doi: 10.30934/kusbed. 1375005 **e-ISSN:** 2149-8571

Kocaeli Üniversitesi Sağlık Bilimleri Dergisi

Özgün Araştırma / Original Article

http://dergipark.org.tr/kusbed

THE EFFECT OF WUSHU ON BALANCE, ANTHROPOMETRIC PROPERTIES AND SOME PERFORMANCE PARAMETERS

Furkan Bilgili[1], Serap Çolak[1*]

[1]Kocaeli University, Faculty of Sports Sciences, Kocaeli, Türkiye

ORCID iD: Furkan Bilgili: 0000-0002-7098-1604; Serap Çolak: 0000-0003-3093-0607

***Sorumlu Yazar / Corresponding Author:** Serap Çolak, **e-posta / e-mail:** srpclk@gmail.com

Geliş Tarihi / Received: 31.10.2023 **Kabul Tarihi / Accepted:** 29.11.2023 **Yayım Tarihi / Published:** 15.03.2024

Abstract

Objective: In this study, it was aimed to determine the effects of Wushu on balance, anthropometric characteristics and some performance parameters.

Methods: An experimental model, which is one of the quantitative research types, was chosen for the research model. The study group of the research consisted of 20 athletes between the ages of 14-17 who practice Wushu in the Bidam Fight Club Sports Club in Düzce. Before starting the 8-week training program and at the end of the 8-week training, balance measurements, anthropometric measurements and performance measurements were taken from the athletes. In this context, bipedal, left foot and right foot balance, shoulder anterior-posterior distance, thigh circumference, calf circumference, biceps circumference, hip diameter, intermalleolar distance, interstiloidal distance, interpicondylar distance and intercondylar distance, right paw strength, left paw strength, push-ups, sit-ups and long jump measurements were made. The analysis of the data was done by applying quantitative analysis methods using SPSS 25.0 package program. All analyzes were evaluated at 95% confidence interval and $p<0.05$ significance level.

Results: Bilateral balance, left foot balance and right foot balance averages of the athletes participating in the research increased significantly ($p<0.05$). All the results of shoulder anteroposterior distance, thigh circumference, calf circumference, biceps circumference, hip diameter, intermalleolar distance, interstiloidal distance, interpicondylar distance and intercondylar distance measurements significantly increased after 8 weeks of Wushu training program ($p<0.05$). After the 8-week Wushu training program, all of the right paw strength, left paw strength, push-up, sit-up and long jump scores increased significantly ($p<0.05$).

Conclusion: It has been determined that Wushu sport affects the balance positively in athletes, improves anthropometric measurements, that is, body composition, and increases performance.

Keywords*: Anthropometric features, balance, performance, wushu.*

Introduction

Irrespective of their chosen sport, athletes undergo training with the overarching goal of enhancing their health-related parameters, fostering physical and mental development, enriching their social environment, achieving personal goals, and delivering peak performances in competitions. These objectives resonate with individuals participating in Wushu training.[1]

Wushu, recognized as Chinese Martial Arts by the International Olympic Committee, is overseen in our country by the Turkish Wushu Federation, boasting 114,000 athletes, 560 clubs, 6,461 coaches, 2,828 referees, and 76 provincial representatives.[2]

The term "Wushu," pronounced as "Vuşu" in Turkish, represents a comprehensive category of Chinese defense and martial arts, born from the fusion of the Chinese words "wu" (warfare, physical activity, authority) and "shu" (technique, tactics, skill, ability). Wushu encompasses a wide range of sports beyond China, often known as Kung-Fu (gongfu), with "Kung-Fu" signifying skill that transcends martial arts and extends to various domains, including music. This diverse sport amalgamates martial styles, combat and defense techniques, and acrobatic choreography, aligned with Far Eastern philosophy that seeks to cultivate respect, love, tolerance, and personal development for both the body and soul.[3]

Today, Wushu has evolved into numerous sub-branches, each showcasing unique styles and goals. While some branches prioritize well-being and mental health, others emphasize traditional combat styles and techniques. Wushu has burgeoned into a competitive sport, cherished by thousands for its captivating styles, evolving systems, and the excitement it offers.[2]

Wushu sports have been active in our country since the 1960s, establishing itself as an independent federation, the Turkish Wushu Federation, in 2006. The mission of the Turkish Wushu Federation is to promote this sport as one of the most enjoyable and beneficial activities today, with the aim of enhancing human health, maximizing physical, mental, and spiritual development, and nurturing active athletes who contribute to our country and nation.

