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Full Length Research Paper

Determination of physical and physiological profiles of international elite sailors

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This study aimed to determine the physical and physiological profiles of sailors. The study group comprised 36 sportsmen (25 males, 11 females), of 7 nationalities, who took part in the intercollegiate sailing championship in Izmir, Turkey. The age, body weight, height, skinfold thickness, measurements of breadth and circumference, somatotype, anaerobic power, reaction times, flexibility and respiration parameters of the sailors were measured. The average age of the female sailors was 22.18±2.09; sport age was 12.45±4.32; sailing age was 9.60±4.50. The average age of the male sailors was 23.4±2.69; sport age was 13.92±3.33; sailing age was 10.92±4.74. Average body weight of the female sailors was 58.36±6.14 kg and 70.28±5.33 kg for the males. The height of the female sailors was 165.55±5.77 cm, and that of the male sailors was 176.60±5.79 cm. The body fat percentage of the female sailors was 17.74±2.30% and that of the male sailors was 8.98±1.83%. Somatotypes were determined to be endomorphic mesomorph for the female participants and ectomorphicmesomorph for the male participants. In conclusion, when the physical and physiological profiles of the sailors in the present study were compared to those of other sports, similar values were found.

Key words: Sailing, physical and physiological characteristics.

INTRODUCTION

Performance in sports, depends on consumption of anaerobic and aerobic energy; neuromuscular functions such as velocity, and; techniques, tactics and psychical factors (Astrand and Kare, 1986).

The aim of sports training is to establish the general and special conditions of the physical growth changes which stem from regular sports training performed in harmony with the sportive conformity level and objective regarding the body structure of the sportsman (Titel, 1978). There is no definite answer to the question of whether sporting champions have different characteristics at birth or whether they acquire them later through training. Muscular power, which is measured dynamometrically, has a hereditary characteristic, but can also be altered through training. Characteristics that are inherited or might be gained through training have been detected and categorized through scientific research (Comparetti, 1978).

Sailing is, primarily, a strategic and tactical sport, which consists of classifications such as Mistral, Finn, and Tornado. Some categories of boats compete with just one person on board (single-handed), while others compete with two persons (double-handed) or more (crewed / fully-crewed). Sailing in high-winds requires great skill and physical effort to control the boat (Gore, 2000).

Legg and Mackie (2000) have published training practices of sailors. They surveyed 28 New Zealand Olympic sailors, 61% of whom underwent strength/circuit training, 36% addressed flexibility, 75% trained aerobically on land, and 86% performed on-water aerobic training while sailing. Studying 25 Olympic sailors with self prescribed strength, endurance, and flexibility programmes, Legg et al. (1999) found that some groups exhibited significant changes in body weight, skinfolds, flexibility, aerobic endurance, and strength, although the results were inconsistent.

Strength, power, muscle endurance, cardiovascular fitness, weight management, flexibility, and agility all play

Table 1. Physical characteristics of test participants.

Sex	Female (n=11)	Male (n=25)
Age (year)	22.18±2.09	23.4±2.69
Sports Age (Year)	12.45±4.32	13.92±3.33
The age of beginning to sailing (year)	9.60±4.50	10.92±4.74
Body weight (kg)	58.36±6.14	70.28±5.33
Height (cm)	165.55±5.77	176.60±5.79

roles in sailors' training regimens (Cunningham, 1996; Legg et al., 1999). Proper warm up and cool down is essential, and appropriate stretching and flexibility can optimise balance and mobility while decreasing muscle tension and unloading repetitively stressed muscles. (Crafer, 2004) Agility exercises may improve hand-eye coordination and the efficiency of movement about a sailboat. (Cunningham, 1999)

Aerobic training and fitness has been shown to be directly related to sailors' reaction speed to wind shifts, (Shephard, 1997) as well as enhanced endurance, decision making, and concentration, particularly in the later stages of races. (Cunningham, 1996; Zelhof, 1991). Physical and mental recovery between races and regattas may also improve with cardiovascular fitness. Whereas some authors feel that rowing is the most applicable aerobic activity for sailors, others allow for cycling, swimming, or running. (Legg et al., 1999; Crafer, 2004)

The objective of this study is to determine the physical and physiological profiles of sailors.

