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Investigation of the Relationships between Selected Anthropometric Characteristics, Anaerobic Power and Leg Strength in Child Windsurfing Athletes

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ABSTRACT

Aim: Windsurfing is a sportive, adventure activity that can be done by individuals of all ages after a training process. This study was conducted to determine the relationships between selected anthropometric characteristics, leg strength and anaerobic power in windsurfing athletes aged 10-15 years.

Material and Methods: A total of 18 athletes from Marmara Sailing Club (age: 12.83 ±2.20 years, height: 151.50 ±13.24 cm, body weight: 45.94 ±11.48 kg, body mass index: 20.25 ±3.00 kg/m²) participated voluntarily. Participating athletes were selected from those who have been actively surfing for at least 1 year. Some anthropometric (height, body weight, body mass index, leg length, sitting height) and motoric (leg strength, vertical jump, anaerobic power) tests were performed. The data were analyzed by Spearman Correlation analysis.

Results: As a result of the analysis, it was determined that there were highly statistically significant between height and anaerobic power, sitting height and leg length, highly significant relationships between body weight and anaerobic power, leg length, sitting height and body mass index, highly significant relationships between anaerobic power and sitting height, age and leg length, moderately significant relationships between sitting height and age and moderately significant relationships between leg strength and anaerobic power.

Conclusion: It can be said that anaerobic power can be positively affected if athletes are selected by paying attention to anthropometric characteristics. Coaches in the windsurfing branch are recommended to make athlete selection and training plans by considering these results.

Keywords: Anaerobic power; leg length; leg strength; windsurfing.

Rüzgar Sörfü Yapan Çocuk Sporcularda Seçilmiş Antropometrik Özellikler, Anaerobik Güç ve Bacak Kuvveti Arasındaki İlişkilerin İncelenmesi

ÖZ

Amaç: Rüzgâr sörfü, bir eğitim sürecinden sonra her yaştan bireyin yapabileceği bir sportif, macera aktivitesidir. Bu çalışma, 10-15 yaş aralığındaki rüzgar sörfü sporcularında seçilmiş antropometrik özellikler, bacak kuvveti ve anaerobik güç arasındaki ilişkileri belirlemek amacıyla yapılmıştır.

Gereç ve Yöntemler: Araştırmaya Marmara Yelken Kulübü sporcularından toplam 18 sporcu (yaş: 12,83 ±2,20 yıl, boy: 151,50 ±13,24 cm, vücut ağırlığı: 45,94 ±11,48 kg, vücut kütle indeksi: 20,25 ±3,00 kg/m²) gönüllü olarak katılmıştır. Katılım gösteren sporcular en az 1 yıldır aktif olarak sörf yapanlardan belirlenmiştir. Sporculara bazı antropometrik (boy, vücut ağırlığı, vücut kütle indeksi, bacak uzunluğu, otuma yüksekliği) ve motorik (bacak kuvveti, dikey sıçrama, anaerobik güç) testler uygulanmıştır. Verilerin analizi Spearman Korelasyon analizi ile yapılmıştır.

Bulgular: Analizler sonucunda, boy uzunluğu ile anaerobik güç, oturma yüksekliği, bacak uzunluğu arasında yüksek düzeyde istatistiksel olarak anlamlı, vücut ağırlığı ile anaerobik güç, bacak uzunluğu, oturma yüksekliği, vücut kütle indeksi arasında yüksek düzeyde anlamlı, anaerobik güç ile oturma yüksekliği, yaş, bacak uzunluğu arasında yüksek düzeyde anlamlı, oturma yüksekliği ile yaş arasında orta düzeyde anlamlı ve bacak kuvveti ile anaerobik güç arasında orta düzeyde anlamlı ilişki olduğu tespit edilmiştir.

Sonuç: Antropometrik özelliklere dikkat edilerek sporcu seçimlerinin yapılması halinde anaerobik gücün de olumlu

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etkilenebileceği söylenebilir. Rüzgar sörfü branşındaki antrenörlere, bu sonuçları göz önünde bulundurarak sporcu seçimi ve antrenman planlamaları yapmaları önerilmektedir.
Anahtar Kelimeler: Anaerobik güç; bacak kuvveti; bacak uzunluğu; rüzgar sörfü.