Training serves as the overarching term encompassing all systematic activities geared toward the psychological, physiological, and spiritual development of athletes. Athletes engage in training with a primary focus on elevating their health-related parameters, fostering their physical and mental development, enriching their social environment, accomplishing personal goals, and delivering outstanding performances in competitions.[4]

The concept of balance in sports is a product of the interplay between internal and external factors, influenced by the duration of athletes' engagement in their respective sports, the time invested in training, and their performance, as well as their day-to-day activities.[5]

This study aims to examine the impact of Wushu sport on the balance, anthropometric characteristics, and select performance parameters of individuals who are new to this discipline.

Methods

Research Type

An experimental model, one of the quantitative research types, was chosen as the research model.

Study Group

The research study group comprised 20 athletes (14 males and 6 females) aged 14-17, who were engaged in Wushu sports at the Bidam Fight Club Sports Club in Düzce.

Data Collection

Athlete measurements were conducted at the gym of the Bidam Fight Club Sports Club in Düzce. These measurements were taken both before commencing the 8-week training program and at its conclusion. Measurement forms were prepared to document all measurements and tests, and the values for each measurement were recorded on the respective forms.

Measurement Methods

Participants in the study were assessed for age, gender, weight, height, right and left arm strength, right and left leg strength, both-leg balance, ankle circumference, knee circumference, wrist circumference, elbow circumference, shoulder circumference, hip circumference, thigh girth, calf girth, biceps girth, long jump, push-ups, and sit-up measurements before and after the High-Intensity Athletic Program (HAP).

Prior to taking circumference measurements, meticulous attention was given to selecting the appropriate measurement locations. A non-flexible, 7 mm thick tape measure from the Aptamil brand was used for these measurements. Participants assumed the anatomical position during circumference measurements, and measurements were taken perpendicular to the body's long axis. To minimize potential errors, no pressure was applied to the skin-contacted area during measurements.[6]

For circumference measurements, width measurements were typically used in modern studies to determine specific body areas. Suitable body areas were identified using fingers before taking measurements, and calipers were used for measurements. The caliper's ends were applied with as much pressure as possible while ensuring contact with the underlying bones. Measurements were recorded with a precision level of 0.1 cm.[6]

Biceps Circumference Measurement

The athlete stood still with arms in the anatomical position, and the biceps muscle was measured by fully rotating from the maximal point.[7]

Thigh Circumference Measurement

For this measurement, the individual wore short tights with their feet positioned hip-width apart, and body weight evenly distributed on both feet. The measurement was taken from the point where the patella was most swollen, approximately 15 cm above the patella.[8]

Leg Circumference Measurement

With the individual standing barefoot and their feet shoulder-width apart, the measurement was taken from the most swollen part of the gastrocnemius, approximately 15-20 cm above the medial malleolus.[8]

Intermalleolar Distance Measurement

While seated on a chair with the knees at a 90-degree angle in the horizontal plane, the horizontal distance between the most protruding points of the medial and lateral malleoli was measured using a sliding caliper.[9]

Intercondylar Distance Measurement
The intercondylar measurement was taken as the distance between the condyles.[10] The distance between the medial femoral intercondyles was measured in millimeters (mm) using a caliper with a precision of 0.01 mm when the athlete was seated with the knees at a 90-degree angle, and the medial tibial malleoli bones touched each other.[9]

Interstyloid Distance Measurement
This measurement represents the distance between the ulnar styloid (medial) and radial styloid (lateral). The athlete stood upright with the elbow flexed at a 45-degree abduction, and a pair of calipers with both ends touching the styloid processes were used to measure the distance between these two points, with an accuracy of 0.1 cm.[9]

