

techniques for organizing training (algorithmizing of educational activities taking into account the characteristics of the impairment, specifics of the structural construction of classes, etc.); 3) logical techniques for processing educational information (specification, establishing analogies by samples, generalization by accessible features of the objects and phenomena under study, etc.); 4) use of technical means, special devices and equipment (technical means for recoding visual and auditory information into accessible stored devices, analyzers that enhance tactile, auditory and other information) [3].

Conclusions.

Forms and types of contact work for students with disabilities and limited health capabilities are established individually for each student or, if possible, for several students. The choice of forms and types of contact and independent work for people with disabilities and limited health capabilities is carried out taking into account individual psychophysical characteristics (orally, in writing on paper, on a computer or using other equipment, in the form of testing). If necessary, students are given additional time for consultations and completing assignments. Assistants, specialists in special technical and software tools may be involved in the implementation of the discipline (module), including the procedure for assessing the level of competence development (in accordance with the requests of students).

Adaptive physical education can be defined as a set of criteria of a sports and health-improving nature, which are aimed at rehabilitation and adaptation to the usual social environment of people with disabilities, overcoming psychological barriers that block the sense of a full life, as well as awareness of the need for their personal investment in the social formation of society.

The main purpose of adaptive physical education is a positive impact on the body and health of a person, promoting positive functional improvements in the body, improving motor coordination, improving the life of the body. The most important task of the theory of adaptive physical education is to study the interests and needs of people with disabilities, their characteristics and individuality in the context of physical education.

The theory of adaptive physical education can be defined as an interdisciplinary science, it closely interacts with such areas and scientific directions as: health care, education, social security. The interaction of these scientific fields and areas of practical activity is aimed at a common goal: to maximally integrate people with disabilities into society, make their lives as comfortable as possible, and create all the conditions for people with disabilities to feel like completely equal members of society.

Adaptive physical education is of the utmost importance in the modern education system, since it helps to ensure equal opportunities for all students, has significant recovery and rehabilitation potential, and ensures the implementation of the most important function of individualization of the approach to learning, based on the physical characteristics and capabilities of each person. Physical activity in accordance with the state of human health contributes to a comprehensive improvement in health indicators (both physical and spiritual and mental), contributes to more effective rehabilitation and recovery of a person, provides a person with confidence in his or her abilities, and improves the quality of his or her life.

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ANTHROPOMETRIC CHARACTERISTICS AND PHYSICAL FITNESS OF UKRAINIAN SAILORS IN ILCA (FORMER LASER CLASS): DIFFERENCES BETWEEN MEN AND WOMEN

Annotation. The anthropometric characteristics and results of the dynamic and isometric hiking test of men and women specializing in sailing in the ILCA class were analyzed. The sample for the study consisted of 10 athletes - yachtsmen of the ILCA class. All of them are members of the national team of Ukraine: 6 men aged 17-18 and 4 women aged 17-18. Experience in sailing: men's average - 9.83 ± 7.45 years, women's - 7.75 ± 3.85 years. Height (cm): men - 180.33 ± 3.72 , women - 164.75 ± 6.80 ; body weight (kg): men - 72.17 ± 9.66 , women - 58.50 ± 15.45 . Results: During the dynamic opening test,

statistically significant differences ($p < 0.05$) in the time of execution (s) between women (155.25 ± 70.41) and men (112.50 ± 68.25) were revealed. During the isometric test there were no significant differences in the time of performance (s) between women (151.50 ± 36.46) and men (127.00 ± 45.17) ($p > 0.05$). There was a significant difference ($p < 0.05$) in heart rate (HR) during the first minute of the dynamic test between women (154.5 ± 13.2 beats/min) and men (147.33 ± 20.03 beats/min). Significant differences ($p < 0.05$) in heart rate at the end of the dynamic test were also found: in women - 161.25 ± 9.57 bpm, in men - 150.33 ± 12.16 bpm. Significant differences between yachtsmen of ILCA class (men and women) according to the results of the dynamic test, heart rate during the first minute and at the moment of failure during the dynamic test were found, differences were found in anthropometric indicators - height, body weight, waist circumference, length of the lower leg, leg and foot. These indicators can become the basis for developing training programs and improving the physical fitness of sailors in sailing.

