wise to divide students by gender to avoid unnecessary injuries.

The methodology used to measure muscle grip strength by hand dynamometer is a simple, cheap, and at the same time reliable test. The test is convenient for practical field application that does not require laboratory conditions. Any physical education and sports teacher and coach can take the necessary indicators. Regarding the reliability of any study, it should always be taken into account that the obtained results for grip strength may vary depending on the choice of dynamometer or the methodology of taking the indicator.

Finding poor handgrip muscle strength in college students is an alarming indicator of frailty and suspected illness. It is recommended that the student be referred for consultation with a medical professional.

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