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**THE INFLUENCE OF BIOLOGICAL RHYTHMS ON THE 11-13-
YEAR-OLD FEMALE TENNIS PLAYERS' COMPETITIVE
ACTIVITY**

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CONCEPTUAL GUIDELINES OF THE RESEARCH

Actuality and importance of the problem addressed. The current performance level of the sporting achievements makes athletes to spend intensive training and competitive tasks, involving the body to adapt to the required efforts and impose on them an enviable physical training in connection with tactical one. Local and foreign scientists, who researched on high performance athletes, denote that their immune indicators are low and many of them suffer from different diseases [41, 51, 64]. A number of experts believe that these consequences are inevitable in sports, as a result of the amount of effort worked during training and competition [83, 94, 96, 112]. Based on the above, it is natural to ask the question: "Is it possible to achieve high sports results and, at the same time, maintain health?"

Sports science that collects new data from various industries is improving year by year, but it still cannot answer many questions. The main goal of sports science is to find perfect ways to individualize the training process. In particular, chronobiology should help in this regard [30, 31]. Chronobiology is a relatively young science, which, in addition is studying the relationships between biorhythms and human health, also dealing with the development of methods and solutions for restoring and harmonizing destroyed biological rhythms. Currently this field is considered to be the most promising in preventive medicine, as it is able to influence the earliest developing symptoms of many diseases.

Human changes his physiological state, intellectual possibilities and even mood depending on the time of day. During the day, the human body is oriented towards processing accumulated nutrients, because they are a source of energy for active daily life. At night, on the contrary, nutrients accumulate, tissues are restored and cells divide. It is known that periodic changes are characteristic not only for the human body, but also for the environment. However, in contemporary society our biological rhythms often do not match the actual daily cycle (since daily activities practically never correspond to the actual day), causing inconsistency in the functioning of the body's organs and systems. In this way, civilization inevitably destroys our natural biological rhythms.

Modern chronobiology studies the regularities in the implementation of the processes of the body's vital activity over time. The rhythmic organization of physiological functions in living systems underlies the temporal organization of biological systems. "A biorhythm is a fluctuation that occurs at approximately equal intervals of time, intensity, or speed of any biological process" [23].

The aim of the research consists in optimizing the training process of 11-13-year-old female tennis players, focused on the biological rhythms of athletes at that age.

Research objectives:

1. Analysis of the modern theory and practice of the competitive activity process of female tennis players.
2. Studying the characteristics of individual biorhythms of athletes and determining their chronobiological type.
3. Elaboration of the structure and methodological content of the sports training program project (STPP).
4. Experimental verification and confirmation of the effectiveness of the training system for junior tennis players based on STPP.

The research hypothesis. It was assumed that the competitive activity can be achieved effectively using means of sports training according to the 11-13-year-old female tennis players biological rhythms.

The tasks proposed for carrying out the study were the following:

- identification of the physiological biorhythms of the human body;
- determining their influence on competitive activities of 11-13-year-old female tennis players in conditions of rest and physical activity;
- drawing up biorhythmograms of emotional, intellectual and physical cycles.

Novelty and scientific originality of the research consists in the elaboration, experimental validation of a sports training program (STPP) focused on biological rhythms and their influence on the competitive activity of 11-13-year-old female tennis players. The practical application of the given program will contribute to the optimization of the training process of junior female tennis players, expressed by increasing the level of motor and technical training, as well as the quality of sports training as a whole.

The research problem consists in optimizing the training process of 11-13-year-old female tennis players, taking into account the biological rhythms of this age.

The theoretical significance consists in the elaboration and experimental argumentation of the content of the experimental program focused on the influence of biological rhythms on the competitive activity of female tennis players - aspects based on which a methodical-didactic guide was developed for coaches "The impact of biological rhythms on sports performance".

The applicative value of the work is determined by the possibilities of implementing the results of research on competitive activity focused on age-specific biological rhythms and the tennis game (11-13 years). As a result of the research, the practical-methodical guide "Impact of biological rhythms on sports performance" was developed and implemented as a new training method for female tennis players.

Implementation of scientific results. The results of the research were implemented in the training process of junior female tennis players from the SSST and the specialized tennis sports clubs of the Republic of Moldova. They can be applied as methodological material for tennis coaches at the junior level, also in the process of professional training of students from higher education institutions of physical education and sports in the "Tennis" specialty, as well as in national and international tournaments and competitions.

THESIS CONTENT

1. THEORETICAL-METHODICAL GUIDELINES REGARDING BIOLOGICAL RHYTHMS IN DIFFERENT ACTIVITY FIELDS (the basic content of chapter 1)

Sports training, from the beginner level to the highest level, is a global process, based on a number of psychological, educational, psychological and other disciplines, all of which are closely related to each other, led by one or more experts.

The concept of sports training can be found in the sources of several local and foreign authors. In general, they represent the same thing, the only difference is how this process is described [4, 10, 14].

In order to achieve the goals set in the training process, the same authors believe that it is necessary to solve some tasks, including:

1. Learning the technique and tactics of the chosen sport.
2. Developing motor skills and increasing the body's functional capacities to ensure the desired results.
3. Improving the mental health, moral-volitional, emotional, aesthetic, intellectual and other qualities of athletes' mobilization during training and sports competitions.
4. The accumulation of theoretical and practical knowledge, which allows the rational construction and productive management of the training process, ensuring a successful cooperation between the athlete and the coach.
5. The complex improvement of skills to achieve the desired level of training necessary for participation in sports competitions.

Recently, one of the important issues in the training of junior athletes is the effectiveness of the sports training management system, which requires a new perspective in tandem with the current requirements of performance sports, many of which have become very popular among young people [3, 15]. Currently, there are different methods to improve the training process at the junior level, one of them being the planning of training in different sports events, which starts at the initial stage and ends at the performance stage [2, 12, 13].

