

SOME PROBLEMATIC ISSUES IN VALIDATING RESEARCH IN SPORTS MEDICINE**ДЕЯКІ ПРОБЛЕМНІ ПИТАННЯ ВАЛІДИЗАЦІЇ ДОСЛІДЖЕНЬ В СПОРТИВНІЙ МЕДИЦИНІ****Mykhaliuk Yevhen***Zaporizhzhia State Medical and Pharmaceutical University, Zaporizhzhia, Ukraine*

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Abstracts

Introduction. Sports medicine plays a crucial role in preserving athletes' health and achieving high athletic performance, which necessitates increased requirements for scientific and methodological support of the training process and recovery. However, terminological ambiguity and methodological problems persist in domestic sports medicine, particularly insufficient consideration of the characteristics of the studied cohort, which complicates the interpretation of results and may lead to erroneous conclusions.

The aim of the study to identify and analyze terminological and methodological inconsistencies in domestic scientific publications on sports medicine in order to standardize research and improve the comparability of their results.

Material and methods. Based on the search and analysis of scientific publications on sports medicine in domestic and foreign peer-reviewed journals, as well as in specialized scientific and sports medical literature from 1966 to 2025, a critical analysis was conducted on problematic issues related to the use of certain specific terms in sports medicine, research on Masters category athletes, and the assessment of morphometric parameters. The search and analysis involved the use of concepts such as «trained» or «untrained», «successful» or «unsuccessful» athletes; the concept of «sprinter»; randomization of research among veteran athletes; and the use of morphometric parameters.

Results. Systemic terminological inconsistencies were identified in domestic sports medicine publications. Incorrect use of the term «untrained individuals» for persons who do not engage in sports was established; the appropriateness of applying this term exclusively to athletes in a state of detraining was substantiated, while for control groups the term «individuals who do not engage in sports» is recommended. The dichotomous classification of athletes as «successful» or «unsuccessful» was recognized as methodologically insufficient, as it does not account for the multifactorial nature of athletic performance and requires evaluation of competitive indicators over training periods. The definition of an «elite» athlete is characterized by the absence of internationally standardized criteria, which complicates the comparison of research results. In studies of veteran athletes, the necessity of correct formation of comparison groups taking into account sport, sex, sports qualification, distance, and weight category was emphasized. The absence of a unified definition of «sprinter» was established; comparisons between sprinters from different sports require consideration of competition duration and dominant metabolic systems. Significant limitations of traditional anthropometric indices (Quetelet, Pignet) for assessing physical development of athletes were identified due to their inability to account for sport-specific body composition and high muscle mass.

Conclusions. The work emphasizes attention to and indicates directions for resolving certain problematic issues regarding the use of terminology, conceptual framework, and organization of research in sports medicine.

Keywords: sports medicine, terminology and conceptual framework, research organization, trained athletes, morphometric assessment

Вступ. Спортивна медицина відіграє важливу роль у збереженні здоров'я спортсменів і досягненні високих спортивних результатів, що зумовлює підвищені вимоги до науково-методичного забезпечення тренувального процесу та відновлення. Водночас у вітчизняній спортивній медицині зберігається термінологічна невизначеність і методологічні проблеми, зокрема недостатнє врахування характеристик досліджуваного контингенту, що ускладнює інтерпретацію результатів і може призводити до хибних висновків.

Мета – виявлення та аналіз термінологічних і методологічних невідповідностей у вітчизняних наукових публікаціях зі спортивної медицини для стандартизації досліджень та підвищення порівнянності їх результатів.

Матеріал і методи. За даними пошуку та аналізу наукових публікацій зі спортивної медицини у вітчизняних та закордонних рецензованих журналах, а також у спеціальній, науковій та спортивно-медичній літературі за період з 1966 до 2025 років проведено критичний аналіз проблемних питань, пов'язаних з використанням деяких специфічних термінів в спортивній медицині, дослідженнями спортсменів категорії Masters, а також з оцінкою морфометричних параметрів. Пошук та аналіз передбачав використання понять «треновані» або «нетреновані», «успішні» або



«неуспішні» спортсмени; поняття «спринтер»; рандомізацію досліджень серед спортсменів-ветеранів; використання морфометричних параметрів.

Результати. Виявлено системні термінологічні невідповідності у вітчизняних публікаціях зі спортивної медицини. Встановлено некоректне використання терміна «нетреновані особи» для осіб, які не займаються спортом; обґрунтовано доцільність застосування цього терміна виключно до спортсменів у стані розренованості, натомість для контрольних груп рекомендовано термін «особи, які не займаються спортом». Дихотомічна класифікація спортсменів як «успішних» чи «неуспішних» визнана методологічно недостатньою, оскільки не враховує багатофакторність спортивної результативності та потребує оцінювання змагальних показників протягом тренувальних періодів. Визначення «елітного» спортсмена характеризується відсутністю міжнародно стандартизованих критеріїв, що ускладнює порівняння результатів досліджень. У дослідженнях спортсменів-ветеранів підкреслено необхідність коректного формування груп порівняння з урахуванням виду спорту, статі, кваліфікації, дистанції та вагової категорії. Встановлено відсутність уніфікованого визначення «спринтера»; порівняння між спринтерами різних видів спорту вимагають врахування тривалості змагання та домінуючих метаболічних систем. Виявлено суттєві обмеження традиційних антропометричних індексів (Кетле, Пін'є) для оцінки фізичного розвитку спортсменів через їхню неспроможність враховувати специфічний для виду спорту склад тіла та високу м'язову масу.

Висновки. У роботі акцентовано увагу та вказані напрямки вирішення деяких проблемних питань з використання термінології, понятійного апарату та організації досліджень у спортивній медицині.

Ключові слова: спортивна медицина, термінологія та понятійний апарат, організація досліджень, тренування спортсменів, морфометрична оцінка.

Introduction. Sports medicine, as a scientific and practical field, plays a vital role in ensuring health, improving performance, and achieving high athletic results. With the constant development of elite sports, there is an increasing need to improve the scientific and methodological support of the training process, prevent injuries and diseases, and develop effective methods for athletes' recovery [12].

One of the key aspects of the development of sports medicine is clear and consistent terminology. Currently, there is some terminological uncertainty in Ukrainian sports medicine, which can lead to misunderstandings and complicate the interpretation of the results of scientific research. In particular, this applies to the use of terms such as «trained» and «untrained» individuals, «successful» and «unsuccessful» athletes [6, 10, 11, 17, 18, 20]. Another problematic area concerns defining criteria for «eliteness» in sports [15, 27, 28, 29].

