Control of the physical and technical fitness of elite professional rugby union players

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How to Cite

Abstract

Background. Rugby is one of the most popular sports abroad, that must have good physical, psychological, physiological, functional, technical condition for every athlete. The search for set of tests for monitoring the physical and technical fitness to achieve the successful performance of an athlete or a team in major competitions in Elite Professional Rugby Union Players continues to be an urgent problem.

Purpose. This study aims to substantiate and develop a set of tests for monitoring the physical and technical fitness of rugby players aged 17-18.

Material and Methods. There were eighty-seven male rugby players aged 17-18 from Ukrainian National team U18. All athletes volunteered to participate in the research. The following research methods have been used to solve the tasks of the research: analysis and synthesis of literature of the research topic; pedagogical observations; testing the technical, tactical and physical fitness; methods of mathematical and statistical analysis which are scientifically based and are widely used in sports science (correlation and factor analysis).

The object of research is the indicators of the technical, tactical skills and physical fitness of 17-18 years old rugby players.

Results. The authors offer the unified testing program and general quantitative criteria in the tests. Two approaches have been used as the main criteria for the informative tests – logical one, based on the explanation of physiological mechanism that determine high efficiency of players in the conditions of gaming activities, and empirical approach, based on the information about the factor structure and the validity of the tests used for these purposes. Information on the level of fitness of players at each stage can be used selectively in connection with aims and objectives that contribute to the management of the training process in general.

Conclusions. With the help of motor and ergonomic tests, a general set of guidelines has been substantiated, which allowed to assess the state of technical, tactical and physical fitness of rugby players aged 17-18.

Key words: rugby, players aged 17-18, control, technical skills, physical fitne
Annotacja

Квасниця О., Тищенко В., Іванська О., Іваненко С., Халемендж Ю., Плахотнюк О., Ференчук Б., Рибак Л., Потапова Л., Позмогова Н. Контроль фізичної та технічної підготовленості елітних професійних регбістів

Передумови. Регбі – один із найпопулярніших видів спорту за кордоном, який передбачає відмінний фізичний, психологічний, фізіологічний, функціональний і технічний стан кожного спортсмена. Дослідження набору тестів для моніторингу фізичної та технічної підготовленості для досягнення успішної діяльності спортсмена або команди на головних змаганнях в елітному професійному Rugby Union Players досі залишаються актуальним.

Мета дослідження полягає в обґрунтуванні і розробці набору тестів для моніторингу фізичної та технічної підготовленості регбістів віком 17-18 років.

Матеріали і методи дослідження. У дослідженні взяли участь 87 регбістів віком 17-18 років національної збірної України U18. Усі регбісти погодилися брати участь в дослідженні. Для вирішення поставлених завдань використані наступні методи дослідження: аналіз і синтез літератури за темою дослідження; педагогічне спостереження; тестування технічної, тактичної та фізичної підготовленості регбістів; методи математичного та статистичного аналізу, що обґрунтовані наукою і часто використовується в спортивній науці (аналіз взаємодії та факторний аналіз).

Результати. Авторами запропоновано уніфіковану програму тестування загальних критеріїв. Ще два підходи використані в якості головних критеріїв інформативних тестів – логічних. Відповідно до пояснення фізіологічних механізмів, що визначають високу ефективність гравців в умовах ігрової діяльності, та емпіричний підхід, відповідно до інформації щодо структурі, факторів і достовірності тестів для досягнення цієї мети. Інформація про рівень гравців на кожній стадії може бути використана вибірково, у відповідності з цілями та завданнями, що сприяють керуванню тренувальним процесом у цілому.

Висновки. За допомогою тестування моторики та ергономіки, обґрунтовано загальний набір рекомендацій, що дозволило оцінити стан технічної, тактичної та фізичної підготовленості регбістів 17-18 років.

Ключові слова: регбі, гравці віком 17-18 років, контроль, технічні вміння, фізична підготовленість
Introduction

Today, selection in sports is considered as a way of predicting the ways of development of a sports achievement, the main task of which is to identify the possible development of a specific phenomenon, which corresponds to scientific knowledge to the greatest extent. It is closely related to the management of the educational and training process, creates prerequisites for making appropriate decisions in the field of sports training and competitive activities. It's directly related to the main direction of their training at each stage, starting from their childhood and ending with the formation of national teams from among adult players. A wide variety of processes and phenomena is the subject of selection in sports. These are the trends in the development of rugby in the broadest sense, and the prospects for the development of the system of sports training and competitions, techniques and tactics of various kinds of sport [1]. The successful performance of an athlete or a team in major competitions is one of the goals of their training system. At the same time, setting a specific goal in sports training is always associated with predicting of the sports results [2].