INTRODUCTION

Although windsurfing is not exactly known, it is generally accepted that it originated 800 years ago in Polynesia. Surfing is practiced in many different ways. The most well- known ones are wave surfing, windsurfing, kite surfing, but there are also varieties such as body surfing, stand-up paddle surfing, boat wave surfing, and wing surfing (1). Windsurfing gained international acceptance in the 1980s and was accepted as an Olympic sport in the following years (2,3). Windsurfing emerged from the combination of two different branches, sailing and surfing. The main goal in surfing is to try to stay in balance by holding the sail with the hands while the hands and feet are shoulder-width apart and tense on the surfboard, and to give direction and speed to the surfboard by moving the sail according to the direction of the wind (4).

In windsurfing, when sufficient speed is reached with the right equipment or when riding a wave, it becomes possible to perform jumps, somersaults, and sharp turns. Additionally, windsurfers can achieve speeds that no other sailboat can reach. (5). It is thought that a high degree of strength is required to achieve high performance in this sport branch in addition to structural features (6). In addition, it has been reported that windsurfing athletes have a lower body mass index and fat percentage compared to athletes in other branches. It is stated that this situation may provide positive feedback to athletes in low weather conditions and negative feedback in high weather conditions (7).

While surfing, arm, leg and core muscle forces are needed. As a result of the combination of these forces, the sailboat and board can be controlled and used in the desired direction. In this way, surfing performance can increase with the effect of force. Endurance is also needed to sustain this strength performance for a long time. The endurance of a windsurfing athlete enables him/her to surf longer and overcome the resistance of the sail against the wind. An endurance athlete can make fewer technical mistakes while surfing, which may contribute to a higher performance compared to their competitors (8). Based on this information, the aim of this study was to investigate the relationships between selected anthropometric characteristics, anaerobic power and leg strength in windsurfing child athletes. As a result of the study, windsurfing branch coaches will be advised to plan and perform their work in line with the relationships that may emerge between the variables**.**

MATERIAL AND METHODS

Characteristics of the Research Group

This study was conducted to determine the relationships between selected anthropometric characteristics, leg strength and anaerobic power in windsurfing athletes aged 10-15 years. The number of participants was determined using the G*Power analysis program (version 3.1.9.3, Germany). In this context, 'Correlation: Point Biserial Model' statistical test was selected from the T-test group and 'One-tailed' was preferred. The effect size was chosen as 0.55, Type I error rate (α err prob) as 0.05, and power (1-β err prob) as 0.80. As a result of the analysis, it was understood that at least 16 participants should be included in the study. In this context, the study was conducted with the voluntary participation of 18 athletes. The population of this study consisted of children aged 10-15 years who windsurf in Istanbul province and the sample consisted of 18 athletes who have been actively windsurfing for at least 1 year in Marmara Sailing Club. Participation in the study was based on volunteerism. Participants were selected among those who had not had any sportive injury in the last 1 year.

A total of 18 athletes from Marmara Sailing Club (age: 12.83 ±2.20 years, height 151.50 ±13.24 cm, body weight: 45.94 ±11.48 kg, body mass index (BMI): 20.25 ±3.00 kg/m²) participated voluntarily. Participating athletes were determined from those who have been actively surfing for at least 1 year.

Before the study, the parental consent form was obtained and necessary information was provided. All protocols and procedures in the study were carried out in accordance with the 2013 Declaration of Helsinki principles, and the ethics committee approval of the study was obtained by Düzce University Scientific Research and Publication Ethics Committee with the decision date of 16.05.2024 and decision number 2024/168.

Research Model

In this study, experimental model, one of the quantitative research methods, was used.

Data Collection Tools

The athletes were informed that they should eat 2-3 hours before coming to the tests, sleep well the evening before the tests, and not take any medication that may affect their performance. Athletes were also asked to participate in the tests wearing appropriate shorts, t- shirts and sneakers.

The measurements were made on the same day at the Marmara Sailing Club facilities. Athletes' height, body weight, leg length, sitting height were measured. Among the motoric characteristics, vertical jump for anaerobic power and leg strength were measured with a dynamometer.

Body Height: The height of the study group was measured in cm at the top of the head with the children barefoot, head in the Frankfort plane, chin parallel to the ground, eyes facing forward, and body in an upright posture (9). The measurement was made with a height scale (Seca stadiometer) with a precision of 0.01 cm.