In addition, an important issue is the methodology of conducting scientific research in sports medicine. The characteristics of the contingent being studied are not always taken into account, which can lead to incorrect conclusions. In particular, this applies to comparing indicators in athletes who develop different physical qualities, as well as in athletes with individuals who do not participate in sports [2, 7, 14, 19].

In recent years, research among Masters athletes has become increasingly relevant, allowing to study the long-term effects of physical activity on the body and assess the impact of lifestyle on health and athletic achievements. However, such studies also require a clear methodological approach and consideration of the specifics of the contingent [12, 30].

Therefore, this review analyzes current sports medicine issues related to terminology, research methodology, and athlete physical development assessment. The objectives are:

- Analyze and critically evaluate the existing terminology in sports medicine, in particular the concepts of «trained» and «untrained» individuals, «successful» and «unsuccessful» athletes, as well as the criteria for determining «elite» athletes.

- Develop recommendations for the formation of comparison groups in studies involving athletes and veteran athletes.

- Differentiate the concept of «sprinter» in different sports and analyze the physiological characteristics of sprinters.

- Critically evaluate the application of anthropometric indices for assessing the physical development of athletes.

The results of this review may be useful for sports physicians, coaches, scientists, and other specialists working in the field of sports and physical rehabilitation.

Material and Methods. This review is based on an analysis of scientific literature addressing current issues in sports medicine, including terminology, research methodology, and assessment of athletes' physical development. A systematic literature search was conducted in the electronic databases PubMed, Scopus, and Web of Science, as well as in peer-reviewed sport science and medical journals from Ukraine and internationally. The following keywords were used: «sports medicine», «terminology», «classification of athletes», «trainability», «anthropometric indices», «Masters athletes», «sprint», and «physical development», with searches conducted in both English and Ukrainian to ensure comprehensive identification of relevant sources.

The review included scientific articles published in peer-reviewed journals, review articles, systematic reviews, conference proceedings, as well as textbooks on sports medicine, given their foundational role in establishing core concepts in the field. We excluded articles unrelated to the review topic, non-scientific publications (e.g., popular media articles), and sources for which full text was unavailable.

The literature analysis covered the period from 1966 to 2024. Earlier sources, particularly textbooks, were included to trace the evolution of terminology and methodological approaches in sports medicine. However, priority was given to contemporary research published within the last 10-15 years, which best reflects the current state of knowledge in the field.

Analytical approaches included critical analysis and synthesis of information from various sources, comparison of

different perspectives on the topics examined, and identification of knowledge gaps and contradictions in the literature. Based on this analysis, we formulated the conclusions and recommendations presented in this review.

Research results. The development of Ukrainian sports medicine faces ongoing challenges, necessitating significant improvements, particularly in the realm of terminology. Existing inconsistencies in the use of terms related to pedagogical, medical, and sports concepts within Ukrainian scientific literature create ambiguity that often complicates the interpretation and analysis of research findings. For example, in the early days of medical monitoring of individuals engaged in physical education and sports (as sports medicine was called until the early 1970s), physicians and scientists conducted examinations of physical education enthusiasts and athletes, comparing the results of athletes «in general», often without considering specialization, and drawing conclusions regarding admission or non-admission to physical education or sports activities. Comparisons were made between data obtained from representatives of different sports and sex with individuals who did not participate in sports, whom some authors subsequently referred to as «untrained individuals» [12].

In the study of P.O. Radzievskiy et al., 28 highly qualified athletes and 28 non-athletes were compared. The study found that in athletes at rest, the rate of oxygen transport in the body and its consumption by tissues are more efficiently synchronized compared to untrained individuals. This manifests as more economical oxygen delivery function, reduced ventilatory and hemodynamic equivalents, higher oxygen effects of the respiratory and cardiac cycles, and a greater proportion of alveolar ventilation in tidal volume [14].

The textbook «Sports Medicine» also uses the term «untrained individuals», whose indicators are contrasted with data obtained from athletes when determining the functional state of the main body systems using functional tests, with better results among the latter [18].

A.A. Chernozub investigated the issue of determining safe and critical levels of physical exertion for trained and untrained individuals under conditions of muscle activity with a strength orientation, using two samples of young men aged 20-21 years. The first sample consisted of 40 individuals who had been engaged in strength fitness for the past 3 years and had a sufficient level of adaptation to training loads in a mode of average intensity and large volume of work, and the second consisted of 40 healthy untrained individuals. The study found advantages in bodybuilders [20].

In the study by O.V. Ivashchenko and S.V. Biletskyi, the motor and functional preparedness of male students in grades 9-11 was investigated. Statistically significant differences were observed in the functional preparedness of the respiratory and cardiovascular systems, as well as in coordination and strength preparedness. Accordingly, based on functional preparedness, the young men are assessed as healthy untrained [6].

A comparison of 40 untrained men aged 18-20 years and 20 trained young men who had been involved in strength fitness for three years showed that the presence of a long-term adaptation process to physical exertion, according to heart rate variability data, indicates a long-term adaptation

process to physical exertion in trained individuals, which leads to economization of the functioning of the cardiovascular system due to an increase in the level of resistance to strength loads during strength fitness training [11].

O.V. Kolosova investigated the relationship between changes in the H-reflex of the human soleus muscle induced by fatigue and the level of adaptation to physical exertion in 21 individuals, including 11 untrained individuals and 10 athletes (candidates for Master of Sport in athletics) aged 18 to 34 years. It was established that in qualified athletes compared to the group of untrained individuals, the first and second phases of inhibition of the H-reflex are less pronounced, which indicates faster utilization of metabolites and a high level of adaptation to physical exertion [7].

In a study by A.V. Simonik, 126 healthy female and male students aged 18-20 years with different forms of adaptation to physical exertion (untrained and trained) were examined. The control group consisted of 34 females and 29 males with a physical activity regime in the form of physical education classes at a higher education institution twice per week. The main group consisted of 32 females and 31 males who had 8-10 years of experience in team sports and significantly higher indicators of physical work capacity, aerobic and anaerobic power and capacity compared to untrained peers. They also showed improved indicators of the cardiovascular system, in particular higher blood flow volumes and ejection fraction, and lower total peripheral vascular resistance. The external respiration system in trained individuals is characterized by better functional indicators, particularly increased maximum ventilation of the lungs and reserve volumes of inspiration and expiration. They demonstrate more active metabolism, which is confirmed by increased content of oxidative stress markers, products of adenine and guanine nucleotide metabolism, a higher rate of generation of reactive oxygen species, greater activity of constitutive NO-synthase, lower activity of inducible NO-synthase (in males), and an elevated level of lipid peroxidation markers [17].