Keywords: ILCA, sailing, anthropometric; dinghy; hiking; physical fitness

Анотація. Савченко К.Ю., Русанова О.М. Антропометричні характеристики та фізична підготовленість українських яхтсменів у класі ILCA (колишній клас LASER): відмінності між чоловіками та жінками. Проаналізовані антропометричні характеристики та результати виконання динамічного та ізометричного тестів відкренювання (hiking test), чоловіків і жінок, які спеціалізуються у вітрильному спорті у класі ILCA. Вибірку для дослідження склали 10 спортсменів — яхтсменів класу ILCA. Усі вони є членами національної збірної України: 6 чоловіків віком 17–18 років і 4 жінки віком 17–18 років. Досвід у вітрильному спорті: у чоловіків середній — $9,83 \pm 7,45$ року, у жінок — $7,75 \pm 3,85$ року. Зріст (см): чоловіки — $180,33 \pm 3,72$, жінки — $164,75 \pm 6,80$; маса тіла (кг): чоловіки — $72,17 \pm 9,66$, жінки — $58,50 \pm 15,45$. Результати: Під час виконання динамічного тесту відкренювання виявлено статистично значущі відмінності ($p < 0,05$) у часі виконання (с) між жінками ($155,25 \pm 70,41$) та чоловіками ($112,50 \pm 68,25$). Під час ізометричного тесту значущих відмінностей у часі виконання (с) між жінками ($151,50 \pm 36,46$) та чоловіками ($127,00 \pm 45,17$) не виявлено ($p > 0,05$). Виявлено значущу різницю ($p < 0,05$) у частоті серцевих скорочень (ЧСС) протягом першої хвилини динамічного тесту між жінками ($154,5 \pm 13,2$ уд/хв) і чоловіками ($147,33 \pm 20,03$ уд/хв). Також виявлено значущі відмінності ($p < 0,05$) у ЧСС наприкінці динамічного тесту: у жінок — $161,25 \pm 9,57$ уд/хв, у чоловіків — $150,33 \pm 12,16$ уд/хв. Встановлено значущі відмінності між яхтсменами класу ILCA (чоловіками і жінками) за результатами виконання динамічного тесту, за показниками ЧСС протягом першої хвилини та в момент відмови при виконанні тесту динамічного тесту, відмінності виявлено за антропометричними показниками — зростом, масою тіла, окружністю талії, довжиною гомілки, ноги та стопи. Ці показники можуть стати основою для розроблення тренувальних програм і вдосконалення фізичної підготовленості яхтсменів у вітрильному спорті.

Ключові слова: ILCA, вітрильний спорт, антропометрія; швертбот; відкренювання; фізична підготовленість

Introduction. In sport sailing, there are five fundamental pillars of performance for dinghy sailors (body composition, fitness, technique and tactics determine performance, equipment, cognitive ability) (Manzanares et al. 2021; Buchardt et al. 2016).

Sailing is a complex water sport in which the sailors use their body weight, position changes, a series of maneuvers and equipment adjustments to maintain the balance of the hull and optimal speed according to the environmental conditions. Due to the difference of boat type and sailor position, the physical demands, fitness characteristics and technical maneuvers of sailors are different (Pan et al 2022; Vaughan 2017; Bourgois et al. 2017).

In the ILCA boats, performance is significantly related to the ability of the sailor to overcome the forces that tend to destabilize the boat, which are generated by the action of the wind on the sails, producing a lateral inclination called heel (Castagna et al. 2007; Caraballo et al. 2019).