Focusing on the research of experts in the field [28, 35, 41] we see that the intensive development of basic motor skills and those specific to the chosen sport begins at the age of 11-13. It is also at this age that the training of the basic technique takes shape in athletes. In order to optimize the process of acquiring different individual actions used in tactical training, it is recommended to enrol children in several sports competitions of different levels. Thus, the training level of the athletes increases significantly, and about 15-16 years old, the competitive training model should reach its peak.

Each stage of training has its own characteristics, depending on the sports event, the level of training of the athlete, the training conditions and many other factors. With all these, the effectiveness of education process at each stage assume to select and combine purposes, objectives, methods and means of training for achieving performance in the chosen sports event. This model can be applied to the training of juniors when a rigorous analysis of the level of sports training in one test or another will be carried out.

However, for juniors there are a series of specific requirements that experts will always respect in sports training in order their students achieve maximum performance, at national or international level. And we are referring, in particular, to the game of tennis, which every year tends to become one of the favourite sports of many young people from all over the world.

Due to the fact that the training process and the rules of official competitions at the level of high-performance tennis are constantly being modernized, it represents a serious challenge for all the staff of experts and technicians in the field, who are constantly intensifying their efforts and professional qualities in order to re-evaluate at the most high level the entire performance tennis methodology.

These visible preoccupations are focused in the direction of technical modernization, superior sports and mental training, as well as increasingly diverse tactical strategies.

The specialized literature from the country and abroad considers, but the practice of the high-performance game confirms a special fact of modernism in the game of tennis that refers to the approach of the offensive line in its entirety, both the technique and the tactics of the singles game in order to complete the game point [1, 2, 5, 11, 15, 20].

The large-scale competitions held internationally today, as well as the spectacular performance of champions from all continents, prove to us that tennis in its higher part has almost reached its peak, both in terms of technical - tactical aspects, as well as that of exceptional physical and mental training of athletes.

Tennis is a sport game which is remarkable through beauty and spectacularity. Athletes' movements are graceful and rhythmic, harmonious and precise, but few know how much effort

athletes need to look flawless on the field. The great attraction of this sporting event lies in the fact that is accessible for all ages, and players can be select depending on preferences or training level.

Currently, the game of tennis enjoys great popularity, both nationally and internationally. Due to the spectacularity and complexity of this game, many people are passionate about tennis. Along with the technical, tactical and psychological training, the physical training, which is the object of study of this paper, has a very large contribution to obtaining performance in tennis. The content of the paper refers to the physical training of 11-13-year-old female tennis players and deals with their training from the point of organization and development view, the methods used in training and from the point of the players' effort view in sports competitions. All this being influenced by human rhythms, on which performance in competitions very often depends. In the specialized literature we find very few sources regarding the physical training of tennis players, therefore this paper makes a small contribution and help the coaches in the field. The purpose of this paper is to contribute to the achievement of the best possible physical training of female tennis players, taking into account the influence of biological rhythms on the athletes' body.

Periodic changes in the functions of the human body are called daily biorhythms. Thanks to them, a person can have increased activity during the hours of optimal body condition, needing a relatively short period to restore strength.

In modern science, human circadian rhythms are used as a universal criterion for assessing health [22, 23, 25]. The daily rhythm of body temperature, which acts as a kind of biological synchronizer, is of great importance for the body's adaptation to constantly changing environmental conditions.

Various specialists have been involved in the rhythm of life, nature and society since ancient times: astronomers, philosophers, musicians, mechanics, architects, sailors, poets and, of course, doctors.

Why do we need a "biological clock"? In the activity of the body, the functions of biorhythms are unusually varied and very important for it. By repeating the natural cycles of his biorhythms, man receives a tool for measuring time - the so-called "biological clock". Our nature is amazingly rhythmic, sequential. This repetition, the predictability of phenomena makes possible life itself, which assimilates this natural rhythm into itself. The biological clock counts not only the absolute time - hours and days, but also the duration of our life.

From birth, the human body is subject to the influence of three biological rhythms: intellectual, emotional and physical. *The intellectual biological rhythm* of a person determines

his mental abilities. In addition, he is responsible for caution and rationality of actions in behaviour. The influence of this biorhythm can be felt most strongly by representatives of intellectual professions: teachers, scientists, financiers. The ability to concentrate and perceive information depends on intelligent biocycles. *Emotional biorhythm* is responsible for the human state of mind. It affects perception and sensitivity and can also transform a person's spectrum of sensations. Due to the influence of this rhythm, people can change their mood during the day several times. He is responsible for creativity, intuition and empathy. The most affected by the impact of emotional rhythm are women and artistic people. The emotional state caused by the fluctuations of this rhythm affects family relationships, love, sex. *Physical biorhythm* is directly related to the activity of the human body. It determines internal energy, resistance, reaction and metabolic rate. By reaching its maximum, this biological rhythm increases the body's ability to recover. This is especially important for athletes and people whose activities are related to physical activity.

The problem of biological rhythms is one of the fundamental problems of modern biology and medicine. The introduction of the time concept into the study of the processes taking place in a living organism makes it possible to consider the category "space-time" in dialectical unity.

In this sense, the understanding of the most important role of biological rhythms in the functional activity of the athlete's body and the use of patterns to predict his condition are very promising.

It is known that performance athletes are usually in better shape in the morning or afternoon. This phenomenon is related to circadian rhythms, i.e. biological rhythms that change every 24 hours. They are of major importance in the context of sports competitions, when athletes want to achieve maximum performance at a particular moment [27, 29].