In the study of N.V. Bohdanovska et al., 31 untrained female students (control group) and 32 trained female athletes (volleyball players with more than 10 years of experience) aged 18 to 22 years participated. The authors determined that almost all of the studied indicators of the energy supply system, cardiovascular and respiratory systems, the intensity of oxidative metabolism, and nitric oxide production were statistically significantly different between untrained and trained female students, except for inducible NO-synthase, H-reductase, and arginase [2].

In the study by S.S. Malyuga et al., 34 practically healthy young men were examined and divided into 3 groups: 11 young bodybuilders, 11 individuals who engage in fitness, and 12 untrained individuals. It was determined that young bodybuilders have better conditioning and adaptation of the cardiovascular system than individuals engaged in fitness and untrained individuals. Their circulatory system demonstrates a response to a mixed exercise mode similar to dynamic loading, while in fitness athletes the response is similar to static loading. The reaction of the circulatory system reflects the least trained type of load, and the performance of the heart and blood vessels in bodybuilders is higher than in untrained individuals and fitness athletes [10].

M.M. Filippov et al. conducted an analysis of the relationship between the nature of physical exertion and internal changes in the body, which is based on an analysis of O₂ mass transfer modes and an assessment of their economy and efficiency. The authors examined 56 individuals, including untrained men, cyclists, and track and field athletes of high sports qualification. A comparison of the parameters studied in untrained men with those in athletes showed that the former had the lowest values of maximum oxygen consumption and maximum volumetric rate of O₂ entry into the lungs, but a larger maximum systolic volume, greater economy of circulatory function relative to ensuring oxygen consumption of the body, and oxygen consumption for each heartbeat. The data obtained indicate significant advantages in the functional capabilities of the athlete's body [19].

We encountered a scientific work in which the author compares data from high-level representatives of sports aerobics (Candidates for Master of Sport (CMS), Masters of Sport (MS), Masters of Sport of International Class (MSIC)) who train for 18 or more hours per week for several years, with students who engage in physical education within the scope of the curriculum for 2 hours per week, and thus draws conclusions about the impact of physical exertion on the functional state of athletes, noting their advantage. In addition, there are reports in which data obtained from representatives of gymnastics are compared with representatives of team sports, martial artists with representatives of weightlifting, representatives of sports aerobics with 800-meter runners, etc. In the latter case, the author compares data from athletes who perform sports aerobics exercises, which cause deep functional shifts in the athlete's body and are accompanied by arrhythmic breathing, with 800-meter running, which is an example of extreme physical activity in the zone of mixed (aerobic-anaerobic) energy supply. However, in our opinion, it is not entirely appropriate to compare data from athletes of acyclic and cyclic sports only by the duration of the competitive movement, which, depending on qualification, is approximately 2 minutes [12].

As can be seen from the presented works, the authors compared the indicators of the functional state of athletes with individuals from the control group, whom they call untrained, and obtained significantly better indicators. But it is already clear that these comparisons have a predetermined result – that is, the parameters obtained from athletes whose motor regime and high physical and mental loads reliably differ from individuals who lead a normal lifestyle will indicate economization of physiological functions in athletes and their high functional state [12].

By selecting individuals who do not participate in sports as control groups, considering them as a relatively healthy contingent and accepting them as «the norm», you inadvertently agree that high-class athletes should be considered «supernormal» – that is, leaders of humanity who have made a breakthrough into the future. After all, covering a distance of 100 meters in running in 9,58 seconds, jumping in height to 245 cm, or pushing a barbell weighing about 270 kg is fantasy for the average person. Therefore, this contributes to the introduction of the concept of «sports norm» with all specific indicators that may differ from average statistical indicators. This, in our opinion, once again

demonstrates the lack of logic when comparing data obtained from athletes with data from individuals who do not participate in sports.

In this regard, we agree that the difference between sports medicine and other medical specialties is that in sports, the «norm» of functioning of the human body is the specific sports activity of the athlete, in contrast to «ordinary medicine», in which the norm is the ordinary existence of a person. Thus, comparing indicators in athletes who develop various physical qualities in the training process, as well as comparing athletes with individuals who do not participate in sports, seems incorrect to us [12].

In addition to the term «untrained individuals», there are also degrees of this state, such as «less trained», «not sufficiently trained individuals», «insufficiently trained individuals», «poorly trained individuals», «more trained», and «well-trained». Unfortunately, such a variety of names for this state is characteristic not only of scientific articles but also of textbooks [1, 3, 8, 9, 16]. This type of formulation is currently surprising, as sports terminology is ignored when the authors forget that only athletes can be trained or untrained. For us, the concept of trained athletes implies the state of an athlete who is in good athletic form (most often in the competitive period), and untrained implies the state of an athlete at the beginning of the preparatory period or after a forced period of rest associated with injuries or illnesses, but not those who do not participate in sports. Therefore, we consider it appropriate to choose the term «individuals who do not participate in sports» instead of the term «untrained». By the way, this is confirmed by the definition of well-known experts in the pedagogy of high-performance sports, which states that «training is the state of the body that determines the level of physical fitness of an athlete, which is the result of training». In more detail, this is a state that develops as a result of systematic training, which determines the possibility of the most effective performance of specific muscle activity and readiness to achieve a sports result. Furthermore, training is a complex multifactorial concept that includes the level of technical, tactical, physical, psychological, and functional preparedness of an athlete in aggregate and determines the level of his general and special sports work capacity and readiness to achieve the highest sports result.

Therefore, training is the prerogative of the coach, who must be able to compare and integrate data on all its components. Sports specialists of various profiles help the coach in this task, and the task of the physician is to determine one of the most important components of training – the functional state of the athlete and the level of his functional preparedness. As follows from these definitions, the question is about athletes and has nothing in common with individuals who do not participate in sports.