To overcome these forces and to thus stabilize the boat, the sailor performs a specific technical gesture called hiking bench. With this gesture, the body is used as a lever arm, placing the feet in straps that are located in the center of the boat while leaning and taking the rest of the body out of the side in order to balance the moment of the resulting forces. The main objective of this maneuver is to maintain stability, which allows the sailor to use the force of the wind to increase the speed of the boat to its maximum during most of the route (Day et al. 2017). With winds greater than eight knots and in certain circumstances, the sailor can make this maneuver for 94% of the total sailing time (Legg et al. 1997).

Regarding the hiking bench, there are three main positions, which are defined according to the angulation between the hip and the trunk (Sekulic et al. 2006). The first position is called sitting and comprises an angulation between 90° and 120° of the hip. The second one is the vertical position, with an angular range of 120° to 150° . The third and last position is called extended position, in which angulation ranges between 150° and 180° .

The most important muscles to perform the technical maneuver of dinghy hiking are the quadriceps; the abdominals (transverse, anterior rectus, major oblique, and minor oblique); and, to a lesser extent, the sternocleidomastoid, iliopsoas, and anterior tibial (Blackburn 1994; Maissetti et al. 2002; Callewaert et al. 2015; Schütz et al. 2011). The muscular action when performing this movement is called “quasi-isometric”, since there is no constant isometric action, as the sailor performs small modifications to adapt to the constant movements of the boat that are produced by the action of the wind and waves (Spurway 2007). The use of simulators for the evaluation of strength, endurance (Maissetti et al. 2006), and performance (Burnet et al. 2012) is widespread in sailing sports, and they allow reproducing the technical action of dinghy hiking.

The Winchcombe (Winchcombe et al. 2021) research confirms that tacking is the most physically demanding aspect of racing. Blackburn (Blackburn 1994) proved that the efficiency of the opening process is related to the strength of isometric

knee extension as the leading muscle for athletes specialising in the Laser class. Tan (Tan et al. 2006) proved that maximal isometric quadriceps strength is an indicator of performance for Laser racing.

Coordination, strength, speed, and power endurance in isometric knee extension can be identified as the indicators that are most correlated with sailing performance in 47 athletes aged 10-18 years specialising in Laser 4.7, Laser Radial, Europe, and Optimist yacht classes. The importance of training primarily coordination in sailors under 15 years of age and strength qualities after 15 years of age is emphasised to increase the strength endurance of isometric knee extension (Callewaert et al. 2015). An adequate level of flexibility in the performance of technical elements is also an integral part of effective competitive activity in sailing (Vaughan 2017; Slater 1995). The results (Tan et al. 2006) showed that higher body weight and knee extensor and hip flexor performance in the HM180 protocol, or 180-degree static hanging, were significantly associated with better racing performance.

Methods. Study Design and Participants. The sample for this research was made up of 10 sailors from the former Laser class and the ILCA sailing class. They all belong to national team Ukraine, 6 were men, with age 17-18 y. and 4 women, with age 17-18 y. Sailing experience for men: average age 9.83 years, standard deviation 7.45 years; for women: average age 7.75 years, standard deviation 3.85 years. Height (cm) for men: average 72,17, SD 9,66; for women: average 164,75, SD 4.13; Weight (kg): for men: average 72,17, SD 9,66; for women: average 58,50, 15,45.

All applicable institutional standards were followed relating to the ethical use of human volunteers (such as the Declaration of Helsinki). Informed consent was obtained in writing from all participants, who were informed exhaustively about the study.

Research Instruments. The fatigue protocol comprises two parts: a static test and a dynamic test. Before carrying out the protocol, the yachtsman will run a familiarisation protocol with the simulator, to eliminate the learning component from the performance. This was followed by muscle activation, to prepare the crew for a sub-maximal effort.

The sailors chose their preferred side to perform the test, as the dinghy can be sailed either side. All the sailors chose to perform the test on the starboard side. As the literature confirms, the sailors obtain better performance by sailing on the starboard side rather than port (Mackie 1999).

