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МИРОВЫЕ НОВОСТИ

Дифференцированный подход при хирургическом лечении тяжелого острого панкреатита с прогнозированием результатов лечения

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Evaluation of clinical and laboratory syndromes in kayak and canoe rowers

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Abstract

Kayaking and canoeing are endurance sports that demand significant physical exertion and resistance to oxidative stress. Athletes involved in these sports are frequently exposed to high physiological loads, which may lead to the development of clinical and laboratory syndromes related to adaptation disorders. This study aims to assess body composition and hemodynamic parameters in kayakers and canoeists to develop preventive measures aimed at avoiding the negative effects of oxidative stress. Objective: To study body composition and hemodynamic parameters in athletes engaged in kayaking and canoeing, aiming to develop a prevention system to avoid adaptation failure. Methods: The study included 24 male athletes aged 14-18 years, systematically engaged in kayaking and canoeing. The control group consisted of 12 physical education students of the same age and gender. Measurements of body mass, fat mass, and muscle mass were taken, along with hemodynamic indicators such as heart rate, blood pressure, and blood circulation volume. Statistical analysis was conducted using SPSS 20. Results: Significant differences were found in body composition between the rowers and the control group. The athletes exhibited significantly higher muscle mass and lower fat mass percentages. Hemodynamic parameters also indicated higher physical endurance among the athletes. Conclusion: The analysis of body composition and hemodynamic parameters demonstrated that athletes engaged in kayaking and canoeing possess higher muscle mass and lower fat content, contributing to their better adaptation to physical loads. Further research should focus on developing more effective methods to prevent oxidative stress in athletes.

Keywords: kayaking, body composition, hemodynamics, oxidative stress, physical endurance.

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Оценка клинических и лабораторных синдромов у гребцов на байдарках и каноэ

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Аннотация. Гребля на байдарках и каноэ является силовым видом спорта, требующим значительных физических нагрузок и устойчивости к оксидативному стрессу. Спортсмены, занимающиеся данным видом спорта, часто подвергаются высоким физиологическим нагрузкам, что может приводить к развитию клинических и лабораторных синдромов, связанных с нарушениями адаптации. Настоящее исследование направлено на оценку параметров телосложения и гемодинамики у гребцов на байдарках и каноэ для разработки превентивных мер, направленных на предотвращение негативных последствий оксидативного стресса. Цель исследования: Изучить состав тела и гемодинамические параметры у спортсменов, занимающихся греблей на байдарках и каноэ, с целью разработки системы профилактики, направленной на предотвращение нарушения адаптации. Методы исследования: В исследовании приняли участие 24 спортсмена мужского пола в возрасте от 14 до 18 лет, систематически занимающиеся греблей на байдарках и каноэ. Контрольная группа включала 12 студентов факультета физического воспитания, соответствующих по полу и возрасту. Были проведены замеры массы тела, массы жировой и мышечной тканей, а также гемодинамические показатели, включая частоту сердечных сокращений, артериальное давление и объём кровообращения. Статистическая обработка данных осуществлялась с использованием программы SPSS 20. Результаты: Полученные данные показали значительные различия в составе тела между гребцами и контрольной группой. У спортсменов наблюдалась значительно большая мышечная масса и меньший процент жировой ткани. Гемодинамические показатели у спортсменов также отличались в сторону более высокой физической выносливости. Заключение: Анализ состава тела и гемодинамических параметров показал, что спортсмены, занимающиеся греблей на байдарках и каноэ, обладают более высокой мышечной массой и меньшим содержанием жировой ткани, что способствует их лучшей адаптации к физическим нагрузкам. Дальнейшие исследования должны быть направлены на разработку более эффективных методов профилактики оксидативного стресса у спортсменов.

Ключевые слова: гребля на байдарках, состав тела, гемодинамика, оксидативный стресс, физическая выносливость.

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Introduction.