Furthermore, moving beyond these considerations, the use of terms like «successful» and «unsuccessful» also introduces subjectivity in how training is judged. The criteria employed to define these states, and who is responsible for their evaluation – coach, athlete, physician, or scientist – are often inconsistent. To properly discuss the degree of training, one must consider the athlete's competitive performance, which is easily measured in individual sports by metrics like meters, centimeters, seconds, minutes, and kilograms. This, however, poses challenges in team sports: if a team wins, yet

certain players do not perform optimally, how should their training level be assessed: as less trained, or simply untrained?

Thus, taking into account that the degree of training belongs to the coach, the sports physician in his research must, in addition to the data obtained by him in laboratory conditions, closely communicate with the coach of this athlete or team.

After the proposed distribution of sports, in which all sports were considered from the perspective of the training process aimed at the development of certain physical qualities, and the physiological patterns of the exercises used in the training process are the same, scientific works appear in which the authors, when comparing their data, take these recommendations into account.

There are works in which some authors compare the results obtained in athletes who are «successful» or «unsuccessful» in sports. We believe that in such cases, researchers should first of all analyze sports results based on the results of competitions. It is known that in order to assess the success of an athlete, it is necessary to record the initial sports result, then conduct appropriate studies of the functional state in one training period (for example, in the preparatory period), and then, having obtained data on the performance in the competitive period, conduct a re-examination – that is, in dynamics. Everyone should understand that at the beginning of the preparatory period, sports results in an absolute majority of athletes will be at a relatively low level, and this is not surprising. Next, under the influence of training loads, there is, most often, an improvement in physical and other qualities, functional state, and technical conditions, which should, under certain conditions, lead to an improvement in sports results. By «certain conditions», we mean the absence of injuries, illnesses, violations of the regime, phenomena of overtraining, and physical overstrain. There are cases when an athlete, despite being in good athletic condition, performed unsuccessfully in competitions due to being psychologically «burned out». There is a fair question: in which of the proposed groups (successful or unsuccessful) should an athlete be placed who showed the same or even worse result in the competition than in the preparatory period but at the same time won a prestigious competition? However, the very fact that with a properly scientifically and methodologically established training process, the functional state of athletes improves during the competition period, which should lead to an increase in sports results, cannot be denied. At the same time, the division of athletes into individuals who improve sports results (that is, are «successful») and those who do not improve them and are «unsuccessful» is clearly a contrived concept [12]. We believe that such a division into «successful» or «unsuccessful» takes place when assessing knowledge among students, cadets, or performances in competitions, festivals, etc.

The methodology of sports research often hinges on the accurate classification of athlete qualifications, a crucial consideration, especially when preparing manuscripts for international publications. Frequently, standards for athlete classification differ significantly across countries. In Ukraine, athletes holding the titles of Candidate Master of Sports (CMS), Master of Sports (MS), and Master of Sports

of International Class (MSIC) are generally recognized as high-level athletes. Based on this, some researchers suggest categorizing a group of athletes with qualifications ranging from 1st class athlete to MSIC as «qualified», while designating athletes with the MS of Ukraine and MSIC titles as high-level or high-class athletes, capable of achieving world records and winning major competitions [4, 5].

In our work, devoted to the study of the appearance of a dystonic type reaction to physical exertion in the form of a submaximal PWC₁₇₀ test, 741 football players were examined and divided into 3 groups: high-class players (high-class) with a sports qualification of MS-MSIC, experienced players (advanced) with a sports qualification of CMS-1st class athlete, and players of average skill level (intermediate) with a sports qualification of 3rd-2nd class athlete [31]. A similar approach to the classification of athletes by their level of skill and achievements was adopted in our other works [13, 32].

A similar definition of the level of sportsmanship is more understandable to specialists from Western European countries and the United States who are not familiar with the classification adopted in Ukraine (from 3rd class to MSIC). In general, foreign authors recognize a certain inconsistency with the definition of levels of sportsmanship, but in general, world-class athletes and participants and winners of the Olympic Games belong to the category of «elite» athletes; participants and winners of national-level competitions belong to experienced athletes; and participants in regional competitions belong to the category of athletes of average level [23, 26, 28].

In a study devoted to the predictors and determinants of competitive activity of athletes in rowing, O. Rusanova notes that «participation in the Olympic Games is a priority task for the vast majority of elite rowers» [15].

A. McKay et al. suggest using training volume and performance indicators to classify a participant into one of the following levels: level 0 – sedentary, level 1 – recreationally active, level 2 – trained/developing, level 3 – highly trained/national level, level 4 – elite/international level, level 5 – world class [29].

According to D.S. Lorenz et al., the problem of a clear distinction between elite and non-elite athletes remains open, although traditionally athletes who participate in top-level sports competitions are classified as elite. However, to determine the «eliteness» of athletes, various researchers propose a number of variables, including anthropometric and physiological characteristics, balance indicators, the athlete's role in the team, duration and type of training, aspects of the development and formation of sports talent, as well as the level of physical fitness [27].

Thus, the differentiation of athletes into «elite» is a complex and multicomponent process. These numerous variables demonstrate the complexity and multidimensionality of the concept of «elite athlete» [27].

With the increasing popularity of Masters category competitions, research dedicated to the functional state of veteran athletes – individuals who continue practicing their sport post-professional career – is gaining prominence. Many of these veterans actively compete. In recent years, sports longevity, as a significant social and cultural phenomenon, has also become a more frequent subject of scientific inquiry. The clear examples of sports and professional

accomplishments of veteran athletes provide powerful arguments for the importance of a healthy lifestyle. Research into the functional state of individuals who have concluded their active sports careers takes on added relevance when it examines not only specific sports like track and field, swimming, and wrestling but also factors such as race distance, weight categories, and other specific characteristics, rather than solely considering sports veterans «in general». Our data from elite track and field throwers indicate that post-active-sport hemodynamic characteristics persist not only in those who continue physical activity but also in veterans with sedentary lifestyles, though these effects are less pronounced [12].

We conducted a study among sports veterans regarding the impact of lifestyle on health indicators of 40 male runners at distances from 100 to 400 meters, among whom 85% are of high level – these are prize winners and winners of World, European, and Ukrainian Championships. Sports veterans ($n=20$) who lead an active lifestyle are significantly more likely to have bradycardia; parasympathetic effects of the autonomic nervous system (ANS) prevail; they have a more physiologically economical hypokinetic type of circulation (TC) with the absence of individuals with hyperkinetic TC, greater physical work capacity, and a smaller body mass index (BMI) compared to those who lead a sedentary lifestyle. Similar studies conducted among 24 female sprinters (75% high level, participants and prize winners of the Olympic Games, World Championships, European Championships, World Universiade, and Ukraine) indicate that those who continue to engage in physical exercises show a tendency toward increased parasympathetic effects of the ANS, a predominance of hypokinetic TC, the absence of individuals with hyperkinetic TC, and differences in the value of BMI during sports and at the present time [30].