The first test was an isometric test (quasi-isometric) where the simulator permanently tilted 5 degrees and fixed as such. The sailors had to grab the sheet and the tiller and hold the hiking position for as long as possible. The test finished when the sailor lost their initial position. This aims to achieve a point of reference for maximum performance.

The second test was performed in a dynamic sailing simulation situation. This involved performing repeated dynamic movements that yachtsmen perform when hiking to failure.

Data Analysis

In order to assess and analyse the data received, the Statistical Package (SPSS 10.0)(SPSS 10.0) was used. Descriptive statistics suggested defining arithmetical average, standard deviation - SD, as well as medaine (Me), maximal (Max) and minimal (Min) indices, Lower and Upper Quartiles, coefficient of variation (Coef.Var.) The data were verified in accordance with the normal probability law (applying the Shapiro-Wilk criteria). If the data allocation complied with the normal probability law, then in order to define the statistical validity of discrepancies, the student criteria were applied. If the data did not comply with the normal probability law, non-parametric criteria of Wilkinson were applied to define the statistical validity of discrepancies. The error probability during the statistical analysis was set at the level of $p=0.05$ (significance level).

Results. Between the group of men, significant differences ($p>0.05$) between men and women are determined by the following indicators: height in women mean $\pm$ SD 164.75 $\pm$ 6.80 and in men mean $\pm$ SD 180.33 $\pm$ 3.72; Weight in women mean $\pm$ SD 58.50 $\pm$ 9.04 and in men mean $\pm$ SD 72.17 $\pm$ 9.66; Abdominal perimeter (cm) in women mean $\pm$ SD 69.25 $\pm$ 5.97 and men mean $\pm$ SD 80.67 $\pm$ 7.61; Tibia length (cm) in women mean $\pm$ SD 41.00 $\pm$ 2.16 and men mean $\pm$ SD 47.50 $\pm$ 4.72; Leg length (cm) in women mean $\pm$ SD 79.50 $\pm$ 5.45 and men mean $\pm$ SD 91.83 $\pm$ 4.31; Foot length (cm) in women 24.25 $\pm$ 1.26 and men 27.00 $\pm$ 1.92. According to anthropometric characteristics, there was a high variation in sitting height in women 21.93 and men 25.31 (Table 1).

Table 1.

Anthropometric characteristics and physical fitness of Ukrainian Sailors in ILCA (former Laser class)

Characteristics	Gen.	Mean	SD	Coef. Var.	Median	Min	Max	Lower Quartile	Upper Quartile
Anthropometric characteristics									
Height (cm)	W	164.75*	6.80	4.13	164.50	159.00	172.00	159.00	170.50
	M	180.33	3.72	2.06	180.50	175.00	186.00	178.00	182.00
Weight (kg)	W	58.50*	9.04	15.45	59.50	48.00	67.00	51.00	66.00
	M	72.17	9.66	13.39	70.50	60.00	85.00	65.00	82.00
Sitting Height (cm)	W	106.75	23.41	21.93	107.50	85.0	127.00	86.50	127.00
	M	106.00	26.83	25.31	93.50	80.00	142.00	89.00	138.00
Abdominal perimeter (cm)	W	69.25*	5.97	8.61	67.00	65.50	78.00	65.5	73.00
	M	80.67	7.61	9.43	80.50	71.00	93.00	75.00	84.00