The main task of selection and sports orientation is not to identify motor qualities and their registration at a given age stage, but to determine the potential and abilities, predisposition to a certain sport and to a specific playing role or specificity, and to identify talents as well [3]. The interrelation of morphofunctional features and motor abilities determines the sports talent of a promising sportsman. The physical capabilities of a person are based on the molecular-genetic factors of the individual. Psychological and mental conditions are based on the individual's genetic abilities for this kind of sport, being the main criteria for planning a long-term training of an athlete. Therefore, in the initial selection process, it is advisable to use simple pedagogical tests to assess the level of motor abilities [4, 5]. So, the results of the researches of the level of physical fitness for different playing positions (the physical fitness qualities of different playing positions) in football [6], handball [7, 8], volleyball [9, 10], basketball [11, 12, 13] turned out very useful for us. To meet the requirements of the training process, not only a wide range of physical fitness attributes is needed, but in addition, an important element which is necessary for successful competitive activity in sports is possession of special technical skills[14].

Thanks to the observational methodology, research, related to the technical-tactical aspects of rugby, is becoming more and more relevant [15].

The selection includes a number of organizational activities related to the solution of the main tasks of training at each stage [16]. This includes: mass viewing and testing in order to determine the potential of the children in connection with the specific requirements of the sports; selection of promising sportsmen into groups of sports improvement and club team formation; selection of athletes as a part of national teams. It is well known that there are relatively separate and, at the same time, closely interrelated sides of the process of training athletes: psychological, physical, functional, moral-willed, technical, tactical and integral [17, 18].

These events provide objective information about the most promising part of the athletes from the examined ones. An important part in the overall chain of events for the selection of talented children and adolescents is justification of comprehensive testing programs, standardization of conditions and the unification of criteria for assessing the potential capabilities of young athletes [19]. The authors note at the same time that the standardization of the control programs and unification of the assessment criteria of the examined children should be carried out in accordance with the specific requirements of sports and the tasks of fitness stages. Increased responsibility in the selection of children for sports sections is the prerogative of the coach. The achievements of the athlete depend on how methodically competently the tests are selected; the evaluation criteria are developed. In this regard, the study of the characteristics of the physical development of the children with the help of motorial tests, generally accepted for this purpose, is becoming crucial, as well as, using motorial tests.

At the current level of the development of sports science, the athlete's achievements depend on how well the tests are methodically selected and the evaluation criteria developed. These methods are used individually or in combination to achieve different goals. At the same time, most of the works are related to a specific kind of sport and a specific goal of selection. However, many of these tests are not specific for the physiology of the sports in which they are used. Nevertheless, ways to solve the problem of optimizing control test sets for assessing the state of fitness of athletes, including in rugby, are...
already well justified [20].

Therefore, it is recommended to use statistics methods that make it possible to choose minimum of the most informative ones from the set of possible tests, taking into account the aims and objectives of the study. Also, the standardization of control programs and the unification of the evaluation criteria of the examinees should be carried out in accordance with the specific requirements of the sport and the tasks of the training stages.

The practical significance of this problem has become a prerequisite for conducting this research.

The purpose of the research is to substantiate and develop a set of tests for monitoring the physical and technical fitness of rugby players aged 17-18.

Materials and methods

Participants

There were eighty-seven male rugby players aged 17-18 from Ukrainian National team U18. All athletes volunteered to participate in the research. Prior to the testing, the procedures have been explained to all of them, including possible risks involvement, and after the explanation, an informed consent form was signed. The experiment has been done after every participant was tested. The athletes were free from any injuries or neuromuscular disorder. The study has been approved by the Institutional Ethics Committee, complied with all the relevant national regulations and institutional policies, followed the principles of Helsinki declaration, and it has been approved by the authors’ institutional review committee.

Procedure

The study was conducted in September 2021 – May 2022 on the base Ukrainian National team U18.