Body Weight: The body weights of the research group were measured in kg using a digital scale with the children wearing shorts and t-shirts (9).

Sitting Height: The distance between the chair surface and the peak of the head of the athlete sitting on a non-stretchable wooden chair was recorded in cm with a tape measure (10).

Leg Length: The leg length of each athlete was measured and recorded in centimeters in the supine position bilaterally from the anterior superioriliac point of the thigh to the distal point of the medial malleolus of the foot (11).

Vertical Jump Test: The athlete reaches upwards with one arm to the maximum point in front of the test area. The distance between the point on the wall and the ground was determined with a mesuro. The difference between the distance the athlete could reach and the highest distance he/she could reach by jumping was determined and the height was recorded in cm. The test was repeated twice to determine the best score (12).

Leg Strength: The athletes placed their feet on the dynamometer with their knees bent, arms stretched, trunk slightly tilted forward and pulled the dynamometer bar vertically upwards using maximum leg strength. The measurement was performed using a Takei back and leg dynamometer (13).

Anaerobic Power Calculation: Anaerobic power (AP) values of the athletes were determined with Lewis formula by using vertical jump and body weight values. AP: It was calculated using Lewis formula; (√4.9 x (body weight) x √D) (D: Jump Distance) (14).

Statistical Analysis

The data were analyzed using the SPSS 22.0 program. The normality test of the data was performed with the Shapiro-Wilk test. Since the data did not show normal distribution, the relationships between the variables were analyzed Spearman Correlation analysis. Significance value was initially accepted as $p<0.05$

RESULTS

Descriptive statistics of the windsurfing athletes in the study are as shown in Table 1.

Table 1. Descriptive statistics of the windsurfing athletes

	n	Min.	Max.	X̄±SD
Body height (cm)	18	122.0	182.0	151.50±13.24
Body weight (kg)	18	27.0	74.0	45.94±11.48
Age (years)	18	10.0	15.0	12.83±2.20
Sport age (years)	18	1.0	3.0	1.50±0.78
Body mass index (kg/m2)	18	16.4	28.8	20.25±3.00
Sitting height (cm)	18	68.0	94.0	82.44±7.00
Leg length (cm)	18	72.0	102.0	89.16±7.13
Anaerobic Power (W)	18	258.0	949.1	482.05±156.13
Leg Force (kg)	18	32.0	134.5	77.30±28.91

The relationships between the variables in the study are as shown in Table 2.

Table 2. Relationships between anthropometric, motoric characteristics, leg strength and anaerobic power parameters

Spearman Correlation		**b**	**c**	**d**	**e**	**f**	**g**	**h**
Body Height (a)	r	0.890	0.638	0.559	0.806	0.910	0.796	0.872
	p	**<0.001**	**0.004****	**0.016***	**<0.001**	**<0.00**1	**<0.001**	**<0.001**
	n	18	18	18	18	18	18	18
Body Weight (b)	r	1.000	0.568	0.792	0.791	0.780	0.653	0.879
	p	.	**0.014***	**<0.001**	**<0.001**	**<0.001**	**0.003****	**<0.001**
	n	18	18	18	18	18	18	18
Leg Strenght (c)	r		1,000	0.278	0.631	0.532	0.576	0.589
	p		.	0.264	**0.005****	**0.023***	**0.012***	**0.010***
	n		18	18	18	18	18	18
BMI (d)	r			1.000	0.640	0.588	0.362	0.556
	p			.	**0.004****	**0.010***	0.140	**0.017***
	n			18	18	18	18	18
Anaerobic Power (e)	r				1.000	0.712	0.721	0.750
	p				.	**0.001****	**0.001****	**<0.001**
	n				18	18	18	18
Sitting Height (f)	r					1.000	0.809	0.683
	p					.	**<0.001**	**0.002****
	n					18	18	18
Age (g)	r						1.000	0.664
	p						.	**0.003****
	n						18	18
Leg Length (h)	r							1.000
	p							.
	N							18