We were the first in Ukraine, and perhaps in the world, to conduct studies of two groups of sports veterans who in their youth had significant sports results in running at distances of 100-200 meters (first group) and 400-800 meters (second group) and continued to run with participation in competitions of the Masters category. It was shown that among 5 athletes of the CMS and MS level in athletics aged 55-59 years (runners at 100-200 meters) from 2013 to 2017, there was a tendency to decrease sports results by 6,27% and the value of PWC_{170}/kg by 8,79%, and in 2019 the decrease in PWC_{170}/kg by 17,91% ($p=0,0019$), which was significant. Over a similar period, the sports result in 4 runners at a distance of 400-800 meters of the same age and qualification decreased insignificantly by 8,72 seconds, which amounted to 6,53%, and there was a significant decrease in the value of PWC_{170}/kg by 17,86% ($p=0,022$), which in 2019 decreased even more to 24,93% ($p=0,018$). That is, despite regular training during the sports season (but naturally with a smaller volume and intensity of the training process than in youth and without violations of the state of health associated with injuries, illnesses, etc.), with age, sports veterans experience a decrease in sports results and indicators of physical work capacity – the so-called regression – due to the totality of involitional processes of the body. In this case, this is more pronounced in middle-distance runners compared to sprinters, which requires further understanding [30].

We believe that comparisons with their peers who have never participated in sports, in order to study the positive or

negative effects of physical exertion of a particular sport on the human body, can be considered valid studies among sports veterans. The resulting interpretation of persistent changes in functions in sports veterans can contribute to the clinical assessment of similar changes in athletes who are training. Comparisons are also possible between a group of veterans of one sport and sex who have stopped active sports but continue to engage in physical exercises in a maintenance mode and a group of sports veterans who lead a sedentary lifestyle. Finally, relevant comparisons are possible between sports veterans and current athletes who have the same personal sports results. Such comparisons carry useful information when they are carried out only in sports where there are sports results expressed in meters, centimeters, seconds, kilograms – that is, in athletics, swimming, rowing, weightlifting, etc. [12].

Regarding the perspective, research is very appropriate among high-class sports veterans regarding the monitoring of indicators of the functional state with sports results shown in youth compared to the results obtained in competitions of the Masters category – that is, 20-30 years after active sports.

To ensure valid comparisons in scientific papers, we believe athletes should be grouped based on multiple factors. These include age, training experience in a specific sport, sports qualification, sex, height (for team sports), and body weight (in disciplines like martial arts or weightlifting). Further differentiation can be made according to the period of the training process (preparatory or competitive) and, in team sports, by the player's role (e.g., attacker, goalkeeper). An equally important, though more nuanced, approach is to compare athletes who develop the same primary physical quality, such as endurance in marathon runners and road cyclists, or speed in track and field and swimming sprinters. However, this particular comparison requires caution, as the very concept of a 'sprinter' needs to be carefully differentiated across various sports.

According to most scientists (sports physicians, physiologists, educators), in athletes who develop the quality of endurance (stayers) in the training process, the heart rate at rest is less than in sprinters – that is, in athletes who develop the quality of speed or speed-strength qualities. By the way, sprint (sprint, English) is running at distances from 60 to 400 meters (400 m is a long sprint) and swimming at distances from 50 to 200 meters. But in general, the concept of «sprint» and «sprinters» also includes such sports as cycling (track 200 m from a running start), kayaking and canoeing (200 m), and speed skating (500 m). The time to overcome these distances, depending on sex and sports qualification (from 1st class athlete to MSIC), in male cyclists ranges from 12,0 to 10,7 seconds and in females from 13,6 to 12,7 seconds (one still needs to take into account the surface: cement or wood). In male rowers, times range from 43,0 to 38,0 seconds and in females from 49,0 to 44,0 seconds. In male skaters, times range from 44,0 to 36,5 seconds and in females from 48,5 to 39,5 seconds. Thus, it is permissible to compare rowers with skaters and 400-meter runners, since they perform maximum cyclic physical work with the development of speed and strength with very similar times to overcome their competitive distances.

In addition, there are sprint distances in biathlon, cross-country skiing, and, strangely enough, in some types of triathlon, but this terminology is very arbitrary, since it

concerns mostly several smaller competitive distances that do not correspond to the concept of the term «sprint» in its classical sense. As an example, we cite a work in which the maximum accumulation of oxygen deficit in sprint skiers was compared with highly qualified distance runners [21].

To investigate the widely held notion that athletes in speed-based sports exhibit higher heart rates compared to those in endurance sports, we compared data from female track and field sprinters and female swimming sprinters with athletes from a representative endurance sport – classical triathlon. It is important to remember that Olympic triathlon distances encompass a 1500-meter open-water swim, a 40-kilometer cycle, and a 10-kilometer run, thus presenting a complex of endurance challenges.

Our comparisons showed that in female runners of 1st class-CMS sports qualification at a distance of 100 meters, the average heart rate was 70,0±1,4 bpm, while in female triathletes of similar qualification it was 57,9±1,6 bpm (p=0,0001). A similar comparison among MS-MSIC athletes showed that the average heart rate value in female runners was 69,2±2,2 bpm, while in female triathletes it was 52,1±1,3 bpm (p<0,001).

As for female swimming sprinters, the average heart rate in athletes of 1st class-CMS sports qualification was 57,8±1,8 bpm, while in female triathletes of similar qualification it was 57,9±1,6 bpm (p=0,969). Among female MS-MSIC swimmers, the average heart rate was 54,3±1,9 bpm, while in female triathletes of similar qualification it was 52,1±1,3 bpm (p=0,438).

Comparison of heart rate among male and female swimmers of 1st class-CMS sports qualification (in whom it was 60,1±1,8 and 57,8±1,8 bpm, respectively) and male and female triathletes of the same level (55,8±1,2 and 57,9±1,6 bpm, respectively) showed insignificant differences at the level of p=0,081 and p=0,969, respectively. A similar comparison among male and female swimmers at the MS-MSIC level showed that the average heart rate in males was 55,1±2,5 bpm and in male triathletes 52,6 bpm (p=0,187), while in female swimmers it was 54,3±1,9 bpm and in female triathletes 52,1±1,3 bpm (p=0,438).