Statistical analysis

In the first cycle of statistical operations the authors studied the correspondence of the control indicators recorded in the examined athletes to the nature of Gaussian distribution. In the case of normal distribution of the main array of the experimental data, the possibility of using the following statistical operations – correlation and factor analysis analysis opened up. Statistical analysis of the actual research material has been carried out in the several ways. For this purpose, the method of correlation analysis has been used in order to justify the minimum complex of the most informative indicators which make it possible to characterize objectively and with high information content the state of the main components of the motorial functions of the rugby players.

The results of initial surveys of the rugby players were subjected to correlation analysis using a large number of tests. Then the correlation matrices have been processed by factor analysis methods which allowed the authors to research the factor structure of the physical fitness of the rugby players and to highlight tests and individual indicators which were highly informative, as well as, to recommend the optimal control content among them. The scree plot method was used to determine the number of factors. The Cattell scree test plots the components as the X-axis (factors) and the corresponding eigenvalues as the Y-axis (dispersion, %). As one moves to the right, towards later components, the eigenvalues drop. When the drop ceases and the curve makes an elbow towards less steep decline, Cattell's scree test says to drop all further components after the one starting at the elbow.

The correlation analysis of the achievements of the rugby players in the tests has been carried out in accordance with methodological requirements. In accordance with the purpose and objectives of the research in order to update the informative tests, the authors needed to study the nature of the relationship between the results of the rugby players performing different test exercises of a general and special nature, as well as, between some indicators that characterize the level of technical skills. As for the criteria for the normality of the statistical distribution, the authors have used the average value and standard deviations of each of the control indicators. For this the authors have considered it possible to limit themselves studying the nature of the distribution, using three sigma rules. This made it possible to characterize the distribution frequency of all variants that are in the interval $3\sigma - 1\sigma$. This method is recommended for solving similar problems in sports science where it is underlined that when studying the motility of the athletes, the normal distribution is more common.
Results

Much attention is paid in the scientific and methodological literature to the assessment of physical fitness, indicating the level of speed, speed-strength, strength and functional capabilities of the body of rugby players [21, 22]. In addition, taking into consideration the specific features of rugby, where the assessment of technical skill is expressed not in quantitative, metric criteria, but in the form of subjective assessments of experts, in order to substantiate the information content of the set of control indicators, we have used two approaches [23]. The first approach is based on the logical method of efficiency analysis of technical skills of the rugby players. The analysis is based on the literature data and our own pedagogical observations. The second approach is based on the calculation of a number of coefficients of efficiency, reliability and feasibility of technical activities of the players, using standard mathematical methods.

In this regard, the development of the methods of pedagogical control over the most significant indicators of physical fitness is of great importance. Therefore, we have taken the indicators of complex testing, the total number of which was 30 tests, which indicated a multi-vector analysis of the structure of the features of the integral (complex) readiness of the young rugby players. As a result of mathematical processing of 30 indices of the complex tests of the athletes, the authors have determined the structure of integrated fitness on the young rugby players.

Rugby, of course, is a multifactorial type of sports activity that requires a high manifestation of individual abilities of athletes, and consists in a complex combination of manifestations of physical qualities, different in the nature of actions [24]. This increases the number of factors affecting athletic performance [25]. Consequently, as for the next step in substantiating the complex of control tests, the factor analysis method has been used. The authors have been guided by the recommendations of specialists which expressed their opinion on the advisability of using this statistical method in those cases when the experimental set of the tests have not strictly defined quantitative criteria for sports results, expressed in metric units [26]. In accordance with the requirements of the procedure during the factor analysis from the primary matrix excluded indicators that duplicate each other and have a high degree of relationship, which leads to changes in the factor loads of the obtained indices.

During the factor analysis 9 factors have been found out (Fig. 1.).

Fig. 1. The contribution of each factor to the total amount of dispersion
Based on the data in the figure, the "elbow" inflection is visually visible, on the basis of which significant factors were selected. The third factor is almost twice as large as the fourth (1.9 times), while the fourth is only 1.2 times greater than the fifth. Among them, there are the most significant three ones which have the total sum of dispersion 63.2%. Other factors in terms of the number and the level of connection between the studied characteristics do not make a significant contribution to the total dispersion and have a low value (less than 27%). When analyzing the factor loads of the athletes, the authors have used reliable correlation coefficients of each index as a separate factor with \( p < 0.05 \). Thus, when making a factor analysis, the following indices have been taken into account (Table 1).