Interepicondylar Distance Measurement
With the hand in pronation and the elbow flexed, the arms of the caliper were brought into contact with the condyles to measure the distance between the humeral condyles.[9]

Shoulder Anterior-Posterior Distance Measurement
The athlete stood upright with shoulders in a normal position, and the researcher, positioned behind the athlete, measured the distance by placing the ends of the calipers on the outermost acromial protrusions.[9]

Hip Circumference Measurement
This measurement represents the greatest distance between the points where the trochanters protrude. The measurement was taken with the athlete standing with heels together, and the longest distance between the trochanters was recorded. The measurement was recorded to the nearest 0.1 cm.[9]

Height Measurement
Individual height measurements were conducted using a meter. Participants stood barefoot against the wall, and their height was measured with a meter, ensuring that their heads remained parallel to the ground. The values were recorded in centimeters.

Body Weight Measurement
Participants' body weight was measured while standing barefoot and shirtless on a Fakir brand scale, and the measurements were recorded in kilograms.

Measurement of Right-Left Hand Grip Strength Test
The "Grip Strength Dynamometer T.K.K. 5101 Grip-D" dynamometer was used for this measurement. It was conducted with participants in a standing position. The dynamometer was adjusted according to each athlete's hand size. The measurement was performed without bending the arm at the elbow, and the dynamometer did not touch the body. Two repetitions were taken for each hand, and the best result was recorded.[11]

30-Second Push-up Test
A chronometer with a precision of 1/1000 was used for this test. Athletes were instructed to perform push-ups for 30 seconds upon the "start" command. Push-ups were executed with athletes lying on the ground, facing downward, knees extended, bodies lifted and lowered with weight supported on toes and hands. The number of push-ups completed within 30 seconds was recorded.[12]

30-Second Sit-up Test
For this test, a chronometer with a precision of 1/1000 was employed. Athletes lay on their backs with bent knees, initially with their hands on the ground, and then with their hands behind their necks, and the soles of their feet in contact with the ground. They were instructed to perform as many sit-ups as possible within 30 seconds, ensuring that their feet remained in contact with the ground at all times.[12]

Balance Measurement
The EasyTech Libra Balance Measurement Device was used to assess the dynamic balance performance of the Wushu athletes. The device included a balance board (43 cm in length, 42 cm in width, and a height of 65 cm) and a USB interface connected to the EasyTech 2, 2001-2.0 computer software to complete the system. Measurements were conducted with bare feet, and each participant's balance was evaluated three times for the right foot, three times for the left foot, and three times for both feet, with a 30-second rest period between repetitions.[13]

Standing Long Jump Test
Participants were instructed to stand with their toes just behind a designated line, feet shoulder-width apart, and not touching the line. They were then asked to jump forward as far as possible with a parallel body position, arms forward, knees bent, and both feet landing simultaneously. The test was repeated twice, and the best distance achieved by each participant was recorded in meters.[14]

Statistical Analysis
Data analysis was carried out using quantitative analysis methods through the utilization of the SPSS v25.0 software package. Descriptive statistical methods such as frequency and percentage distribution, arithmetic mean, and standard deviation were employed to evaluate athletes' characteristics, including gender, age, height, and weight.
The findings related to balance measurements, anthropometric measurements, and performance parameters were analyzed using related samples (dependent groups) t-test and Wilcoxon signed-rank test, and comparisons were made between pre-test and post-test measurements. The reason for using two different tests was that data for some variables exhibited a normal distribution and parametric characteristics, while data for other variables did not meet the assumptions of normal distribution and showed non-parametric characteristics.
The decision regarding whether the data exhibited normal distribution was made by examining the skewness and kurtosis values. It is crucial to determine whether these values fall within the ±1.50 range to decide if the data follows a normal distribution.[15] Findings related to skewness and kurtosis values are presented in Table 1.
All analyses were conducted with a 95% confidence interval and a significance level of $p<0.05$.