**p<0.01 *p<0.05

BMI: Body Mass Index

As a result of the Spearman correlation analysis, according to Cohen (1988) (15), there is a highly positive and statistically significant relationship between body height and body weight (r=0.890, p<0.01), AP (r=0.806, p<0.01), sitting height (r=0.910, p<0.00), age (r=0.796, p<0.01), leg length (r=0.872, p<0.01), leg strength (r=0.638, p=0.04), and BMI (r=0.559, p=0.016). Body weight is highly positive and statistically significant relationship with leg strength (r=0.568, p=0.014), age (r=0.653, p<0.05), BMI (r=0.792, p<0.01), AP (r=0.791, p<0.01), sitting height (r=0.780, p<0.01), and leg length (r=0.879, p<0.01). Leg strength highly positive and statistically significant relationship with AP (r=0.631, p=0.05), sitting height (r=0.532, p=0.023), age (r=0.576, p=0.012), and leg length (r=0.589, p=0.010). BMI is highly positive and statistically significant relationship with AP (r=0.640, p<0.05), sitting height (r=0.588, p=0.010), and leg length (r=0.556, p=0.017). AP is highly positive and statistically significant relationship with sitting height (r=0.712, p<0.01), age (r=0.721, p<0.01), and leg length (r=0.750, p<0.01). Sitting height is highly positive and statistically significant relationship with age (r=0.809, p<0.01) and leg length (r=0.683, p<0.05). Age is highly positive and statistically significant relationship with leg length (r=0.664, p<0.05). No significant correlation was observed between the other variables (p>0.05) (Table 2).

DISCUSSION

This study was conducted to determine the relationships between selected anthropometric characteristics, leg strength and anaerobic power values in windsurfing child athletes. When the findings were examined, the mean age of the surfers was 12.83 ±2.20 years, mean height was 151.50 ±13.24 cm, body weight was 45.94 ±11.48 kg, BMI was 20.25 ±3.00 kg/m^2, leg length was 89.16 ±7.13 cm, sitting height was 82.44 ±7 cm, leg strength was 77.30 ±28.91 kg and anaerobic power values were 482.05 ±156.13 watts (Table 1).

In a study conducted with windsurfers aged 12-18 years, it was reported that the mean height of the athletes was 171.62 ±8.45 cm, mean body weight was 63.82 ±14.51 kg, and BMI was 21.43 ±3.04 kg/m^2 (16). In another study, anthropometric characteristics of optimist athletes aged between 11-15 years were evaluated. In the study, the participants were divided into 2 groups. As a result of the evaluation made in the two groups, those between the 1st and 45th place in the end-of-race ranking (Group 1) and those between the 135th and later places (Group 2) were determined. The average age of the athletes in the first group was 14 ±0.7 years, height 160 ±5.4 cm, body weight 48.8 ±6.37 kg, leg length 90.7 ±3.9 cm. The average age of the athletes in the second group was 13.2 ± 1.1 years, height 155 ±8 cm, body weight 44.2 ±7.1 kg, and leg length 86.3 ±14.5 cm (17). The BMI and leg length values obtained in our study are similar to the mentioned studies. On the other hand, the mean height and body weight values in our study were lower than those found in the mentioned studies. These results are thought to be due to the different age groups in the studies.

In a different study, the relationships between sitting height, height, body weight and BMI were examined in 626 windsurfing athletes aged 6-16 years. It was reported that the mean body weight was 33.95 ±11.26 kg in girls and 34.05 ±11.50 kg in boys, height was 138.84 ±13.92 cm in girls and 140.19 ±15.01 cm in boys, body mass index was 17.12 ±3.16 kg/m^2 and 16.86 ±2.96 kg/m^2 in boys (18). The mean height, body weight and BMI values in our study were higher than the results of the mentioned studies. These results are thought to be due to the difference in age groups in the studies.

In another study, anthropometric and motoric measurements were made with 27 windsurfers who were national team athletes aged 14-15 years. As a result of the study, it was reported that height was 168.66 ±10.56 cm, body weight was 56.21 ±8.83 kg and body mass index was 19.65 ±1.79 kg/m^2, leg length was 91.12 ±7.11 cm and leg strength was 127.77 ±66.58 kg (19). When the findings of our study are compared with the results of this literature, it is seen that the mean values are lower in terms of these variables (Table 1). This is thought to be due to the fact that the participants in the mentioned literature consisted of national athletes. Considering the other variables in our study, the mean sitting height was found to be 82.44 ±7 cm (Table 1). In a study, the mean sitting height of 626 windsurfing athletes aged 6- 16 years was found to be 72.82 ±7.24 cm in boys and 72.39 ±7.15 cm in girls, and it was reported that there was a statistically significant difference between the two genders in terms of sitting height (18). When compared with the findings in our study, it was observed that the values obtained were higher (Table 1).