One of the methods of assessing the individual nature of the daily variability of the level of wakefulness is *Horne-Östberg method* [42]. According to it, 4 main types of daily biorhythms were identified in athletes: morning-day type (moderate "lark"), intermediate day type (pigeon), evening-day type (owl). Moreover, intermediate day (38.4%) and evening-day (43.8%) types predominated, evening (13.4%) and morning-day (4.5%) types being less frequent.

These studies help to plan physical activity in the training process of athletes, taking into account the individual profile of biorhythms [30, 37]. A true athlete works at the limit of human abilities, therefore the biological characteristics of his body, especially his biorhythms, must be taken into account during training, competition and in everyday life.

Knowledge of individual biorhythms is necessary for coaches in the planning and rational forecasting of sports training, which will allow the athlete to adapt most effectively to the proposed tasks and to achieve high sports performance, but at the same time to maintain health. If the daily routine is compiled without taking biorhythms into account, this can lead to a decrease in performance.

The development of motor skills and the improvement of the body's great capacities are essential aspects for achieving the objectives in the physical training process. Making them effectively represents a difficult and complex process, requiring the player to be in direct contact with a logical system of operations and actions that are the basis for achieving the highest possible level of the morphofunctional indices value and motor qualities.

Optimizing the physical training process requires deep knowledge of the players' skills and characteristics, a basic condition for reaching maximum effectiveness in the training process. Based on these particularities, the exercises are selected, the weight of the effort is established, it is decided on which aspects of the training to put more emphasis, the individual treatment of each athlete is followed in view of the training content and working methods used, establishing the performance objectives, the basic fund of physical training, come to exploit the possibilities of the players to the maximum.

Tennis coaches should encourage varied and fun exercises as much as possible so that the growing child can develop the various motor skills necessary for the game. Therefore, the coach's role is to emphasize the work of coordination in young players, studying the influence of human biorhythms on the body's activity. After that, other factors characteristic of physical condition must be taken into account and also playing an important role in the physical development of female players. It is hoped that this chapter will help coaches to understand the importance of biorhythms in the activity of tennis players and, as a result, to try to combine the skills of players who are both challenging and systematic through training in accordance with their biological rhythms.

The selection in tennis is done naturally, it is difficult to confirm after a lot of work and effort. All players are good, but not all get to practice high performance tennis. Performance in lawn tennis requires seriousness, systematic training, special physical and mental effort, perseverance.

2. RESEARCH METHODOLOGY. ANALYSIS OF BIOLOGICAL RHYTHMS WITHIN THE COMPETITIVE ACTIVITY OF FEMALE TENNIS PLAYERS (the basic content of chapter 2)

The integrity of the research objectives cannot be possible without the careful use of scientific research materials, being of real use both the data collection methods, the processing methods, and the results elaboration methods. The analysis of the training activity of beginners in lawn tennis through motor learning, focused on the impact of biological rhythms, their training conditions, led us to the conceptions related to the pedagogical activity of the teacher, the coach's professional activity, the pedagogical system and the training lesson [2, 12, 15]. In order to analyse the structure and content of the competitive activity of 11-13-year-old female tennis players, we applied research methods, thanks to which we planned to obtain concrete data regarding the impact of biological rhythms and tactical training models on their competitive activity.

Based on the purpose and objectives proposed at the initial stage for the organization and conduct of scientific research on the competitive activity of tennis players over the period of three competitive years, several research methods were used, some conservative and specific to the game of tennis, others being more special. These include:

- *Analysis, synthesis and generalization of bibliographic sources.*
- *Studying the normative acts for the training of junior female tennis players.*
- *Pedagogical observation.*
- *Sociological questioning (survey, discussions).*
- *The method of pedagogical experiment.*
- *Test method.*
- *Statistical-mathematical methods of data processing and interpretation.*

The theoretical approach of the given paper results from the conceptions about the professional activity of the physical education teacher, the pedagogical system, the training lesson, the methodology of extracurricular activities, the training of beginners in lawn tennis through motor learning. The need to analyse bibliographic sources emerges from the consideration of scientific argumentation in the planned research, focusing on the influence of biological rhythms on competitive activity, but also on the motor training of junior female tennis players and skill development.

The analysis of the specialized literature took place over the course of several years and includes a spectrum of sciences, which address general and particular problems of the

docimological doctrine as a science that deals with the systematic study of examinations and the identification of the means that contribute to ensuring the objectivity of the evaluation, the problems related to the training of beginner tennis players through motor learning as well. In this regard, sports training plans are developed by organizations involved in the training of young tennis players, sports training programs, planning documents and organization of the junior training process, various methodological and scientific publications were analyzed at various national and international scientific symposia and forums. Taking into account the fact that information on the influence of biological rhythms on the athlete's body is scarce in the specialized literature, we used the Internet - it being a very current and easy-to-use source of information. Here we refer to the research sites, where the most current materials can be collected and analyzed, in our case with reference to the training of junior tennis players.

Pedagogical observation

Observation is the oldest method of ascertainment, on the basis of which descriptions, classifications are made, hypotheses are formulated or conclusions are drawn. The given method is one of the most requested in research in the field of physical education and sport [33, 34, 58].

Sociological questioning (survey, discussions)

The investigation is an activity developed with the help of the analysis and generalization of the opinions of specialists from different fields of activity, including physical education and sports field [8, 9, 18], especially tennis, on the problem of training female tennis players aged 11-13.

The pedagogical experiment

The pedagogical experiment represents a rational and systemic approach of scientific research in the educational sciences field and is of a confirmative or formative nature. New conditions or situations are created, capable of causing changes in the conduct of educational activities in order to confirm or deny the initial hypothesis formulated at the beginning of the investigations [33, 34].

The experiment is a research method that involves the conscious and active participation of the researcher in the course of events, selecting the means, methods and assessment measures specific to the game of tennis.