Results

Athletes' Gender, Age, Height, and Weight Characteristics
A total of 20 athletes comprising from 14 male (70%) and 6 female (30%) between the ages of 14 and 17 were included in this research conducted to determine the impact of Wushu

on balance, anthropometric characteristics, and certain performance parameters.

According to this information, 14 (70%) of the participants are male, and 6 (30%) are female. Descriptive statistics for the athletes' age, height, weight, and shoe size are provided in Table 1.

Findings on Balance Measurements

Table 2 presents the results of the related samples (dependent groups) t-test for comparing the pre-test and post-test values of balance measurements. The dual-leg balance value was measured as 7.06 and 8.94, respectively, indicating a 1.87-point increase in performance from the pre-test to the post-test, which was statistically significant ($t(19)=3.199$; $p<0.05$). Similarly, the left-leg balance value increased from 4.91 in the pre-test to 6.20 in the post-test, a 1.29-point increase, which was also found to be statistically significant ($t(19)=3.890$; $p<0.05$). Likewise, the right-leg balance value increased from 4.50 in the pre-test to 6.46 in the post-test, showing a 1.96-point increase, and this change was statistically significant ($t(19)=3.872$; $p<0.05$) (Table 2).

When considering the results related to balance measurements collectively, it is evident that Wushu has a positive and statistically significant effect on balance.

Findings on Anthropometric Measurements

To compare anthropometric measurements, related samples (dependent groups) t-tests were performed on variables meeting the assumption of a normal distribution, and the results are presented in Table 3.

The shoulder front-back distance was measured as 37.50 and 38.75 cm, respectively. There was an increase of 1.25 cm in the transition from the pre-test to the post-test, and this increase was found to be statistically significant ($t(19)=6.140$; $p<0.05$).

Thigh circumference was measured as 46.45 and 48.25 cm, respectively. There was an increase of 1.80 cm in the transition from the pre-test to the post-test, and this increase was found to be statistically significant ($t(19)=4.346$; $p<0.05$).

Calf circumference was measured as 33.65 and 34.25 cm, respectively. There was an increase of 0.60 cm in the transition from the pre-test to the post-test, and this increase was found to be statistically significant ($t(19)=3.943$; $p<0.05$).

Biceps circumference was measured as 25.10 and 26.20 cm, respectively. There was an increase of 1.10 cm in the transition from the pre-test to the post-test, and this increase was found to be statistically significant ($t(19)=5.395$; $p<0.05$) (Table 3).

As seen in Table 3 once again; the intermalleolar distance was measured as 6.70 and 7.25 cm, respectively. There was an increase of 0.55 cm in the transition from the pre-test to the post-test, and this increase was found to be statistically significant ($t(19)=4.819$; $p<0.05$). The interstyloid distance was measured as 5.08 and 5.40 cm, respectively. There was an increase of 0.33 cm in the transition from the pre-test to the post-test, and this increase was found to be statistically significant ($t(19)=3.901$; $p<0.05$). The intercondylar distance was measured as 6.30 and 6.85 cm, respectively. There was an increase of 0.55 cm in the transition from the pre-test to the post-test, and this increase was found to be statistically significant ($t(19)=4.222$; $p<0.05$).

Additionally, for variables that did not meet the assumption of a normal distribution in the comparison of anthropometric measurements, the Wilcoxon signed-rank test was conducted, and the results are presented in Table 4.

a. Post-Test Hip Circumference<Pre-Test Hip Circumference
b. Post-Test Hip Circumference>Pre-Test Hip Circumference
c. Post-Test Hip Circumference=Pre-Test Hip Circumference
d. Post-Test Intercondylar Distance <Pre-Test Intercondylar Distance
e. Post-Test Intercondylar Distance>Pre-Test Intercondylar Distance
f. Post-Test Intercondylar Distance=Pre-Test Intercondylar Distance

According to this, there were no athletes whose hip circumference decreased from the pre-test to the post-test (negative sequence n=0). However, hip circumference increased in 18 athletes (positive sequence n=18), and it remained the same in 2 athletes (equality n=2) during the transition from the pre-test to the post-test. As a result, it was found that hip circumference values showed a significant increase ($z=-3.746$; $p<0.05$).