In a different study conducted with national and international windsurfers between the ages of 14-24, the relationships between values such as age, height, BMI, performance ranking, and duration of sports age were examined. As a result of the study, it was reported that there was no statistically significant relationship between the mentioned parameters (7). In our study, it was found that there were significant relationships between height and age, body weight and BMI values (Table 2). It is thought that this may be due to the fact that the participants in our study were in better condition than the others in terms of performance and anthropometric structure, although their average age was lower.

In a study conducted with soccer players and sedentary individuals, it was reported that as height and age increased, sitting height also increased; therefore, taller individuals would have a higher sitting height and these criteria should be taken into consideration when making sportive choices (20). In another study, the relationships between sitting height, height, body weight and body mass index were examined in 626 windsurfing athletes aged 6-16 years. As a result, it was reported that there was a highly significant positive relationship between sitting height and height (18). In our study, it was observed that there were highly significant positive relationships between sitting height and age, height and body mass index (Table 2). Our study supports the results of the literature in terms of these variables.

The relationships between anthropometric, motoric measurements and strength were investigated in 27 windsurfers who were national team athletes aged 14-15 years. As a result of the study, it was stated that there was a significant positive relationship between height and leg strength parameters that may be effective in the performance of windsurfing athletes (19). In our study, a highly significant positive relationship was found between height and leg strength variables (Table 2). Our study supports the aforementioned literature result in terms of these variables. In a study conducted with sub-elite athletes, it was reported that body weight and height were associated with anaerobic power and there was a relationship between body weight and strength (21).

Anaerobic power is important in terms of organizing training programs in sports, writing exercise prescriptions and determining exercise intensity (22). In the literature, leg strength is positively correlated with anaerobic power. In a study examining the relationship between leg strength and anaerobic power in young male handball players, it was observed that the variables of the study, anaerobic power and leg strength, had a positive, moderate and statistically significant relationship (23). In another study, it was determined that there was a significant relationship between leg muscle volume, absolute anaerobic power and capacity values (24). In another study in this field, it was reported that absolute anaerobic power and capacity values may increase with the increase in leg volume even if body weight, skinfold thickness and age were kept under control (25). In the study aiming to determine the relationship between body composition, leg volume, leg mass, anaerobic performance and leg strength in climbers, it was determined that there was a positive significant relationship between isometric leg strength and anaerobic performance. Based on this result, it was stated that mountaineers with more leg volume may have better anaerobic performance (26). In a study conducted with female volleyball players, it was stated that an 8-week strength training program positively affected the anaerobic power performance of the athletes (27). In a study conducted to investigate the relationship between leg strength and anaerobic power in futsal athletes, it was reported that leg strength positively affected anaerobic power performance (28). In a study conducted in 14-15-year-old wrestlers, when the relationship between isokinetic muscle strength and balance and anaerobic power was examined, it was reported that there were positive significant relationships between these three variables (29). In a study in which strength and anaerobic power parameters of young and junior category tennis players were examined, a significant relationship was found between isokinetic muscle strength and anaerobic power (30). In a study conducted with female soccer players, it was reported that the relationship between lower extremity strength values and anaerobic power and vertical jump values increased (31). Although some of the research results in the mentioned literature are not directly related to windsurfing, they are similar to the values in our study. Because in the results of our study, it was determined that there were high positive correlations between anaerobic power and leg strength, leg length, sitting height, height, body weight, BMI and age values (Table 2).

CONCLUSION

In this study, the findings obtained from pediatric windsurfing athletes aged 10-15 years show that height, body weight, sitting height, body mass index and leg length are related to anaerobic power. In addition, there was a moderately significant relationship between leg strength and anaerobic power. In line with these results, it is recommended that windsurfing coaches should take these factors into consideration when selecting athletes and planning training programs. However, it should be kept in mind that this study was based on a limited sample and other factors may also affect the performance of athletes. Therefore, it is also recommended to consider larger sample groups and different variables in future studies.

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