The data obtained reliably confirm the generally accepted statements regarding statistically lower heart rate values in athletes who develop the quality of endurance (triathlon) compared to track and field sprinters, but the same comparisons between triathletes and swimming sprinters of

both sexes indicate insignificant differences (Table 1). It should be noted that there were from 9 to 55 athletes in the comparison groups, with an average of 25.

That is, sprinters in athletics, who (depending on sex and sports qualification) cover a distance of 100 meters in 14,0-10,7 seconds, and swimming sprinters who cover the same distance (also depending on swimming style) in 84,0-53,0 seconds, differ sharply in the energy supply of muscle training and competitive work. Therefore, swimming sprinters in average heart rate values practically do not differ from representatives of triathlon, despite the fact that the latter develop the quality of endurance.

Notable are the heart rate data obtained from elite athletes representing sports for endurance compared to track and field sprinters. Thus, the 4-time Olympic champion in running at 5000 and 10000 meters, Mo Farah, had a heart rate of 33 bpm, and the 5-time winner of the Tour de France, Miguel Indurain, had a heart rate in the range from 28 to 33 bpm. However, a heart rate at the level of 33 bpm was also recorded in the sprinter and 8-time Olympic champion in running at 100 and 200 meters, Usain St. Leo Bolt.

In this case, it should be said that sharply expressed bradycardia, as one of the indicators that suggests economization of physiological functions (so characteristic of highly qualified athletes in good sports shape), can also occur in athletes who develop not only the quality of endurance but also other physical qualities – for example, speed.

The obtained personal data of athletes once again indicate that in sports medicine there are often no universally accepted patterns, which we will address further.

But whatever heart rate this athlete has, it moderately decreases with increasing training and increases with detraining. Therefore, dynamic observations are of great importance – comparing the data of heart rate and other indicators in the same athlete in different periods of the training process. At the same time, serious attention should be paid to ensuring the standardization of measurement conditions, which consists of conducting research at the same time of day (preferably after a day of rest), excluding the influence of previous training and food, ensuring a standard room temperature, etc. Only under such conditions can data be obtained that are of significant importance not only for the athlete but also for the physician in interpreting the functional state of the athlete.

Table 1

Heart Rate of Triathletes and Swimmers (mean ± SEM)

Rank	Running	Triathlon	p	Swimming	Triathlon	p
Men						
1 st class -CMS	60,9±1,10	55,8±1,20	0,002	60,1±1,80	55,8±1,20	0,081
MSIC	61,4±1,80	52,6±0,70	0,000	55,1±2,50	52,6±0,70	0,187
Women						
1 st class -CMS	70,0±1,40	57,9±1,60	0,000	57,8±1,80	57,9±1,60	0,969
MSIC	69,2±2,20	52,1±1,30	0,000	54,3±1,90	52,1±1,30	0,439

It is known that female track and field sprinters, depending on sports qualification (1st class-MSIC), cover a distance of 100 meters in 12,5 and 11,30 seconds, respectively, while female swimming sprinters of similar qualification cover the same distance, depending on swimming style (breaststroke-freestyle), in 85,0-68,0 and 75,0-60,0 seconds, respectively. Furthermore, it is known that in the energy supply of work of maximum intensity that lasts for several seconds (up to 25 s), anaerobic alactate sources play a decisive role, which are mainly associated with glycogen stores in muscles that are broken down to form ATP and creatine phosphate. This is what we observe in track and field sprinters, in contrast to lactate anaerobic sources in which energy supply is characterized by a more slowed-down action, less power, but significantly longer duration – that is, which occurs in swimming sprinters. Therefore, a sprinter in running and a sprinter in swimming are different concepts that differ in the energy supply of muscle work. Since the time to overcome sprint distances in athletes varies significantly – that is, swimmers perform work in a different time regime – therefore their average heart rate at rest does not significantly differ from the heart rate of triathletes, and comparing track and field sprinters with swimming sprinters will not be entirely appropriate.

Naturally, this applies to the perception of the concept of sprinter in swimming «in general» and therefore should not be felt otherwise, since these comparisons exist taking into account the time to overcome the competitive distance, which should not exceed 25 seconds. The meaning of such research is beneficial for both sports physicians and scientists when comparing the functional state of athletes who develop the same physical qualities but in a different environment and body position, as well as for coaches, as it becomes possible to expand the arsenal of training exercises for the development of physical qualities, time regimes of heart rate during their performance, etc.

No less important are the issues of comparing indicators of the functional state in athletes who have differences in physiological positions when performing training and competitive physical exertion – that is, athletes who perform this exertion in a vertical (runners) or horizontal (swimming) plane, but with the same energy supply of muscle training work.

A group of scientists studied respiratory and hemodynamic reactions when comparing swimmers and runners, measuring indicators of physical work capacity and central hemodynamics [14]. Several reports were devoted to similar comparisons from the perspective of echocardiographic data between runners and swimmers [23, 24, 25]. Notable is the work of Currie et al. (2018), in which elite athletes participated (16 swimmers and 16 runners) who correspond in age, sex, and race. After conducting echocardiography research, the authors showed that runners had a greater cardiac output than swimmers, which was associated with a higher heart rate (56 vs. 49 bpm, $p < 0,001$), while all other indices of systolic function and left ventricular (LV) dimensions were similar between groups, which is probably due to its faster untwisting. Thus, the impact of exercises such as swimming and running probably has the same impact on the structure of the LV and systolic function, since these indicators were similar between groups, which further confirms the concept of no differences in LV

function specific to these sports. The authors believe that running is associated with faster untwisting of the LV during diastole and increased early diastolic filling, so further research is needed to determine whether these observations are a product of the prevailing exercise stimulus or a necessary adaptation to facilitate filling during vertical exercise [25].

Similar dynamic observations of the functional state between male 400-meter runners and 100-meter swimmers showed that in the competitive period compared to the preparatory period, despite the physical loads occurring in the vertical and horizontal planes respectively and similar energy provision for muscular work during training, there was an enhancement of parasympathetic influences within the autonomic nervous system (ANS), a statistically significant increase in physical work capacity, and an elevated functional state index. Moreover, correlational analysis indicated a reduction in the cardiac index toward a physiologically advantageous hypokinetic circulatory pattern. However, this was achieved through an increase in physical work capacity in runners and a reduction in the autonomic balance of the ANS in swimmers [34].