Furthermore, during the transition from the pre-test to the post-test, the intercondylar distance value decreased in 1 athlete (negative sequence n=1), increased in 9 athletes (positive sequence n=9), and remained the same in 10 athletes (equality n=10). Consequently, it was determined that intercondylar distance values showed a significant increase ($z=-2.530$; $p<0.05$).

When considering the findings of anthropometric measurements as a whole, it can be said that Wushu significantly increased the anthropometric measurement results.

Findings on Performance Parameters

For the comparison of findings related to performance parameters, related samples (dependent groups) t-tests were conducted on variables that met the assumption of normal distribution, and the results are presented in Table 5.

According to the data, the right hand grip strength was measured as 33.57 and 34.87, respectively, indicating a significant increase of 1.30 ($t(19)2.256$; $p<0.05$) in the transition from the pre-test to the post-test. Similarly, the left hand grip strength showed a significant increase from 33.94 in the pre-test to 35.68 in the post-test, with a difference of 1.75 ($t(19)=5.116$; $p<0.05$). In the push-up test, participants achieved scores of 12.70 in the pre-test and 18.40 in the post-test, resulting in a notable increase of 5.70 ($t(19)=5.921$; $p<0.05$).

Furthermore, the sit-up test values demonstrated a significant rise, measuring 19.30 in the pre-test and 24.60 in the post-test, indicating an increase of 5.30 ($t(19)=8.320$; $p<0.05$).

Additionally, the variable "long jump" which did not meet the assumption of normal distribution, was analyzed using the Wilcoxon signed-rank test, the results of which are displayed in Table 6. According to this, the long jump value decreased in 2 athletes (negative sequence n=2), increased in 17 athletes (positive sequence n=17), and remained the same in one athlete (equality n=1) during the transition from the pre-test to the post-test. As a result, it was determined that long jump values showed a significant increase ($z=-2.578$; $p<0.05$) (Table 6).

a. Pre-test Long Jump>Post-test Long Jump
b. Pre-test Long Jump<Post-test Long Jump
c. Pre-test Long Jump=Post-test Long Jump

In summary, the comprehensive evaluation of performance parameters suggests that Wushu sports significantly enhanced athletes' performance levels.

Table 1. The descriptive statistics for athletes' age, height, weight, and shoe sizes.

	Variable	N	Min.	Max.	$\bar{x}$	s
Male	Age	14	14	17	15.14	1.03
	Height	14	1.49	1.80	1.64	0.09
	Weight (1. Measurement)	14	40.20	86.00	55.72	13.39
	Weight (2. Measurement)	14	37.90	83.00	55.56	12.84
	Shoe Size	14	37	45	40.25	2.72
Female	Age	6	14	17	15.83	1.17
	Height	6	1.43	1.82	1.69	0.14
	Weight (1. Measurement)	6	38.00	76.75	59.04	14.70
	Weight (2. Measurement)	6	39.50	78.90	59.57	14.74
	Shoe Size	6	38	44	41.17	2.14
Total	Age	20	14	17	15.35	1.09
	Height	20	1.43	1.82	1.66	0.11
	Weight (1. Measurement)	20	38.00	86.00	56.71	13.49
	Weight (2. Measurement)	20	37.90	83.00	56.77	13.17
	Shoe Size	20	37	45	40.53	2.54

Table 2. Comparison of pre-test and post-test values for balance measurements

	n	$\bar{x}$	s	Post-Test and Pre-Test Difference	t	df	*p*
Post-Test Dual-Leg Balance	20	8.94	3.96	1.87	3.199	19	0.005
Pre-Test Dual-Leg Balance	20	7.06	3.73				
Post-Test Left-Leg Balance	20	6.20	2.53	1.29	3.890	19	0.001
Pre-Test Left-Leg Balance	20	4.91	2.17				
Post-Test Right-Leg Balance	20	6.46	2.64	1.96	3.872	19	0.001
Pre-Test Right-Leg Balance	20	4.50	1.88				