Canoeing is classified as an endurance sport that necessitates specialized strength training to meet the demands of the sport. As highlighted by Kornilov Y.P. (2014), the strength abilities of canoe rowers are manifested through muscular efforts, which result in the forces acting within the system of the rower, oar, and boat (including the seat, footrest, and oar). These forces exhibit specific characteristics, including dynamic and static muscle forces. Dynamic forces are essential for producing maximum pulling force on the oar, while static forces help maintain the rower's working posture. Furthermore, the speed and strength abilities determine the maximum rate of rowing and the intensity of force application on the oar during each rowing stroke, which directly affects the rower's performance. Power endurance, both static and dynamic, plays a critical role in maintaining the application of forces on the oar, thereby ensuring the rower sustains a rational working posture for prolonged periods.

Morphofunctional prerequisites, including muscle composition, anthropometric characteristics, energy capacity, and muscle group topography, significantly influence a rower's strength abilities. Rowers need to optimize these traits to achieve peak performance. Maintaining high sports results also necessitates developing effective preventive strategies to protect the functional reserves of the athlete's body. Regular medical examinations are conducted to detect early signs of occupational pathology based on in-depth medical evaluations. However, a limitation of this approach is that therapeutic and rehabilitation measures may require adjustments to the training process. Such adjustments can hinder athletes from reaching their planned fitness level within the expected timeframe.

A more effective approach involves identifying early stages of adaptation failure to physical and psycho-emotional stress before clinical symptoms manifest. Early identification allows preventive interventions to be implemented at the pre-disease stage. Developing universal criteria to assess various aspects of adaptation, organ and system function, and prevent adaptation breakdowns is essential for athletes. This is particularly relevant in sports like rowing, which imposes high physical demands.

Fiskalov V.D. (2010) emphasized that the development of rowing as a sport is closely tied to the study of athletes' anthropometric and morphological data. Accurate measurements can only be achieved through strict adherence to standardized requirements and the use of specialized tools (Mikhailina T.M., 2004). Inaccurate anthropometric measurements, due to non-compliance with standardization guidelines, yield inconsistent results. Platonov V.N. (2013) further highlighted the significance of anthropometric indicators such as height, weight, and other body dimensions in determining rowers' technical abilities. These characteristics influence the amplitude and speed of the rowing cycle, which are critical for efficient rowing technique. Moreover, the body composition, muscle mass, and skeletal muscle fiber composition of rowers significantly impact their potential to develop and maintain the strength and endurance required for competition.

The present study aimed to investigate the body composition and hemodynamic parameters of athletes involved in canoeing. The goal was to develop a preventive system to address oxidative stress, a known contributor to adaptation failure in sports. Oxidative stress results from the imbalance between the production of reactive oxygen species and the body's ability to neutralize them. In high-intensity sports such as canoeing, excessive oxidative stress can lead to muscle fatigue, decreased performance, and even long-term damage to tissues and organs.

By assessing body composition and hemodynamic parameters, this study seeks to provide insights into the physiological demands of canoeing and the strategies needed to mitigate the negative impacts of oxidative stress. Specifically, the research focuses on the relationship between muscle mass, fat composition, and endurance, as well as the cardiovascular adaptations required to sustain long periods of physical exertion in canoeing. Findings from this study can inform training protocols and preventive measures that enhance rowers' ability to adapt to physical demands, reduce injury risk, and improve overall performance.

Material and methods of research.

The study was conducted between February and March 2024, focusing on 24 male athletes aged 14 to 18 years, all of whom systematically engaged in canoeing and held sports categories ranging from I to III adult. The control group consisted of 12 male students from the Faculty of Physical Education, matched in age and gender to the main group. The study took place during national team training camps at a water stadium.

All participants underwent the PWC 170 test, a cycling ergometer test designed to assess aerobic power and endurance. The test involved two five-minute workloads on the Monark Ergomedic 828 E bicycle ergometer. The first workload was set at 50 watts, followed by a three-minute rest. The second workload's power was calculated using the PWC 170 formula. Data was collected at three intervals: before exercise, after the first load, and at the end of the second load.