MATERIALS AND METHODS

Test participants

Thirty-six test participants (25 males and 11 females) participated in the study. They came from 7 different countries (Austria, Hong Kong, Japan, Hungary, Poland, Slovakia, and Turkey).

The male test participants were 23.4±2.69 years; their heights were 176.60±5.79 cm; and body weight was 70.28±5.33 kg. The female test participants were, on average, 22.18±2.09 years old; height was 165.55±5.77 cm; and weight was 58.36±6.14 kg as shown in Table 1.

Anthropometric measurements

A medical scale with 0.1kg accuracy was used to measure body weight. A stadiometer accurate to ±0.5 cm was used to measure the height of test participants. Test participants were barefoot and brought their heels together during the measurement of height. A Holtain skinfold caliper was used to measure skin thickness and measurements of breadth and circumference were performed using a Lafayette anthropometric caliper. Body fat percentages were calculated according to the Sloan-Weir formula (Tamer, 2000) and somato types (Table 3) were calculated according to the Heath-Carter method (Ozer, 2009).

Physiological tests

Reaction times of the test participants were measures using a Power 2000 New Test. Leg was measured using a Lafayette dynamometer. Grip-strength was measured using a handgrip and anaerobic power was measured via a vertical bounce test using the formula

$P= (\sqrt{4.9}\ (\text{Body weight})\sqrt{D^n})(5)$

The flexibility of the test participants was measured by sit-and-reach-table and lung-volume were observed using a Vitalograph spirometer.

Statistical analysis

Statistical analysis was done using the SPSS program for Windows (Version 11.0). Data are given as means and standard deviation.

RESULTS AND DISCUSSION

The study was performed to determine the physical and physiological profiles of 25 male and 11 female sailors who participated in the world collegiate sailing championship in İzmir, Turkey.

Skin body fat percentages of the tested participants were 8.98±1.83% for males and 17.74±2.30% for females as can be seen in Table 2. This compares with a previous study of volleyball players, which found skin body fat percentage o be 15.85% in A Group First League players, 16.18% in B Group Second League players and 17.11% in C Group Local League players (Ergül and Günay, 1997). Moka (1987) reported that body fat percentage of elite female volleyball players was 23.12%. Fleck (1983), Puhl (1982), Thissen et al. (1991) reported that body fat percentage was 17.9, 17.2 and 17.2% respectively In a study of sportswomen, Cicioğlu et al. (1998) determined that body fat percentage was 13.62% in basketball players; 20.37% in handball players and 16.44% in volleyball players. A study of male Alpine skiers found that body fat percentage was 8.67%. That of Nordic Skiers was observed to be 8.84% (Yarım et al., 1998). A study of handball players found that body fat percentage was 14.15% before the season and 11.52% at the end of the season (Eler et al., 1999). A study of soccer players found that body fat percentage was 7.53% before

Table 2. Skin thicknesses and body fat percentages of test participants.

Sex	Female(n=11)	Male(n=25)
Leg Skinfold (mm)	13.33±5.37	9.87±4.26
Subsscapular Skinfold (mm)	9.99±1.97	9.02±2.08
Abdominal Skinfold (mm)	10.09±3.39	10.02±3.83
Subrailiac Skinfold (mm)	9.67±3.69	7.13±2.43
Triceps Skinfold (mm)	12.01±3.43	7.80±2.10
Calf Skinfold (mm)	7.56±2.39	7.34±1.83
Fat%	17.74±2.30	8.98±1.83

Table 3. Circumference, breadth measurements and Somato types of test participants.