The formative experiment constituted the basic element of our research. 2 groups of subjects who practice tennis at the junior level participated in the experiment. Thus, the *experimental group* ($n=6$) represented the subjects registered at the Tennis Specialized Sports School, and the *control group* ($n=6$) - from "Sportpark" sports club. This experiment tests the effectiveness of the implementation in the training process of junior female tennis players of an

experimental sports training program focused on the biological rhythms of the athletes and their influence on the competitive activity depending on the human chronotypes. The use of the traditional training methodology for junior female tennis players was aimed at achieving the objectives set at the beginning of the experiment.

Test method

During the conducted research, 7 control tests were applied, which highlighted the level of motor and technical-tactical training of junior tennis players. At the same time, a series of tests were applied to evaluate the level of developing the coordinative capacities of the participants in the study. Thus, in our research, the following *tests* were applied *to assess motor skills*:

1. Abs.
2. Standing long jump.
3. Endurance running on a distance of 600 m.
4. Speed running 30 m.
5. Throwing the medicine ball:
6. Running with step added.
7. The "Fan" test.

The results of the indicators of training and physical development at the initial stage of research obtained by the subjects participating in the experiment are represented in the table below (Table 1). Some events from the control tests group are considered "off court" (outside the tennis court), others are "on court", because they take place on the tennis court.

Table 1. Indices of the physical training of the subjects included in the ascertainment experiment (n = 12)

No. crit.	Tests	The average value	Scales NFMT
1	Speed running 30 m (s)	6,80	6,69
2	Standing long jump (cm)	140,20	145,20
3	Endurance run 600 m (s)	250,52	240,26
4	Medicine ball throw (cm)	344,7	355,0
5	Abs (30s)	18,80	19,55
6	Running with step added (s)	5,07	4,97
7	Fan (s)	16,94	16,77

Following the interpretation of the initial physical testing data we observed an increased homogeneity of the subjects selected for our research. The proposed tests were known to all sportswomen, because they are part of the exercises used in general and specific physical

training during workouts, a fact that allows us to state that the indices obtained at the respective stage of the research correspond to the particularities of age and tactical training models of junior female tennis players.

For appreciation the *technical training level*, junior female tennis players were subjected to the following tests:

- The right shot (forehand).
- The left shot (rever or "back-hand").
- Move the ball diagonally (cross).
- Move the ball along the line (long-line).
- Passing the ball around the opponent (passing-shot, passant).

These tests are simple to apply, being appropriate for the ages researched. The method of testing the level of physical training was used to establish the level of physical training, general and specific, initial and final of the players from both groups subjected to research. Based on the results obtained in these tests, it was possible to argue the progress achieved by the experimental group.

3. EXPERIMENTAL ARGUMENTATION OF THE INFLUENCE OF BIOLOGICAL RHYTHMS IN THE SPORTS TRAINING OF 11-13-YEAR-OLD FEMALE TENNIS PLAYERS (the basic content of chapter 3)

In tennis, as in any other sport, physical (motor) training is one of the fundamental elements that underlies the performances in the preparation of any athlete. Therefore, in our research this compartment is very actual, because, for example, the qualities of strength and endurance need to be developed starting from the junior age [15, 19, 36].

In order to assess the level of motor training of junior female tennis players during the pedagogical experiment, the change of several parameters of the control tests at the beginning and at the end of the experiment was analyzed both in the experimental group and in the control group (Table 2).

The testing is based on the national standards for the training of athletes in the lawn tennis event, the regulatory requirements for their physical, tactical and technical training, the scientific and methodological development of specialists in the field, used in recent years for the training of highly qualified athletes [32, 35, 36, 39, 40].

Table 2. Comparative analysis of the motor training level of the subjects of the control and experiment group (initial testing, n=12)

No. crt.	Control tests	Control group T.I. X±m	Experimental group T.I.X±m	t	P
1	Speed Running 30 m (s)	6,76	6,78	0,24	>0,05
2	Standing long jump (cm)	138,60	141,60	0,34	>0,05
3	Endurance running 600 m (s)	248,36	252,16	0,52	>0,05
4	Medicine ball throwing (cm)	342,45	346,25	0,06	>0,05
5	Abs (30s)	18,80	20,40	0,23	>0,05
6	Running with step added (s)	4,97	5,14	0,12	>0,05
7	Fan(s)	16,79	17,09	0,22	>0,05

The purpose of implementing these tests was to confirm the effectiveness of the training system for junior female tennis players, to achieve high performances depending on the influence of biological rhythms on the body, to prepare the sports reserves and to enrol in the national teams of the Republic of Moldova.

Like the other motor qualities, speed is a quality transmitted, in most cases, genetically, but it can and must be developed, especially at the junior level. This quality, although it can be improved, done within quite narrow limits.

If we analyze the results recorded in the speed running test, we notice a clear equality of them in both groups at the initial test, the control group registering an average of 6.76 seconds, and the experimental group – 6.78 seconds, and this proves that the groups at this indicator are practically at the same level of sports training. Even if at first glance the difference between the results of both groups at the end of the experiment is not substantial, the calculations showed a statistically significant difference ($P < 0.05$).

The initial testing data for the "Long Jumping" test shows that both groups demonstrated approximately equal values, recording averages of 138.60 cm in the control group and 141.60 cm in the experimental group. Obviously, the difference in the results recorded by the two groups is statistically insignificant ($P > 0.05$).

The analysis of the indicator that represents the level of development of the abdominal strength of female tennis players shows us that during the initial testing both groups participating in the experiment recorded a very close average. Thus, the control group had an average of 18.80 in raising the torso, and the experimental group – 20.40 repetitions. The calculations showed that there is no statistically significant difference between the two results ($P > 0.05$), which proves that in this parameter the groups were homogeneous in the level of abdominal strength development.