Thigh Length (cm)	W	45.50	4.20	9.24	45.50	41.00	50.00	42.00	49.00
	M	47.50	3.21	6.76	46.50	45.00	53.00	45.00	49.00
Tibia length (cm)	W	41.00*	2.16	5.27	40.50	39.50	44.00	39.50	42.50
	M	47.50	4.72	9.94	47.00	40.00	53.00	46.00	52.00
Leg length (cm)	W	79.50*	5.45	6.85	81.00	72.00	84.00	75.50	83.50
	M	91.83	4.31	4.69	90.00	88.00	99.00	89.00	95.00
Chest circumference (cm)	W	91.00	11.63	12.78	88.00	81.00	107.00	82.50	99.50
	M	94.50	7.71	8.16	96.00	83.00	102.00	89.00	101.00
Chest circumference at inhalation (cm)	W	95.25	11.09	11.64	92.50	85.00	111.00	88.50	102.00
	M	100.17	7.65	7.64	100.50	88.00	108.00	96.00	108.00
Chest circumference at exhalation (cm)	W	89.00	11.40	12.81	86.50	78.00	105.00	82.00	96.00
	M	90.33	7.00	7.75	89.00	81.00	99.00	86.00	98.00
Foot Length (cm)	W	24.25*	1.26	5.19	24.50	22.50	25.50	23.50	25.00
	M	27.00	1.92	7.12	27.00	24.00	29.00	26.00	29.00
Upperthighperimeter (cm)	W	52.75	6.29	11.93	52.00	47.00	60.00	47.50	58.00
	M	56.33	5.13	9.10	57.50	47.00	62.00	55.00	59.00
Calf Girth (cm)	W	35.50	3.70	10.41	35.00	32.00	40.00	32.50	38.50
	M	37.75	3.06	8.11	38.50	32.00	41.00	37.50	39.00
Knee Girth (cm)	W	36.13	2.53	7.00	36.25	33.00	39.00	34.25	38.00
	M	38.50	2.81	7.30	39.00	34.00	42.00	37.00	40.00
Physical fitness characteristics									
Resting heart rate (RHR)	W	79.75	11.73	14.71	81.50	66.00	90.00	70.00	89.50
	M	70.83	13.70	19.35	76.00	50.00	85.00	58.00	80.00
Heart rate at 5 seconds of isometric hiking (bpm)	W	127.75	10.21	7.99	127.50	118.00	138.00	119.00	136.50
	M	112.83	18.24	16.16	115.00	82.00	139.00	110.00	116.00
Heart rate at 1 minute of isometric hiking (bpm)	W	142.00	22.46	15.82	138.00	123.00	169.00	123.50	160.50
	M	129.67	15.56	12.00	130.50	105.00	152.00	123.00	137.00
Heart rate at failure of isometric hiking (bpm)	W	144.25	28.36	19.66	144.50	112.00	176.00	121.50	167.00
	M	139.50	7.94	5.69	138.00	132.00	151.00	133.00	145.00
Isometric Hiking Times)	W	151.50	36.46	24.06	150.00	120.00	186.00	120.00	183.00
	M	127.00	45.17	35.56	113.50	80.00	185.00	90.00	180.00
Recovery heart rate at 1 minute (bpm)	W	114.00	18.78	16.47	106.00	102.00	142.00	103.50	124.50
	M	106.33	26.27	24.71	100.50	80.00	151.00	85.00	121.00
Recovery time heart rate (s)	W	81.75	7.89	9.65	81.00	75.00	90.00	75.00	88.50
	M	85.00	22.58	26.57	90.00	60.00	120.00	60.00	90.00
Heart rate at 5 seconds of dynamic hiking (bpm)	W	125.75	17.17	13.66	125.00	110.00	143.00	111.00	140.50
	M	118.00	15.40	13.05	120.00	95.00	142.00	110.00	121.00

Heart rate at 1 minute of dynamic hiking (bpm)	W	154.50	13.20	8.55	159.00	136.00	164.00	145.00	164.00
	M	147.33	20.03	13.59	151.00	112.00	173.00	143.00	154.00
Heart rate at failure of dynamic hiking(bpm)	W	161.25*	9.57	5.93	163.50	148.00	170.00	154.50	168.00
	M	150.33	12.16	8.09	149.00	136.00	172.00	143.00	153.00
Time in dynamic hiking (s)	W	155.25*	70.41	45.35	150.00	80.00	241.00	100.00	210.50
	M	112.50	68.25	60.66	97.50	60.00	240.00	60.00	120.00
Recovery heart rate at 1 minute (bpm)	W	126.75*	24.30	19.17	131.50	94.00	150.00	109.00	144.50
	M	102.67	17.75	17.29	104.50	82.00	122.00	85.00	118.00
Recovery time heart rate (s)	W	100.50	17.54	17.45	100.00	82.00	120.00	86.00	115.00
	M	91.00	25.58	28.11	99.00	60.00	115.00	60.00	113.00