Sex	Female (n=11)	Male (n=25)
Girth of forearm (cm)	23.23±1.27	26.80±1.44
Girth of elbow (cm)	23.23±1.21	26.44±1.63
Extended biceps Girth (cm)	24.82±2.03	27.84±1.80
Girth of breast (cm)	81.50±9.15	90.08±9.41
Girth of stomach (cm)	71.50±5.43	77.46±5.55
Girth of hips (cm)	93.73±6.66	92.92±9.00
Girth of upper-legs (cm)	50.14±3.13	49.40±2.87
Girth of knee (cm)	35.91±2.60	36.70±1.65
Girth of calf (cm)	35.86±2.84	35.40±2.35
Biceps Girth in flexion (cm)	28.31±1.79	33.12±2.03
Breadth of chest (cm)	26.73±1.71	29.52±1.48
Breadth of wrist (cm)	4.93±0.31	5.64±0.28
Breadth of ankle (cm)	6.45±0.28	7.19±0.30
Humerus biconduler breadth (cm)	6.03±0.43	6.89±0.41
Femur biconduler breadth (cm)	8.90±0.65	9.68±0.53
Endomorph	3.32±0.80	2.28±0.64
Mesomorph	4.08±1.11	4.73±1.00
Ektomorph	2.76±0.99	2.82±0.92

attending a preparation camp and 6.11% after the preparation camp Bostancı et al., 2004). Gençay et al. (2000) observed that body fat percentage was 8.1% in the footballers. According to Öztop (1999) and Chin et al. (1992), the body fat percentage was 7.77% and 7.3% respectively. The results of the present study are similar to those found in other studies within the literature.

The somato types of participants in the present study were found to be endomorphic mesomorph for females and ectomorphicmesomorp for males. A study of female volleyball players found the somato types of A Group First League players were endomorphic mesomorph. That of B Group Second League players was found to be ectomorphicesomorph and that of C Group Local League players was designated to be endomorphic mesomorph (Ergül and Günay, 1997). Yarım et al. (1998) observed that the somato types of Alpine skiers were ectomesomorphic and that of Nordic skiers were ectomorphic mesomorphs. The results of the present study are similar to the findings of previous studies in the literature.

The mean reaction time of male test participants in response to a light signal was 228.45±31.83 msn for the right hand and 225.36±27.65 msn for the left hand. The mean reaction time of male test participants in response to a light signal was218.20±24.77 msn for the right hand and 216.12±23.94 msn for the left hand. The mean right hand reaction time in response to an audio signal was 203.00±29.74 msn in females and that of the left hand was 233.73±30.24 msn. For males, the mean right hand reaction time in response to an audio signal was 201.72±35.55 msn and 201.20±33.58 msn for the left hand as seen in Table 4. Karakuş et al. (1996) found a reaction time of 0.16 s in their study of female

Table 4. Reaction time, strength, vertical bounce, anaerobic power, flexibility and respiration values of test participants.

Sex	Female (n=11)	Male (n=25)
Light Right hand reaction (msn)	228.45±31.83	218.20±24.77
Light Left hand reaction (msn)	225.36±27.65	216.12±23.94
Audio Right hand reaction(msn)	203.00±29.74	201.72±35.55
Audio Left hand reaction (msn)	233.73±30.24	201.20±33.58
Leg Strength (kg)	90.79±23.66	132.64±27.55
Right hand grip strength (kg)	33.29±4.53	48.28±5.31
Left hand grip strength (kg)	32.38±4.79	47.80±4.34
Vertical Jump (cm)	40.91±5.28	51.20±7.98
Anaerobic Power (kgm/sn)	82.46±9.83	110.89±11.27
Flexibility (cm)	32.45±5.07	29.76±4.77
Vital capacity VC (lt)	3.99±0.65	5.47±1.15
Forced vital capacity FVC (lt)	3.50±0.85	4.23±0.97

badminton players. Şener et al. (1998) found that right-hand reaction times of female badminton players was 126.6 s. and that of the left hand was determined to be 135.0 s additionally, average right-hand reaction time in response to an audio signal was found to be 118.3 s and that of the left hands was 126.6 s. İmamoğlu et al. (2000) found that the audio reaction time of footballers was 160.0±19.0msn, and their visual reaction time was 175.0±14.0 msn. They also observed that the audio reaction time of amateur footballers was 163.0±20.0 msn and their visual reaction time was 177.0±18.0 msn Hasçelik et al. (1989) studied the reaction times of volleyball players before and after a training program. They found that the audio reaction time was 214.55 msn before the program and 200.0 msn after; average visual reaction times were found to be 191.3 msn before the training program and 175.05 msn after.

The reaction times recorded for female sailors in the present study are slower than the values reported in previous studies in the literature. This may be due to the different types of sports analysed in the various studies. The reaction times recorded for male sailors in the present study are slower than the values reported by İmamoğlu et al. (21), but are similar to those of Hasçelik (1989).