Table 3. Comparison of pre-test and post-test values for circumference and girth measurements (parametric values)

	n	$\bar{x}$	s	Post-Test and Pre-Test Difference	t	df	*p*
Post-Test Shoulder Front-Back Distance	20	38.75	3.09	1.25	6.140	19	0.000
Pre-Test Shoulder Front-Back Distance	20	37.50	3.38				
Post-Test Thigh Circumference	20	48.25	6.97	1.80	4.346	19	0.000
Pre-Test Thigh Circumference	20	46.45	6.84				
Post-Test Calf Circumference	20	34.25	3.45	0.60	3.943	19	0.001
Pre-Test Calf Circumference	20	33.65	3.36				
Post-Test Biceps Circumference	20	26.20	3.02	1.10	5.395	19	0.000
Pre-Test Biceps Circumference	20	25.10	2.77				
Post-Test Intermalleolar Distance	20	7.25	0.44	0.55	4.819	19	0.000
Pre-Test Intermalleolar Distance	20	6.70	0.73				
Post-Test Interstyloid Distance	20	5.40	0.60	0.33	3.901	19	0.001
Pre-Test Interstyloid Distance	20	5.08	0.59				
Post-Test Intercondylar Distance	20	6.85	0.93	0.55	4.222	19	0.000
Pre-Test Intercondylar Distance	20	6,30	0,68				

Table 4. Comparison of pre-test and post-test values for circumference and girth measurements (nonparametric values

		n	Mean Sequence	Sequences Total	Z	*p*
Post-Test Hip Circumference - Pre-Test Hip Circumference	Negative Sequence	0[a]	0.00	0.00	3.746	0.000
	Positive Sequence	18[b]	9.50	171.00		
	Equality	2[c]				
Post-Test Intercondylar Distance - Pre-Test Intercondylar Distance	Negative Sequence	1[d]	5.50	5.50	2.530	0.011
	Positive Sequence	9[e]	5.50	49.50		
	Equality	10[f]				

Table 5. Comparison of pre-test and post-test values for performance parameters (parametric values)

	n	$\bar{x}$	s	Post-Test and Pre-Test Difference	t	df	*p*
Post-Test Right Hand Grip Strength	20	34.87	10.17	1.30	2.256	19	0.036
Pre-Test Right Hand Grip Strength	20	33.57	9.60				
Post-Test Left Hand Grip Strength	20	35.68	10.51	1.75	5.116	19	0.000
Pre-Test Left Hand Grip Strenght	20	33.94	10.13				
Post Test Push-up	20	18.40	4.63	5.70	5.921	19	0.000
Pre-Test Push-up	20	12.70	6.51				
Post-Test Sit-up	20	24.60	6.04	5.30	8.320	19	0.000
Pre-Test Sit-up	20	19.30	5.51				

Table 6. Comparison of pre-test and post-test values for performance parameters (non-parametric values)

		n	Mean Sequence	Sequences Total	Z	*p*
Post-test Long Jump - Pre-test Long Jump	Negative Sequence	2[a]	15.50	31.00	-2.578	0.010
	Positive Sequence	17[b]	9.35	159.00		
	Equality	1[c]				

Discussion

The primary objective of this study was to assess the influence of Wushu training on balance, anthropometric characteristics, and various performance parameters. The study included a total of 20 athletes, aged between 14 and 17, with a gender distribution of 70% males and 30% females. The average age of the participants was 15.35, indicating a relatively young group. Additionally, the athletes' mean height was 1.66 meters, mean weight was 56.71 kilograms, and mean shoe size was 40.53.