The study recorded significant indicators that reflect functional fitness and training efficiency according to Baevsky R.M. These included oxygen saturation of hemoglobin (SpO2), systolic and diastolic arterial pressure (CAD and DAD), respiratory rate (HR), heart rate (HR), stroke volume (EF), and minute blood volume (MOC). In terms of height-weight parameters, the two groups were similar. Additionally, data on fat mass (in % and kg), muscle mass (kg), and weight-bearing indices were recorded for each participant. The results were statistically analyzed using SPSS 20, with appropriate tests (such as t-test and Mann-Whitney U) applied to assess normality and determine statistical significance between samples.

Results of the study and their discussion.

The physical characteristics and body composition of athletes play a crucial role in determining performance in various sports, including rowing. In sports such as rowing, which demands both strength and endurance, the anthropometric and morphological features of athletes directly influence their performance outcomes. Academic rowers, in particular, exhibit physical attributes that allow them to excel in both technique and endurance, which are key components of competitive success in this sport. Rowers often possess specific body compositions, characterized by greater muscle mass and reduced fat mass, allowing them to efficiently generate the power necessary for sustained physical effort.

One of the key determinants of rowing success is height. Taller athletes generally have a mechanical advantage due to their longer limbs, which allow for a more extensive range of motion during each stroke. This increased stroke length translates into greater propulsion per stroke, giving taller rowers an edge in races. According to research, the average height of competitive rowers ranges between 186 and 193 cm. These athletes also possess higher body mass, with values typically ranging from 83 to 91 kg. This elevated body mass is primarily attributed to increased muscle mass rather than fat mass, a characteristic that enhances their ability to produce the force necessary for rowing.

Comparative studies analyzing body composition parameters of canoe rowers against non-athletes have consistently demonstrated significant differences in muscle mass and total body weight. Canoe rowers generally possess a lean body composition, characterized by higher muscle mass and lower fat percentages compared to non-athletes. This optimal body composition supports not only rowing technique but also the physical endurance required for long-duration muscular effort. These findings align with research indicating that rowers tend to develop larger muscle fibers, particularly in the lower limbs and back, which are essential for generating power during each rowing stroke.

Anthropometric data, such as height, body mass, and muscle distribution, have been shown to correlate strongly with rowing performance. Athletes who exhibit the ideal combination of these factors are better equipped to handle the physical demands of competitive rowing, particularly in long-distance races. The importance of anthropometry in rowing is further supported by studies examining the body composition of high-level rowers, including those holding the titles of Master of Sports or Candidate Master of Sports. These athletes consistently exhibit superior body compositions compared to non-athletes, highlighting the role of physical development in achieving sporting success.

Body composition analysis in canoe rowers has revealed marked differences when compared to non-athletic individuals. For instance, rowers display significantly higher muscle mass and lower fat mass percentages, contributing to enhanced endurance and strength capabilities. These differences are particularly important for maintaining the physical intensity required for competitive rowing over extended periods. Additionally, elite rowers often show a higher proportion of fast-twitch muscle fibers, which support the explosive power needed during the acceleration phase of rowing. Fast-twitch fibers are essential for generating the high levels of force required for propelling

Indicators	Rowers on canoes and rowers canoeists n= 24	Control group n=12
Height, cm	189.43 ± 14.08	179.21 ±12.84
Weight, kg	87.81 ± 2.29*	77.69 ± 1.12
Fat mass, kg	12.48 ± 0.48*	16.23 ± 0.34
Muscle mass, kg	45.94 ± 1.57*	39.58 ± 0.22
Bone mass, kg	12.73 ± 0.78	11.23 ± 0.47
Fat-free mass, kg	70.24 ± 2.48*	60.87 ± 2.45

Table 1

Body composition indices in canoe paddlers

Note: * - significance of differences P < 0.05 relative to the comparison group

the boat, especially during the start of a race or in moments of increased effort, such as overtaking opponents.

Rowers' ability to maintain a high level of muscular endurance is another key factor contributing to their performance. Endurance in rowing is not solely reliant on cardiovascular fitness but also on the muscle's ability to sustain force over prolonged periods. Rowers with greater muscle mass, particularly in the legs and back, are better able to maintain consistent power output throughout a race. Furthermore, the development of muscle endurance is crucial for minimizing fatigue and sustaining technique, both of which are vital for achieving optimal race performance.