Right hand grip strength of the female test participants in the present study was 33.29±4.53 kg and mean left-hand grip strength was 32.38±4.79 kg. The mean right-hand grip strength of the male test participants was 48.28±5.31 kg and mean left-hand grip strength was 47.80±4.34 kg. The mean leg power of the female test participants was 90.79±23.66 kg and that of males was 132.64+27.55 kg. The right hand grip strength of A Group First League female players was found to be 33.27 kg; that of B Group Second League players was 29.92 kg, and that of C Group Local League players was found to be 30.09 kg. The Left hand grip strengths were observed to be 32.06, 28.41 and 29.34 kg, respectively (Ergül and Günay, 1997). Ateşoğlu et al. (1999) reported that the clutch power of the right hands of female handball players, who were members of the First team of the league, was 33.36 kg and that of the left hand was 29.60 kg. Average leg power was found to be 71.57 kg (23). A previous study of female sailors found that average grip strength was 39.5 kg (Gore, 2000). A recent study of skiers found that the grip strength of the right hands of Alpine skiers was 42.15 kg and that of the left hand was 39.92 kg in comparison, the grip strength of the right hands of Nordic skiers was found to be 42.34 kg and that of their left hands was found to be 39.83 kg; the leg power of Alpine skiers was 161.58 kg and that of Nordic skiers was found to be 118.77 kg (Yarım et al., 1998). A previous study of sailors found that the grip strength was 59.8 kg (Gore, 2000). When the results of the present study are compared to those in the literature, the date for the female test participants are seen to be similar to those in the literature; however, the grip strength of the males test participants in the present study are seen to be sometimes higher and sometimes lower than those of previous studies. Additionally, the leg-strength data for male test participants in the present study are similar to some values reported in previous studies, but lower than those reported in other studies.

The anaerobic power and flexibility values of the female test participants were 82.46±9.83 kg.m/sn and 32.45±5.07 cm respectively; those of males were 110.89±11.27 kg.m/sn and 29.76±4.77 cm respectively. In comparison, a previous study found that the anaerobic power of A Group First League volleyball players was 100.40 kg.m/s; that of B Group Second League players was 91.17 kg.m/s; that of C Group Local League players was 84.13 kg.m/s (Ergül and Günay, 1997). Şenel et al.

(1998) reported that the anaerobic power of female volley-ball players was 97.28 kg.m/s and their flexibility was 29.5 cm. Ateşoğlu et al. (1999) reported that the anaerobic power value and flexibility of the female handball players who came league champions were 81.58 kgm/sn and 30.93 cm respectively. Bostancı et al. (2004) reported that the anaerobic power of football players was 110.10 kg.m/s before attending a preparation camp, compared with 111.95 kg.m/s after the preparation camp. In the same study, flexibility was found to be 34.35 cm before and 35.24 after attending a preparation camp. In a study carried out on handball players, Eler et al. (1999) reported that anaerobic power values were 134.06 kg.m/s before and 141.26 kg.m/s after the playing season. They also indicated that flexibility values were 28.7 cm and 32.28 cm before and after the season. The findings of the present study are comparable to those reported in other studies within the literature.

In the present study, the vital capacity and forced vital capacity of the test participants were found to be 3.99±0.65 lt. and 3.50±0.85 lt. for females, respectively. Those of male test participants were found to be 5.47±1.15 lt. and 4.23±0.97 lt. respectively. A previous study of female volleyball players found that vital and forceful vital capacities of A Group First League sports women were 3.98 and 4.10 lt, respectively; those of B Group Second League players were 4.15 and 4.42 lt; those of C Group Local League players were found to be 3.76 and 4.05 lt, respectively (Ergül and Günay, 1997). In a study of make skiers, Yarım et al. stated that the vital capacity and forceful vital capacity of Alpine skiers were 5.28 and 4.52 lt respectively, and those of Nordic skiers were 5.32 and 4.68 lt (Yarım et al., 1998). The findings of the present study are similar to those of previous studies within the literature.

In conclusion, when the physical and physiological profiles of the sailors in the present study were compared to those of other sports, similar values were found.

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