The other factors as for number and level of the connection among the studied characteristics have no significant contribution to the total sum of the dispersion and they are low. Thus, for selection of athletes into the groups of the stage of preliminary basic training the authors have selected the most informative tests.

**Discussion**

A profound and comprehensive consideration of various aspects of theory and practice is contained in the works of Nash, C., Till, K. and other, where the scientific justification is given of the performance, development and preparation of the young rugby player [20, 27]. In the research the authors have used general terms of the theory of control of assessment methods of fitness, technical skills during competitions and according to the athletes’ capabilities. The authors have also taken into account that the results of the research of specific rugby players had to be compared with the similar data obtained from other players, and, as well as, with the model characteristics of the players of different ages and qualifications [28].

The research is aimed at developing two methods of control. The first involves the control of technical skills of young athletes. The second one involves the control of functions of the players’ conditions during the tests, that was close to the specifics of competitive activities in rugby. At present, when the volume of the training load reaches sufficiently high values, further improvement of sportsmanship largely depends on the intensification of the training process and improving performance in the training process. Therefore, the purpose of the control is to determine the main priorities, to substantiate the principles for choosing the means and methods of evaluation. The scientists have proven that the introduction of an integrated management system in practice reduces the adverse effects of extreme training and competitive loads [29]. According to Rich D. Johnston, who claims that with a change in the rules of the game in rugby and the increase in its intensity, which in turn requires a sufficient level of physical fitness from rugby players, experts should attach great importance to the improvement of physical training programs in rugby [30].

Without objective information about the diverse physical training of athletes, it is unthinkable to manage the training process, which is the main factor in the further growth of sports achievements. A number of the researchers have pointed out the significant influence of the physical qualities of athletes on the positive final result of the leading teams in important competitions [31]. The results of the physical fitness in sport measured in quantitative and metric units can be interpreted for the broad purposes of stage, current and operational management [32]. This experience has already been accumulated in rugby [33].

A lot attention is paid to assessment of physical fitness, which indicates the level of speed, speed-strength, power and functional capabilities of the rugby players body, in the scientific and methodological literature [34]. Modern researchers agree (share the opinion) that there is a close relationship between the level of physical fitness and its transfer to effective actions during competitive activities [35]. Scientists have proven that the control of the physical fitness of rugby players takes into account the ultimate requirements for training and competitive activities, contained in high-intensity and short-term highly specific loads, aimed at the use of tools and methods that provide objective information about indicators of a predominantly anaerobic nature, with an emphasis on complex strength and speed-strength qualities, coordination abilities (various manifestations), special performance, explosive speed and strength of a pronounced dynamic nature[36]. Also the developed method of using musical accompaniment is an effective, accessible and reliable means of improving the psychophysiological state of young rugby players. Scientists use of musical accompaniment positively
The development of physical qualities during the training process occurs with the help of rugby-specific tests [38], which reproduce the physiological requirements of the game, technical and tactical actions, etc., which must necessarily meet the requirements of informativeness, reliability and equivalence [39]. The researchers have proposed an intermittent fitness test for team sports players as an alternative to classical continuous testing to determine speed endurance (this is an accurate estimate of $V_{0_{\text{max}}}$) because the ability to sprint again is a critical factor in the outcome of a match [40]. The results of Edward A Gannon’s research, who examines the development and improvement of strength qualities and explosive power of professional rugby players, have proven to be very useful for us [41]. Paying tribute to what has been done by our predecessors, we nevertheless believe that the constant search and improvement of new methods aimed at the development and improvement of the physical qualities of rugby players needs more appropriate attention from specialists and coaches who work with professional teams. It is known that technical control of the players’ activities is difficult to carry out, because its results are largely dependent on the overall game situation. The results differ significantly in games with opponents of different strength. In this case the organization of current control becomes more difficult. Summarizing the results of a series of matches is required to generate quantitative information about the level of technical skills of the players according to the requirements of management.