The study of body composition and physical characteristics in athletes engaged in rowing sports provides valuable insights into the factors that contribute to athletic success. Height, body mass, muscle distribution, and fat percentage are all critical determinants of performance in rowing. Athletes who possess these attributes are more likely to excel in competitive settings, where the demands of strength, endurance, and technique are at their peak.

In conclusion, the physical characteristics and body composition of rowers significantly influence their ability to perform at a high level. Height, body mass, and muscle composition are key factors that determine rowing efficiency, endurance, and overall performance. Comparative studies of rowers and non-athletes underscore the importance of physical training and development in enhancing these characteristics. Understanding the relationship between body composition and rowing performance can guide training protocols, ensuring that athletes are prepared to meet the physical demands of the sport.

This study highlights the importance of body composition and physical characteristics in determining athletic success in canoeing and rowing, and future research should continue to explore the role of these factors in optimizing performance outcomes.

Anthropometric, height, weight and other dimensional parameters of rowers-academics have mainly biomechanical significance. They predetermine the technical capabilities of rowers, namely, the amplitude and speed characteristics of the rowing cycle, which are associated with the mechanisms of oar stop formation and determine the effective rowing technique (E. Yu. Ivannikov, 2006). As our research has shown (tabl1), rowers-academics on average surpass their peers in a number of anthropometric characteristics - in terms of height - by 4.4% and weight - by 7.3%. At the same time, there were significant differences in body composition indicators and, in particular, in the value of muscle, fat and fat-free masses. The analysis of body composition showed statistically significant differences between rowers and the group of non-athletes in weight and muscle mass. Weight increase in the studied rowers was due to the development of the muscle component, while fat mass remained almost within normal values. It is known that body composition, muscle mass and the composition of skeletal muscle fibres determine the potential for developing the strength and special endurance required by a rower and maintaining it at the appropriate level over a standard distance (A. F. Sinyakov, 1985). In our studies, the greatest differences between athletes and non-athletes were found in absolute and relative (in relation to body weight) indicators of fat and muscle mass. No significant differences between the groups were found in bone mass. Significant, reliable differences were observed in the indicator of lean mass - by 13.%. Thus, rowers-academics have a number of significant, distinctive characteristics of physique and body composition, which can be used as criteria for selection for rowing, these are length and body weight, values of muscle, fat and fat-free mass in relative form (in relation to body weight). All obtained parameters of body composition in canoe rowers, allows to visually assess both individual characteristics of an athlete and the degree of approximation to the standard of a group of athletes. Moreover, systematic measurements (with annual or semi-annual intervals) allow to determine trends in the evaluation of this or that parameter in the dynamics of development and improvement of the athlete. It should be noted that the lowest values of efficiency were shown by the criterion of fat mass, which means that the specific weight of fat in the body composition is not taken into account and is not controlled during the training of rowers-academics, although its reduction would have a tangible effect - would lead to an increase in the proportion of muscle mass. Thus, in our opinion, when organising the selection of young men for rowing it is advisable to use as selection criteria not only height and weight (as it happens in practice at present), but also indicators of muscle and fat body mass in relative form (as a percentage of body weight). This will improve selection performance and avoid errors at the initial selection stage. At the next stage of research, we studied the peculiarities of blood circulation in rowing and non-rowing athletes. In the course of the study it was found that there were no big differences between the studied groups in terms of cardiovascular system parameters (Table 2). In addition to the chronotropic function of the heart, lower HR values were observed in canoeists compared to the control group. At the same time, a similar situation is observed according to the data obtained at different stages on such parameters as Sp02 (blood haemoglobin oxygen saturation), HR (pulse rate), CAD, DAD (systolic and diastolic blood pressure), HRreo (respiratory rate), HR (heart rate), EF (stroke volume), IOC (minute blood volume).