Commentary: * - The differences are reliable at $p < 0.05$

When performing the dynamic hiking test, significant differences were found significant differences ($p < 0.05$) in the time of performance (s) between the group of women mean $\pm$ SD 155.25 $\pm$ 70.41 and men mean $\pm$ SD 112.50 $\pm$ 68.25. When performing the test in Isometric hiking ($p > 0.05$) there were no significant differences in the time of performance (s) between the group of women mean $\pm$ SD 151.50 $\pm$ 36.46 and men mean $\pm$ SD 127.00 $\pm$ 45.17. There was a significant difference ($p < 0.05$) in heart rate during the dynamic hiking test for 1 minute in women mean $\pm$ SD 154.5 $\pm$ 13.2 and in men mean $\pm$ SD 147.33 $\pm$ 20.03. Also significantly different ($p < 0.05$) is the heart rate during the dynamic hiking test at the end of the performance in women mean $\pm$ SD 161.25 $\pm$ 9.57 and in men mean $\pm$ SD 150.33 $\pm$ 12.16. High variability of physical fitness indicators by indicators of time of isometric hiking test: coefficient of variation in women 24.06 and men 35.56; and time of dynamic hiking in women 45.35 and men 60.66. What requires additional analysis.

Discussion. One of the decisive moments in a single-handed dinghy race is sailing upwind, as it requires a high physical demand from the sailors to keep the boat flat and make the best decisions according to the tactical conditions of the race (Manzanares et al. 2021, Sánchez-Oliver 2023) The objective of the research is to analyze the performance of sailors on the hiking position in a dynamic virtual sailing situation. The sample consisted of 10 sailors from the ILCA sailing class and belonging to the national team Ukraine, 6 of them men and 4 women. The fatigue protocol consisted of a static test and a dynamic test of the sac body position. Both tests measure the sailors' effort up to extreme fatigue or loss of position. The results obtained show statistically significant differences between the group of women and men on time hiking. This does not lead to the conclusion that the simulator is a valid tool to assess fatigue specifically in ILCA class sailors.

In order to predict racing performance, it is important that the test for measuring hiking performance simulates on-water racing as closely as possible. Other studies (Blackburn 2000; Walls et al. 1998).

The results (Castagna et al. 2007; Sprada et al. 2007) show differences in the sailing test between men and women in 3 sailing variables: total distance sailed, sailing velocity and hiking mean, where the results are greater in the group of men over all three variables. The performance in these three variables is interconnected, as greater hiking means that the boat sails flat, generating less resistance with the water (hydrodynamic) and consequently higher velocity. We also reflected significant differences between men and women.

The purpose of study was to examine the effects of anthropometric characteristics, strength, and endurance on the performance of the sailor on hiking isometric and hiking dynamic. Ten sailors of the ILCA class were evaluated according to age, navigation experience, body weight, size, sitting height, thigh length, tibia length, foot length, abdominal perimeter, and upper thigh perimeter. Despite the significant differences between men and women in Ukrainian sailing, it is necessary to analyze this data in more depth and detail on a larger sample of sailors. And to link it to the distance covered and performance.

Conclusions. Significant differences were found between Ukrainian yachtsmen in the ILCA yacht class between a group of men and women during the dynamic hiking test, heart rate during the dynamic hiking test at 1 minute and at the moment of failure. As well as anthropometric indicators by height, weight, abdominal perimeter, tibia length, leg length, foot length. These indicators can be the basis for developing training programs and improving the physical fitness of sailors in sailing.

Prospects for further research. Necessary implantation of provisions in the process of improving the physical training of qualified athletes in sailing class ILCA (former Laser class)

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