Despite inherent limitations in these studies, the fact remains that the structural and functional cardiac indices are comparable between swimmers and runners. It can also be hypothesized that these differences would likely be significantly reduced if comparison groups were truly homogeneous. These requirements were carefully considered in our comparisons between runners and swimmers matched for age, sex, athletic classification, competitive race completion time, and energy provision for muscular activity.

For example, within the group of female 400-meter runners, there were athletes ranging in qualification from 3rd class athlete to MSIC, with completion times ranging from 67,0 to 51,35 seconds, respectively. In contrast, within the 100-meter female swimmers, athletes ranged in qualification from 2nd class athlete to MS, and their completion times, depending on swimming style (breaststroke-freestyle), ranged from 95,0-75,0 to 75,0-60,0 seconds, respectively. Dynamic observation from the preparatory to the competitive phases revealed analogous reactions from the ANS, central hemodynamics (absence of female athletes exhibiting the physiologically disadvantageous hyperkinetic circulation in either group), physical work capacity, and functional state index for athletes in both groups, which is attributable to the comparable duration of cyclic high-intensity work emphasizing the development of speed and strength during training.

In the competitive period, the PWC_{170}/kg value increased by 15,25% in female runners, from $17,11 \pm 0,73$ to $19,72 \pm 0,74$ $kgm \cdot min^{-1} \cdot kg^{-1}$ ($p < 0,05$). In female swimmers, the increase was 12,44%, from $12,86 \pm 0,732$ to $14,46 \pm 0,823$ $kgm \cdot min^{-1} \cdot kg^{-1}$ ($p = 0,002$). Substantial improvements were also seen in competition performance: one female runner achieved the standard for Master of Sport of Ukraine, two 1st class athletes met the CMS standard, two 2nd class athletes qualified for 1st class, and three 3rd class athletes achieved 0 2nd class sports qualification. Among the swimmers, two reached the Master of Sport standard, one 1st class athlete reached CMS, and two 2nd class swimmers qualified for 1st class [32].

We emphasize the importance of justifying the comparisons of examined variables between runners and swimmers. The rationale stems not only from the athletes' relatively similar competitive performance times but also because both groups engage in cyclic, high-intensity activity prioritizing the development of speed and strength. Furthermore, both derive muscular energy primarily from lactate-producing anaerobic pathways, typically operating for around 30 seconds, aligning with the glycolytic processes and race completion times.

It is worth noting that despite comparable competitive times, the absence of statistically significant shifts in some variables may be attributed to a limited sample size and the heterogeneity in the classification of athletes within the groups. It is widely recognized that training regimens for high-level athletes (CMS, MS) diverge significantly from 2nd and 3rd class athletes. Another factor is the advantage given to swimmers in terms of training volume, derived from completing training in a horizontal, physiologically advantageous condition, which contrasts with runners. This has an impact on the relatively smaller PWC₁₇₀/kg value in swimmers. This is in line with current techniques in swimming training, which focus on the rate of speed-strength development, reducing work directed at improving the endurance of the athletes – a point mentioned in our prior research [13].

Expanding on this theme, similar comparisons are justified in examining variables among male and female swimmers who compete only in the 50-meter sprint distances with track and field sprinters running the 200-meter dash. Both exhibit comparable performance times and energy provision for muscular work. Also defensible are comparisons between 5000-meter runners and 1500-meter swimmers, where competitive race times average around 15 minutes, utilizing muscular energy aerobically, facilitating highly efficient training for sustained durations.

We consider investigations tracking athletes of the same age and sex across extended periods of 15-20 years as pivotal. These studies provide insight into how innovative or experimental training approaches influence variables reflecting functional status. For example, the intensified training programs of male and female swimmers at the CMS, MS, and MSIC levels have led to earlier training starts, a trend toward increased body mass, and deterioration in multiple indices of the autonomic nervous system and central hemodynamics, and a particularly reliable decline in the indicators of physical work ability. Despite this, they reached the thresholds necessary for each of the CMS, MS, and MSIC classifications more quickly than other athletes of their own age in the following 15 years. We infer that changes in modern training are directed at lessening training stress in the zone of development of general endurance (aerobic) with increased stress on those emphasizing rate of speed and strength (anaerobic) [13].

The assessment of athletes' physical characteristics presents several challenges, as some anthropometric indices and their corresponding interpretations are often debated. When seeking quick but approximate evaluations of physical attributes, the validity and limitations of certain indices and their interpretations require careful consideration [1].

The mass and height index – the Quetelet Index – is calculated in accordance with the formula: body mass (g) /

height (cm). On average, the value of the Quetelet index in adults ranges from 350-400 g·cm⁻¹ for men and 325-375 g·cm⁻¹ for women. Values above 500 are suggestive of obesity, and values below 300 suggest malnutrition. In the case of high-performance athletes such as basketball players, boxers, heavyweight weightlifters, and throwers, this index is likely to range between 500-650 g·cm⁻¹ or more. Examples include Arvydas Sabonis (1988 Olympic champion in basketball, 1982 world champion, 221 cm in height, 130 kg – Quetelet index: 588 g·cm⁻¹) and Robert Harting (2016 Olympic champion in discus throw, 201 cm in height, 130 kg – Quetelet index: 647 g·cm⁻¹). Yet there are conflicting examples. In the case of female athletes (in rhythmic gymnastics, high jump, long-distance running, etc.), the index is often less than 325 g·cm⁻¹. For instance, Anna Bessonova (2007 world champion and multiple medalist at the Olympics, World Championships, and European Championships, 175 cm in height, 50 kg – Quetelet index: 286 g·cm⁻¹). Analyzing these results suggests that male athletes may have excess mass, whereas the gymnast may exhibit inadequate body mass. These values either overestimate or underestimate the actual physical attributes of the athletes, despite their physical appearance suggesting otherwise [18].

Incidentally, reference to the well-known handbook «Tests in der Sportpraxis» indicates that the Quetelet «Body Fullness» Index is measured by the formula: body mass (kg) / height (cm) [22]. However, the commonly used body mass index is referred to as the Kaup «Body Constitution» Index and is calculated in accordance with the formula: body mass (g) / height (cm²). These differences pertain to the expression of body mass in kilograms in the former as opposed to grams in contemporary calculations, whereas the latter index does the reverse: it expresses body mass in grams as opposed to kilograms.