Indicators	Stages of research.	Canoe racers n=26	Control group n=12
Sp02 (blood hemoglobin oxygen saturation)	1	49.87 ± 3.64	54.12 ± 6.03
	2	58.05 ± 6.02	63.48 ± 7.12
	3	87.02 ± 7.48	76.35 ± 7.13
SBP (systolic blood pressure)	1	114.13 ± 9.56	116.22 ±9.67
	2	123.14 ± 11.05	128.35 ± 11.67
	3	134.12 ± 11.43	139.89 ± 12.64
DBP (diastolic blood pressure)	1	68.89 ± 6.59	71.45 ± 6.67
	2	70.83 ±6.58	76.18 ± 6.74
	3	72.67 ±5.88	79.13 ± 6.54
Respiratory rate (breathing frequency) cycle/min	1	16.34 ±1.54	18.67 ±2.13
	2	20.17 ±2.05	22.47 ± 2.65
	3	22.13 ± 2.67	24.58 ± 2.73
HR (heart rate), (bpm)	1	63.45 ± 16.34	71.03 ± 8.42
	2	90.87 ± 8.74	102.54 ± 10.73
	3	124.15 ± 11.89	136.13 ± 12.17
SV (stroke volume) (ml)	1	80.54 ± 7.58	76.89 ± 7.02
	2	84.69 ± 8.01	72.87 ± 6.48
	3	72.58 ± 7.04	62.59 ± 5.78
IOC (minute blood volume), (ml)	1	6.82 ±1.04	7.34 ± 1.78
	2	8.63 ± 1.45	7.69 ±1.54
	3	9.78 ±1.19	8.24 ± 1.78

Table 2

Indicators of central hemodynamics in athletes involved in kayaking and canoeing

Note: * - significance of differences P < 0.05 relative to the comparison group.

Despite the similarity of cardiovascular system in the studied subjects, we found that physical performance was higher in the group of athletes. It can be stated that at this age, when there is still growth and formation of various systems of the organism, physical load does not bring significant changes in cardiovascular system parameters. Improvement of performance apparently occurs through other mechanisms, in particular due to more adequate functioning of the musculoskeletal apparatus, which having the same demands in blood circulation can provide higher performance. All this was expressed in the fact that the PWC -170 index was better in the group of rowing athletes (Fig.2) both in absolute and relative values. At the same time, higher values of stroke volume were achieved at the moment of loading, indicating greater efficiency of inotropic function of the heart. Of course, such calculation is based on indirect methodology and significant inaccuracies are possible, but according to the rheography parameters (Table 1.), which were recorded between stages (at rest), there was a tendency to higher values of EF in athletes with the same values of HR. We found that systematic canoeing in adolescents does not affect the resting cardiovascular system. At the same time, the maximum EE during physical exercise PWC-170 in canoeists was higher, which indicates a greater inotropic reserve of the cardiovascular system. Physical performance recorded by means of PWC-170 test was better in the group of athletes, which, apparently, indicates more rational functioning of the musculoskeletal system, which, with practically similar parameters of the cardiovascular system between the groups, can provide higher performance.

Conclusions.

Physical characteristics and body composition are critical determinants of rowing performance. Athletes involved in rowing typically exhibit high body mass and height, which offer a mechanical advantage during the rowing stroke. Their greater muscle mass and lower fat percentage contribute to efficient technique execution and enhanced endurance capacity, both of which are essential for long-distance rowing competitions.

Muscle mass and anthropometric measurements strongly correlate with athletic success. Rowers with higher muscle mass, particularly in the lower limbs and back, are able to generate greater power per stroke, which improves their rowing technique and allows them to sustain the necessary physical intensity throughout races. These findings underscore the importance of muscle development in maximizing performance.

Comparison with non-athletes reveals significant differences in body composition. Rowers possess considerably higher muscle mass and lower fat mass percentages

compared to non-athletic individuals, highlighting the physical adaptations that enable athletes to maintain high levels of physical activity and efficiently manage endurance demands in rowing.

Endurance training and power endurance are vital for rowers' physical preparation. The combination of optimal muscle mass and high physical endurance enables rowers to sustain performance over long periods, essential for the prolonged physical demands encountered in rowing competitions.

Future research should focus on developing enhanced training strategies that optimize body composition and improve adaptation to the physical stresses of rowing, particularly with regard to mitigating the effects of oxidative stress. Understanding how to optimize muscle mass and endurance through targeted training will be crucial for improving performance and preventing adaptation failure in athletes.

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