The relationship between balance and athletic performance is complex, influenced by various neurophysiological and mechanical factors, such as height, weight, body composition, and limb length.[16,17] Experienced athletes tend to exhibit better balance, which may result from the repetitive movements in their training programs. This study revealed significant findings regarding the impact of Wushu on balance, as the double-leg, left-leg, and right-leg balance of the participants improved significantly. The double-leg and left-leg balances increased by approximately 21%, while the right-leg balance exhibited a 30% increase. These findings indicate that Wushu has a positive effect on balance, an essential attribute for athletes.[17] Similar improvements in balance have been observed in other sports training programs, such as a 6-week program for high-school female basketball players.[18]

Anthropometric measurements are crucial for predicting young athletes' future athletic performance.[19] Long extremities are often advantageous in striking sports, like combat sports, and studies have shown correlations between limb length and Wushu performance.[19,20] After an 8-week Wushu training program, significant improvements were observed in anthropometric measurements, including shoulder anterior-posterior distance, thigh circumference, calf circumference, biceps circumference, hip circumference, intermalleolar distance, interstyloid distance, interpicondylar distance, and intercondylar distance. This suggests that Wushu enhances body composition and may be particularly beneficial for athletes with specific limb characteristics.

Hand grip strength is crucial in various sports, such as archery, hockey, golf, and judo. Enhanced hand grip strength often leads to better athletic performance in these sports.[21] Resistance training has been found to positively impact muscular power and sports performance, including vertical jumping and sprint running.[22] In this study, significant improvements were noted in performance parameters following an 8-week Wushu training program. Hand grip strength, right and left punch force, push-up and sit-up scores, and long jump distances all increased significantly. These findings underscore the positive effect of Wushu on athletes' performance across a range of parameters.

In conclusion, Wushu, often regarded as a combat sport, has demonstrated significant positive effects on balance, anthropometric measurements, and performance parameters. Even in the absence of competitive combat, training programs focused on enhancing Wushu techniques significantly improved athletes' muscle, bone, joint coordination, and balance abilities. This study highlights the multifaceted benefits of Wushu, which combines physical strength, skill, balance, breathing exercises, flexibility, mental strength, and meditation. The "harmony between body and mind" that Wushu promotes contributes to a healthy and balanced lifestyle. Therefore, the promotion and encouragement of Wushu, particularly among young individuals, should be actively supported by both official and private institutions through promotional activities, incentives, rewards, and other means.

Conflict of Interest
The authors have no conflicts of interest to disclose.

Compliance with Ethical Statement
The study was performed after obtaining the necessary permission from the local ethics committee (Date 13.01.2022 and Decision Number 2022/01.029).

Financial Support
The authors declared that no financial support was received for this paper.

Author Contributions
FB, SC: Study idea/Hypothesis; FB, SC: Data preparation; FB, SC: Analysis; FB, SC: Literature review; FB, SC: Writing; FB, SC: Critical Review.

References

1. Muratlı S, Şahin G, Kalyoncu O. Antrenman ve Müsabaka. 3rd ed. Nobel Akademik Yayıncılık; 2011.
2. Türkiye Wushu Federasyonu. https://www.twf.gov.tr/wushu-tarihce/ Accessed October 3, 2023.
3. International Wushu Federation. http://www.iwuf.org/ Accessed October 3, 2023.
4. Dündar U. Antrenman Teorisi (10. Baskı). 10th ed. Nobel Akademik Yayıncılık; 2017.
5. Gürkan AC. Birinci ve Bölgesel Ligde Oynayan Elit Kadın Futbolcuların Denge Dağılımlarının Incelenmesi. Yüksek Lisans Tezi. Gazi Üniversitesi Sağlık Bilimleri Enstitüsü; 2011. Accessed December 10, 2023. https://tez.yok.gov.tr/UlusalTezMerkezi/TezGoster?key=zqI_ZOq-b18GC2rT9c2JGq2HfGPYOdf66sJj8c3RXRCGRhvWKlss7vI8NKjmkRTS
6. Yıldırım İ, Ozdemir V. Elit düzey erkek hentbol oyuncularinin antropometrik özelliklerinin incelenmesi. *Spor Ve Performans Araştırmaları Derg.* 2010;1(1):6-13.
7. Callaway C, Chumlea W, Bouchard C, et al. Anthropometric standardization reference manual. *Anthr Stand Ref Man.* 1988;177.
8. Otman S, Köse N. Tedavi hareketlerinde temel değerlendi rme prensipleri 11th ed. Hipokrat Yayınevi; 2019.
9. Zorba E. Vücut yapısı ölçüm yöntemleri ve şişmanlıkla başa çıkma. Morpa Kültür Yayınları; 2005.
10. Asadi K, Mirbolook A, Heidarzadeh A, Kivi MM, Meybodi MKE, Rad MR. Association of soccer and genu varum in adolescents. *Trauma Mon.* 2015;20(2).