However, F. Q. Nuttall indicates that the Quetelet index was proposed in 1835 by a Flemish mathematician, astronomer, and statistician, Lambert Adolphe Jacques Quetelet, and it is no longer possible to accurately attribute the index's origin to either Quetelet or Kaup. However, the Quetelet formula takes the form we recognize: body mass (kg) / height (m²) [33].

Some scientists propose assessing physique robustness with the Pignet index, although some authors rightly point out its deficiency due to its «inaccuracy and illogicality, which stems from its empirical approach to calculations». This index of «robustness» was initially proposed in 1901. Its author, seeking to elucidate the trends among body mass, chest circumference, and height, sought to tabulate the average values of chest circumference at exhalation and body mass, subtract this sum from height while standing, and apply this calculation across all size groups. From the modern perspective regarding biometric indices, «the Pignet index» is simply an empirical regression equation. The problem is that when summing chest circumference and body mass, it combines two disparate components into one «variable». In other words, it is incorrect to add centimeters (chest circumference) to kilograms (body mass). High emphasis is placed on height when calculating the index: the shorter the height, the more robust the physique – but this is not always the case. In addition to these errors, the Pignet index fails to account for sex, age, or profession (in this case,

a specific sport) of the examined subject. As such, «the use of the Pignet index cannot be justified with contemporary scientific understanding» [12].

When evaluating physical attributes, it is essential to analyze the ratios and interdependence between these characteristics rather than the values in isolation. The value of any individual parameter ought to be assessed considering age and sex. In athletes, it is crucial to factor in the athlete's discipline and classification; a given value may be favorable or unfavorable to athletes in different specializations. Evaluating physical attributes can be qualitative and quantitative. To that end, the more common methods used include the standard method, anthropometric profile, indices, correlation, percentiles, etc.

Discussion. This review draws attention to key issues in contemporary sports medicine, where terminological clarity and methodological rigor are crucial. Ukrainian sports medicine, as an evolving field, requires substantial adjustments, particularly in the realm of terminology, where numerous inconsistencies exist between pedagogical, medical, and sports literature, disorienting researchers.

A central issue is the use of the term «untrained individuals». At the dawn of sports medicine, athletes were often compared to individuals who did not participate in sports, referring to them as «untrained individuals» [12]. This terminology is problematic because the status of being trained applies only to athletes. A trained athlete is one who is in peak form (most often in the competitive period), while an untrained athlete is one at the beginning of the preparatory period or after a period of detraining due to injury or illness. We propose using the term «individuals who do not participate in sports» instead, or reserving «untrained individuals» only for cases when referring to athletes who are in a detrained state. This aligns with sports pedagogy literature, where trainedness is defined as the state of the body determining the level of an athlete's physical fitness, which is a result of systematic training.

Regarding the terms «successful» and «unsuccessful» athletes, we believe success should be evaluated based on competitive results. This requires recording a baseline level, monitoring functional status in the preparatory period, and reassessment during competition. While performance is typically lower at the beginning of a training cycle, it should improve through systematic training. However, an athlete may underperform despite excellent physical condition due to psychological factors. Therefore, the «successful/unsuccessful» dichotomy is an oversimplification and does not reflect the multifaceted nature of athletic performance [12].

The definition of «elite» athletes is also important. Due to the lack of internationally standardized classification systems, Ukrainian rankings (CMS, MS, MSIC) are often considered elite. Some researchers suggest classifying athletes from Category I to MSIC as «qualified» and MS/MSIC as «high-level» [4; 5]. Generally, world-class athletes, Olympic medalists, or finalists are considered «elite». However, the definition of «eliteness» is complex and depends on many sport-specific variables [27].

Research methodology in sports medicine also requires attention. Using non-athletes as a control group implies that elite athletes are in a suprathreshold physiological state. Therefore, comparing physiological data between athletes developing

different physical qualities or between athletes and non-athletes is methodologically problematic [12]. Sports medicine differs from clinical medicine in that reference values should be linked to the specifics of the sport rather than general population norms. Therefore, sports physicians should work closely with coaches to assess the state of training and readiness for competition.

Research among veteran athletes («Masters athletes») is valuable for studying the long-term effects of training. Studies of former elite athletes are most informative when the specific sport, distance, and weight categories are considered. Comparisons of veterans with non-athlete peers or between veterans with different levels of physical activity after their careers are methodologically appropriate approaches. Comparisons between veterans and current athletes with similar personal records are also useful.

Researchers should be cautious with the term «sprinter». Sprinting exists in various sports with different durations and metabolic demands. For example, track and field sprinters and swimming sprinters have different physiological profiles. Therefore, comparing sprinters from different sports requires caution.

Regarding anthropometric indices such as the Quetelet index and the Pignet index, their application for assessing the physical development of athletes has limitations. The Quetelet index may be inaccurate in athletes with high muscle mass, and the Pignet index is outdated and does not account for sport-specific characteristics. More modern and accurate assessment methods are needed [1].

This review has limitations inherent in literary analyses. Further research should include experimental studies, the development of new assessment methods, and the study of the long-term effects of physical exertion. However, the results of this review have practical significance and can contribute to the improvement of terminology and methodology in sports medicine research.

Conclusion. This work highlights pressing issues in Ukrainian sports medicine, emphasizing the need for terminological clarity and methodological rigor in research. Numerous terminological inconsistencies have been identified, particularly regarding the concepts of «trained» and «untrained» individuals. It is proposed to use the term «individuals not engaged in competitive sports», as trained status applies exclusively to athletes, while «untrained» refers to athletes in the initial stages of preparation or after a break.

Categorizing athletes as «successful» or «unsuccessful» is recognized as an oversimplification that fails to account for the complexity of athletic performance. It is emphasized that the definition of an «elite» athlete is multifaceted and depends on numerous variables, not just national classifications. From a methodological standpoint, the use of non-athletes as control groups is criticized, as reference values in sports medicine should be sport-specific, and physicians should work closely with coaches.

Research involving veteran athletes is considered valuable for investigating the long-term effects of training, provided careful comparisons are made with non-athletes or with current athletes who have achieved similar results. Caution is advised against inappropriate comparisons of «sprinters» from different sports due to variations in physiological demands. Finally, the limitations of traditional

anthropometric indices (Quetelet, Pignet) for assessing athletes' physical development are highlighted, advocating for the use of more modern and accurate methods. Thus, this work draws attention to the need to address problematic issues concerning terminology, the conceptual framework, and the organization of research in sports medicine.

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