The next control test that comes to demonstrate the effectiveness of the endurance development in junior female tennis players and which has always been one of the basic motor qualities is the test of endurance running on a distance of 600 meters, in which the control group recorded the result of 2.48 sec., and the experimental one - 2.52 sec., so the difference in the results recorded by the two groups is statistically insignificant ($P>0.05$).

The initial testing took place 45 days after the start of the experiment, after which all the exercise complexes were implemented (except those for behind the hand service, which were used in October).

In the table below we have the data of the final testing of the motor skills of the subjects from the control group (Table 3).

Table 3. Comparative analysis of the motor training level of the subjects of the control group (initial and final testing, n=6)

No. crt.	Control test	Control group T.I. X±m	Control group T.F. X±m	t	P
1	Speed Running 30 m (s)	6,76	6,60	0,86	>0,05
2	Standing long jump (cm)	138,60	147,90	0,78	>0,05
3	Endurance running 600 m (s)	248,36	243,08	1,02	>0,05
4	Medicine ball throwing (cm)	342,45	355,38	1,35	>0,05
5	Abs (30s)	18,80	21,70	0,69	>0,05
6	Running with step added (s)	4,97	5,92	0,90	>0,05
7	Fan(s)	16,79	18,90	0,60	>0,05

Referring to the morphofunctional indices of the control group that had a classic course of skill development, we note that it registered insignificant increases in all tested parameters. We can say that positive results were recorded for most of the indicators, and at the end of the experiment, indices were obtained with a difference of 0.01 sec., which represents an increase of 1% ($P>0.05$).

The data in Table 4 represent the results of the control tests of the researched subjects from the experimental group at the initial and final testing.

The experimental group, after completing the program based on the development of coordinative capacities, recorded significant values compared to the initial ones. For example, the speed ability tested by the 30m running improved at the initial test compared to the data at the final test by 0.4 seconds, which is a significant increase of about 5% ($P<0.01$). In our opinion, this is due to the application of means of developing coordinative capacities, a fact that

led to the improvement of both intermuscular and intramuscular coordination, which substantially influences the frequency of movements, a determining factor of speed capacity.

Table 4. Comparative analysis of the motor training level of the experimental group subjects (initial and final testing, n=6)

No. crt.	Control tests	Experimental group T.I. X±m	Experimental group T.F. X±m	t	P
1	Speed Running 30 m (s)	6,78	6,69	3,78	<0,01
2	Standing long jump (cm)	141,60	152,26	3,71	<0,01
3	Endurance running 600 m (s)	252,16	247,05	3,89	<0,01
4	Medicine ball throwing (cm)	346,25	359,20	4,66	<0,001
5	Abs (30s)	20,40	22,55	3,86	<0,01
6	Running with step added (s)	5,14	5,99	4,49	<0,001
7	Fan(s)	17,09	18,98	3,21	<0,001

In the "Standing long jump" test, the experimental group recorded average values compared to the values recorded at the initial test, and at the end of the experiment we note considerable differences in the test results (11 cm), which represents an increase of 11% (P<0.001). And in the ball throwing test, very significant final values of these motor qualities were recorded, showing the importance of the researched experiment.

Comparing the recorded values of the subjects group at the end of the experiment, we can mention that for the speed indicator the control group obtained lower values compared to those in the experimental group, which represents 6%, and (P<0.05). In the standing long jump, the control group recorded lower values compared to the experimental group, namely 16.7 cm, which represents 9% (P< 0.05). At the endurance indicator, there were significant differences in the increase of the indices of the experimental group compared to the control group, respectively of 4 sec., which represents a 5% increase (P<0.05) (Table 5).

Analyzing the results of the tests in order to assess the level of motor training of the sportswomen participating in the experiment, we clearly observe a trend of their improvement, a fact that demonstrates the effectiveness of the implementation of the experimental program and the confirmation of the effectiveness of the training system for the development of coordination capacities in junior female tennis players.

Table 5. Comparative analysis of the motor training level of the control and experiment group subjects (final testing, n=12)

No. crt.	Control tests	Control group T.F. X±m	Experiment group T.F. X±m	t	P
1	Speed Running 30 m (s)	6,60	6,69	2,22	<0,05
2	Standing long jump (cm)	147,90	164,60	2,31	<0,05
3	Endurance running 600 m (s)	243,08	247,05	2,43	<0,05
4	Medicine ball throwing (cm)	355,38	359,20	2,28	<0,05
5	Abs (30s)	21,70	22,55	2,36	<0,05
6	Running with step added (s)	5,92	5,99	2,24	<0,05
7	Fan(s)	18,90	18,98	2,20	<0,05

In other words, increasing the level of development of coordinative capacities has a positive influence on the development of other motor qualities, a fact demonstrated in the conducted formative experiment.

The final testing of motor qualities showed significant increases in most of the tested indicators and the program piloted by the experimental group reached the goal proposed by us and the research hypothesis came true.

Evaluation of the competitive activity of 11–13-year-old female tennis players with different types of surfaces and biological rhythms

In their works, the specialized authors [1, 5, 6, 11, 13, 26] emphasize that today's tennis has the main characteristic imposed by dynamism competitive stages, thanks to physical training almost perfect of tennis players, harmonized with their individual characteristics. Most elite tennis players are exceptionally physically fit. Depending on the surfaces used, tennis can be very different as a game. On hard tennis courts, the pace and intensity are lower, and on fast surfaces (grass, green-set, carpet, cement) they are very high and require players to play at a higher speed and move faster. Depending on the opponent's capabilities and his desire to win, some matches can last from one hour to 4-5 hours, the weather conditions in which the game is played also vary, the air temperature can vary from 7-8 degrees to at over 40, games can be played outside or indoors, all of which require a very high level of physical fitness. Therefore, physical training of a tennis player includes all the basic motor qualities, speed, skill, force and endurance in all their display, as well as combinations in order to achieve great performances.