11. Coşkuner Z. Taekwondo Sporu Yapan, 7 Ve 8 Yaşlarındaki Erkek Çocukların Bazı Fiziksel Ve Antropometrik Ölçümlerinin İncelenmesi. *Sport Sci*. 2011;6(2):148-158.
12. Pekel H. Atletizmde Yetenek Aramasına Bağlı Olarak 10-12 Yaş Grubu Çocuklarda Bazı Değişkenler Üzerinde Normatif Çalışma. Doktora Tezi. Gazi Üniversitesi Sağlık Bilimleri Enstitüsü; 2007. Accessed December 10, 2023. https://tez.yok.gov.tr/UlusalTezMerkezi/TezGoster?key=-Z0vbSUgrhM9fXoGkRe6Q5VKXK2CmwmUhCWQDXQ6Y8e0XMCm9jVeqScAFIXVBFLC.
13. Tchórzewski D, Bujas P, Jankowicz-Szymańska A. Body posture stability in ski boots under conditions of unstable supporting surface. *J Hum Kinet*. 2013;38:33.
14. Yılmaz M. 8 Haftalık Kuvvet Antrenmanının 13-16 Yaş Arası Çocuklarda Bazı Fiziksel Uygunluk Parametrelerine Etkisinin İncelenmesi. Yüksek Lisans Tezi. Selçuk Üniversitesi. Accessed December 10, 2023. http://acikerisimarsiv.selcuk.edu.tr:8080/xmlui/bitstream/handle/123456789/6224/369921.pdf?sequence=1&isAllowed=y
15. Tabachnick BG, Fidell LS, Ullman JB. Using Multivariate Statistics. 6th Ed. Boston, MA: Pearson; 2013. Accessed December 10, 2023. https://ebook.upgrisba.ac.id/ebook/komputer-informasi-referensi-umum/6th-edition-using-multivariate-statistics-pearson/download.
16. Hrysomallis C. Balance Ability and Athletic Performance. *Sports Med*. 2011;41(3):221-232. doi:10.2165/11538560-000000000-00000.
17. Tabrizi H, Abbasi A, Jahadian H. Comparing the Static and Dynamic Balances and Their Relationship with the Anthropometrical Characteristics in the Athletes of Selected Sports. *Middle East J Sci Res*. 2013;15:216-221.
18. McLeod TCV, Armstrong T, Miller M, Sauers JL. Balance improvements in female high school basketball players after a 6-week neuromuscular-training program. *J Sport Rehabil*. 2009;18(4):465-481.
19. W M Viraj Denuka C, D Sameera Lakruwan P. Determinants of Sports Performance in National Level Wushu Players: A Correlational Study between Anthropometric Variables and Wushu Performances. *IOSR J Sports Phys Educ*. 2023;10(1):43-49.
20. Formalioni A, Antunez BF, Vecchio FBD, et al. Anthropometric characteristics and physical performance of taekwondo athletes. *Rev Bras Cineantropometria Desempenho Hum*. 2020;22:e55697. doi:10.1590/1980-0037.2020v22e55697.
21. Iermakov SS, Podrigalo LV, Jagiełło W. Hand-grip strength as an indicator for predicting the success in martial arts athletes. *Arch Budo*. 2016;12:179-186. https://api.semanticscholar.org/CorpusID:55694475.
22. Harries SK, Lubans DR, Callister R. Resistance training to improve power and sports performance in adolescent athletes: A systematic review and meta-analysis. *J Sci Med Sport*. 2012;15(6):532-540. doi:10.1016/j.jsams.2012.02.005.