The control of the technical training of rugby players shows high demands on automatism, stability, performance and sustainability of motor skills and performance during competitive activities. The complexity of the study and set of control exercises tests was in a large number of their own actions and technical options for their application in real conditions of competitive activity. The researchers pay the greatest attention to the control of the technical readiness of athletes, to the transfer and ball kick, which has been confirmed by our results [42].

On the issue of technical and tactical training in rugby, there are several points of view, which can be reduced to two main ones: the first is an open game on the hands with an attempt to score a try and get the maximum number of points in one attack, and the second one is a game from the defense in the hope of an opponent’s mistake, which will allow to receive a free kick and implement it [43]. Thus, the scientists indicate certain changes in the technical and tactical training of rugby teams, in connection with changes in the rules of the game. The example is the work of Tee, Jason C. and co-authors on the concept of tactical periodization for its application in rugby union, to coordinate long-term planning, to increase the specification of the training process, etc. [44]. The researchers have declared the postulate that the effectiveness of competitive activity is mainly determined by strong defense, breaking through the line of defense and a large number of ball possessions in the attack phase [45].

Next criteria in the study are the requirements to reliability and information content of the benchmarks. These requirements are of specific nature and they are formulated in details in a number of works. The above considerations were the basis of research methodology which made it possible to systematize the acquired knowledge in accordance with the general theoretical provisions of management and the specifics of the training process and game activity of rugby players. For these purposes in the control process were mainly used the tests that were had been widely used before.

When choosing control tests, we have been guided by logical considerations. We believed that further improvement of technical skills will proceed inextricably with increasing requirements for the physical fitness. Considering the features of the game activities, a set of tests involved exercises that required the predominant manifestation of speed and power qualities of athletes and their aerobic and anaerobic endurance [46]. On this base the authors have considered it advisable to formulate a preliminary set of control tests and indices from among already introduced into practice of controlling related sports and rugby. The next stage in the research is the justification of the reliability and information content of subsequent tests according to metrological requirements (Fig. 2): to correspondence of the tests and the testing procedures to the age of rugby players; to correspondence of the tests and the specific conditions of game activities; to meet the requirements of universality, i.e. characterize several abilities, for example, the state of high-speed qualities and the ability to hold the ball and so on; to contain a set of information reliable tests; quantitative criteria for assessing the state of the rugby players; scales for standardizing; grades of different tests in a single point system; formulas of the race of generalized estimates of the players’ fitness.
Fig. 2. The most informative tests for selection of athletes into the groups

Thus, the empirical study of a set of control tools for various groups of indicators has pointed out their objectivity, informativeness and reliability. This is necessary to ensure a certain level of assessment of the relevant parameters of athletes and teams of rugby players in the relevant tests and control exercises.

Conclusions

The results of the research allow us to draw an objective conclusion, which has applied significance, that in order to assess the state of the speed-strength qualities of young rugby players, there is no need to use many tests that are found in various teaching aids and programs. For objective assessment of speed and strength capabilities of the children, a minimum number of tests, given in Table 1, can be used, guided in this case, first of all, by logical considerations. Based on the results of the research, the authors can conclude that the revealing of the significance of the individual components of the integrated fitness for selecting athletes in the stage of preliminary basic training made it possible to select the most informative tests.

Selection criteria for the formation of training groups in children’s sports institutions are presented in the research. Control standards have been developed in a number of motorial tests, quantitative and qualitative assessment, criteria that are adopted to age characteristics of children and specific conditions of rugby. The testing program provides for two sets of indicators, one of which includes motorial tests with elements of ball holding and the second is based on using maximum ergonomic tests in anaerobic, mixed and aerobic conditions.

Based on these tests and objective quantitative indices that have been recorded during the testing, it has become possible to characterize objectively the individual features of children for making management decisions.

Acknowledgments

The results we have received helped in the selection of candidates for the Ukrainian National team to participate in the Boys U18 7s Championship 2022, comparing with the previous year, where they managed to get only to the Rugby Europe U18 Sevens Boys Trophy 2022. Due to completing coaching studies course in power and physical training and having been awarded WORLD RUGBY Conditioning for Youths (L1) certificate we were able to thoroughly and efficiently assess the level of physical fitness of young rugby players aged 17-18. The obtained results facilitated the coaching staff in selecting the best candidates to participate Rugby-7 Europe Championship in Championship 2022 top division.
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