In modern tennis, competitions are held on courts with different types of surfaces, among which, depending on the height and speed of the ball's withdrawal, fast and slow ones are

distinguished. Depending on the ground coverage, the player has the opportunity to develop certain tactics of the game.

An analysis of the competitive activity of highly skilled tennis players [5, 19, 20, 28, 45, 46] showed that the game on different surfaces is distinguished by the versatility of technical actions, the volume of technical actions and qualitative and quantitative movement parameters, which imposes additional requirements on the organization of the training process.

In many specialized institutions and sports centers in the Republic of Moldova, during the autumn-winter period, tennis players train in the gym on courts with fast surfaces, while the most important competitions take place in the summer on clay courts. Many experts note a decrease in the technical and tactical indicators of the playing activity of tennis players when moving on courts with different surfaces.

In this sense, the problem of optimizing the training process is relevant for increasing the effectiveness of the competitive activity when moving from one surface to another, for the solution of which it is necessary to identify the characteristics of the competitive activity of junior players when the games are spent on fields with different types of coverage, but also from previous studies we came to the conclusion that it is useful to verify and correlate these results and information with the influence of biological rhythms on the activity of athletes. The identification of the specific characteristics of competitive activity and the influence of biological rhythms will contribute to a more effective construction and correction of the training process, depending on the performance on a certain type of surface.

According to experts [35, 36, 38], clay courts are characterized by a long game on the back line, the absence of active exits to the net to finish the volley, which is due to the slower pace of the game than on a hard surface. Hard courts are characterized by active and fast play, using all means of actions, including active and final shots.

Quantitative characteristics of competitive activity, both among highly skilled and junior tennis players, have significant individual variation [44]. In addition, the dependence of the quantitative characteristics of the competitive activity on the type of court cover on which the contests are held was revealed. In particular, on fast surfaces, the net playing time is less than on clay, the number of shots made by each player during the game is also less, but they are executed at a much faster pace.

The statements of experts Drewett J. (2009), Elliot B., Reid M., Crespo M. (2003) prove to us that the most informative indicators for evaluating the effectiveness of competitive activity in tennis are the indicators that characterize the technical and tactical actions of athletes.

In our research, we evaluated the competitive activity of junior female tennis players when they play on courts with different types of coverage, with a two-week interval between starts.

Research results have shown that when young women switch from covering *hard* at that *soft*, the net time of the match increases significantly - by 40%, the distance covered - by 53%, the pace of the game decreases by 30%, the volume of game actions by 14%.

The results of the analysis of the competitive activity of 11-13-year-old female tennis players when playing on courts with different types of surfaces are consistent with the data of the scientific and methodological literature, although the distribution of individual indicators was not as significant as that of skilled athletes. This is probably due to the fact that the competitors throughout the year were always the same (Table 6).

Table 6. General assessment of indicators of competitive tasks of female tennis players aged 11 to 13 years when playing on courts with different types of coverage ($X \pm \sigma$)

Indicators	Hard fields		Soft fields	
	October	April	May	September
Total time (min)	76,7±10,90	78,2±11,15	91,4±18,51*	93±17,29*
Net time (min)	19,4±6,82	20,7±5,61	31,5±11,53*	31,3±11,45*
Number of games (No)	16,6±1,08	16,3±1,32	18,6±3,09*	19,2±3,14*
Number of shots in a game (no)	16±2,31	15,4±2,83	18,4±5,3*1	17,5±5,21*
The sum of the races (number of shots)	237,3±42,63	252,5±35,67	281,4±29,55*	281,5±30,49*
Distance covered in a match (m)	978,8±74,99	968,7±83,50	1675,8±439,6*	1676,7±439,7*
Action volume (beats/hour)	198,3±23,89	194,7±23,53	169,3±21,46*	169,2±21,57*
Tempo (bpm)	23,7±1,23	23,5±1,35	17,4±2,79*	18±2,67*
Motor density (%)	24,83±5,60	26,86±5,61	33,68±6,12*	33,3±6,2*

Note: * - differences are statistically significant at $p < 0.05$ between indicators when playing on fields with different types of coverage

As the results of the study showed (Table 7), the performance efficiency of technical and tactical actions of junior female players during competitions on a hard surface in the autumn-

winter season changed slightly: the hitting percentage of the first serve increased by 9%, the indicator " double fault when serving" improved by 7%, the serve is one of the most important indicators of the level of speed-power endurance, the percentage of forced and unforced errors decreased slightly, namely, tennis players began to make fewer mistakes and became also more attentive to the actions and attacks of the opponent, but could not diversify their game due to the variation of shots. For example, active netting with an additional point gain only got 10% worse. This means that female tennis players have the same pattern of play, only using recovery shots while behind the court.

Table 7. Characteristics of special indicators of competitive tasks of junior female tennis players aged 11 - 13 years on courts with different types of coverage ($X \pm \sigma$)

Indicators	October	April	May	September
Effective percentage at service	17,6±6,52	19,4±7,98	15,6±3,80*	23,6±9,46*
Serving off the field	3,4±0,53	3,1±0,94	2,4±0,67*	3,2±1,20*
Double fault at service	11,6±1,57	10,8±2,23	12,7±2,70*	10,5±2,31*
Forced errors	37,4±7,50	35,3±6,81	40,2±3,73*	27,2±5,24*
Unforced errors	33,5±5,19	31,5±6,08	38,3±1,75*	27,1±5,19*
Point gained from "ace" service	2,3±1,03	2,3±1,03	1,6±0,67*	3,2±0,99*
Active net out with point gain	2,2±0,88	1,8±0,99	1,4±0,53*	2,5±0,84*

Special attention, in our opinion, should be paid to the assessment of special indicators of competitive activity when changing the type of playing field surface. Between the control games in April (hard) and May (soft) there was a short period of time - two weeks. However, the indicators of technical and tactical actions of young sportswomen are changing significantly. The service hitting percentage is statistically significantly reduced (21.5%), the sportswomen's attention and reaction to the opponent's attack are reduced as well, which reflects the "forced errors" indicator, increased by 13%. The percentage of unforced errors also increased (19.5%). The accuracy of hitting the ball in the intended area of the field decreased by 25.5%. An active net out with a point gain was achieved by junior female tennis players on a soft surface 20% less often than on a hard surface.

It can be assumed that a significant decrease in the effectiveness of competitive activity during the transition from hard court to soft court is associated with an insufficient level of physical condition of junior girls. Soft surface courts place increased demands on tennis players' coordination skills and, above all, on the development of speed-strength qualities and the ability to maintain a high tempo of play throughout the match.

In summer, when training sessions are held on soft surface courts, the level of physical condition of junior female tennis players increases significantly, which, in turn, makes it possible to increase the efficiency of competitive activity. This is because on soft courts athletes are forced to run long distances during a training session. As a result, until the end of the spring-summer period, the physical condition indicators of junior female tennis players increase statistically significantly.

Along with the evaluation of the competitive activity, an evaluation of the physical training of the junior female tennis players at different stages of the annual training cycle was carried out. The correlation analysis carried out confirmed the hypothesis that on soft surfaces the efficiency of competitive activity is interconnected with the level of development of speed-endurance qualities. It can be assumed that the training process of junior female players for competitions with a change of the field coverage can be rationalized based on the inclusion of exercise complexes for the development of speed-strength capabilities in the training process.

GENERAL CONCLUSIONS AND PRACTICAL-METHODICAL RECOMMENDATIONS

1. From the study of specialized literature, it was found that the human body obeys the rhythms established by nature itself, these rhythms influence all the processes that take place in the human body, and it is logical that they have an impact including on the sports training process. Considering these rhythms and respecting them is the basis of human health. When a person coordinates the daily routine with his individual biorhythms, the level of his physical and mental performance is much higher.

2. If the competitive activity coincides with the phase of decrease or the phase of decline of the biological rhythms, the athlete must take this fact into account and distribute his forces reasonably both during the training period and during the competition period, because the effort will be spent at the limit of the athlete's physical capabilities, due to the capabilities and volitional qualities.

3. The majority of athletes in the SSST, according to the type of biological activity, belong to the so-called "owls", i.e. people whose work capacity increases in the afternoon.

Biological rhythms have a special influence on the performance of athletes, especially they have a major impact on their mental performance: it has been shown that "larks" during training spent in the first half of the day have a higher mental performance than "owls". Following the research, we found that 16% of athletes belong to the morning chronotype - "lark", 26% of the nocturnal chronotype - „owls” and respectively 58% have intermediate chronotype that is, they are "pigeons".

4. Following the development and implementation of the complex program of dynamic games by applying the specific means of lawn tennis to female juniors aged 11-13 by learning motor processes, which focused on the development of didactic content during a training macrocycle, the training level of junior female tennis players as a result has improved a lot.

5. Referring to the integral results of the study on the development of skills in junior female tennis players, we can mention that at the final test the experimental group obtained significantly higher indicators ($P < 0.05$) compared to the control group, a fact that demonstrates the effectiveness of the application of the means specific to the game of tennis for ages 11-13.

6. Following the application of the experimental program for the development of skills through motor learning, the indices that define the level of psychomotor training in the subjects of the experimental group increased significantly ($P < 0.05$), a fact that demonstrates its effectiveness.

7. The applied experimental program also led to the significant improvement ($P < 0.05$) of the indices that define the level of technical training of the subjects of the experimental group, compared to those of the control group. Thus, after analysing the results of the researches carried out, the scientific problem of major importance was successfully solved, which consisted in the theoretical and experimental substantiation of the managerial training program for junior female tennis players, the optimization of the training process for 11-13-year-old tennis players, focused on the influence of biological rhythms at that age, applying the means of skill development through motor learning, which led to an increase in the level of development of their coordinative capacities.

The analysis of the specialized literature and the results of the pedagogical experiment carried out within our research show us that the problem of skill development through motor learning in junior tennis can be effectively solved only by observing the following methodical recommendations:

1. The teacher-coach must possess a complex system of theoretical knowledge regarding the methodology of skill development through motor learning in lawn tennis at the junior level for the practice of tennis respecting the principles, methods and criteria well determined and scientifically argued at the national and international level.

2. The institutions that organize and carry out the training process of tennis players must provide the coaches with the means and equipment necessary for the selection and testing subjects with skills at the initial stage of practicing the game of tennis.

3. The motor learning process must be directed, systematic and continuous in order to create the necessary conditions for carrying out gradual training activities and monitoring subjects.

4. The best age for starting the tennis training process, at the initial selection stage, is between 11 and 13 years old, depending on the individual characteristics of each subject. The amount of effort at this stage of training must be staggered according to the possibilities of the subjects, their level of development and their physical training.

5. The multi-year training system of tennis players will be based on scientific and methodical criteria applied in the theory and methodology of sports training: somatic, motor, technical, psychological, pedagogical, medical-biological, etc.

6. Taking into account the differences between the development of somatic, motor, technical and psychological indices of the group of subjects included in the research, we suggest as indispensable the application of training plans, based on the rigorous analysis of the development of the skill through motor learning taking into account the particularities of each athlete.

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List of scientific papers on thesis theme

2. Articles in scientific journals

2.2. in recognized foreign journals

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-8. ANGHEL, A., BUDEVICI-PIIU, A. *Cercetarea ritmurilor biologice ale sportivilor de performanță în cadrul activității competiționale (tenis de câmp).* În: Conferința Științifică Internațională a Tinerilor Cercetători „Probleme actuale ale teoriei și practicii culturii fizice”, ediția a I-a, 13 aprilie 2023.

ADNOTARE

Anghel Alexandru: Influența ritmurilor biologice asupra activității competiționale a tenismenelor de 11-13 ani, teză de doctor în științe ale educației, specialitatea 533.04. Educație fizică, sport, kinetoterapie și recreație. Chișinău, 2023.

Structura tezei: introducere, 3 capitole, concluzii generale și recomandări, bibliografie (197 titluri), 113 pagini text de bază, 7 anexe, 35 tabele, 36 figuri. Rezultatele obținute sunt publicate în 8 lucrări științifice.

Cuvinte-cheie: ritmuri biologice, tenis, tenismene junioare, pregătire fizică, pregătire psihică, performanță sportivă, activitate competițională.

Scopul cercetării constă în optimizarea procesului de instruire a tenismenelor de 11-13 ani, axat pe ritmurile biologice ale sportivelor la vârsta respectivă.

Obiectivele cercetării: 1. Analiza teoriei și practicii moderne a procesului de instruire și a activității competiționale a tenismenelor. 2. Studiarea caracteristicilor bioritmurilor individuale ale sportivelor și determinarea tipului lor cronobiologic. 3. Elaborarea structurii și a conținutului metodologic al proiectului programei de antrenament sportiv (PPAS). 4. Verificarea experimentală și confirmarea eficacității sistemului de pregătire a tenismenelor junioare în baza PPAS.

Noutatea și originalitatea științifică a cercetării constă în elaborarea, validarea experimentală a programei de antrenament sportiv (PPAS) axate pe ritmurile biologice și pe influența acestora asupra activității competiționale a tenismenelor de 11-13 ani. Punerea în practică a programei date va contribui la optimizarea procesului de pregătire a tenismenelor junioare, exprimată prin sporirea nivelului pregătirii motrice, tehnice, precum și a calității antrenamentului sportiv în ansamblu.

Semnificația teoretică rezidă în elaborarea și argumentarea experimentală a conținutului programului experimental axat pe influența ritmurilor biologice asupra activității competiționale a tenismenelor – aspecte în baza cărora a fost elaborat un îndrumar metodic - didactic destinat antrenorilor „Impactul ritmurilor biologice asupra performanței sportive”.

Valoarea aplicativă a lucrării este determinată de posibilitățile implementării rezultatelor cercetărilor în activitatea competițională axată pe ritmurile biologice specifice vârstei și jucătoarelor de tenis (11-13 ani). Drept rezultat al cercetărilor a fost elaborat și implementat îndrumarul practico-metodic „Impactul ritmurilor biologice asupra performanței sportive”, ca o nouă metodă de antrenament al jucătoarelor de tenis.

Implementarea rezultatelor științifice: rezultatele cercetării au fost implementate în procesul de antrenament al tenismenelor junioare din ȘSST și cluburile sportive specializate de tenis din Republica Moldova. Acestea pot fi aplicate în calitate de material metodologic pentru antrenorii de tenis la nivel de juniorat, în procesul de pregătire profesională a studenților din instituțiile de învățământ superior de educație fizică și sport la specialitatea „Tenis”, precum și în cadrul turneelor naționale și internaționale la care participă tenismenele junioare.

АННОТАЦИЯ

Ангел Александр: Влияние биологических ритмов на соревновательную деятельность теннисисток 11-13 лет. Диссертация на соискание степени доктора педагогических наук, специальность 533.04. Физическое воспитание, спорт, кинетотерапия и рекреация. Кишинэу, 2023.

Структура диссертации. Диссертация состоит из введения, 3 глав, общих выводов и рекомендаций, библиографии из 197 наименований, 113 страниц основного текста, 7 приложений, 35 таблиц, 36 фигур. Полученные результаты опубликованы в 8 научных работах.

Ключевые-слова: биологические ритмы, теннис, юниорский теннис, физическая подготовка, психологическая подготовка, спортивные результаты, соревновательная деятельность.

Целью исследования является совершенствование процесса обучения юных теннисисток 11-13 лет, основанного на биологические ритмы спортсменов данного возраста.

Задачи исследования: 1. Анализ современной теории и практики процесса обучения и соревновательной деятельности юных теннисисток. 2. Изучение особенностей индивидуальных биоритмов спортсменов и определение их хронобиологического типа. 3. Разработка структуры и методического содержания проекта программы спортивной подготовки (ППСП). 4. Экспериментальное обоснование и подтверждение эффективности системы подготовки юниорок в теннисе на основе ППСП.

Научная новизна и оригинальность исследования заключается в разработке и экспериментальном обосновании внедрения программы спортивной подготовки (ППСП), основанной на биологические ритмы спортсменов и их влияние на соревновательную деятельность теннисисток 11-13 лет. Применение данной программы поможет оптимизировать процесс подготовки теннисисток-юниорок, что приведет к повышению уровня моторной и технической подготовки, а также качества спортивной подготовки в целом.

Теоретическая новизна заключается в разработке и экспериментальной аргументации содержания экспериментальной программы, основанной на влияние биологических ритмов на соревновательную деятельность теннисисток – аспекты, на основе которых было разработано методико-дидактическое пособие для тренеров «Влияние биологических ритмов на спортивные достижения».

Практическая значимость работы определяется возможностью внедрения результатов исследования в соревновательную деятельность, основанную на биологические ритмы, специфичные для возраста теннисисток 11-13 лет. В результате исследования было разработано и внедрено методико-практическое пособие «Влияние биологических ритмов на спортивные достижения» как новый метод тренировки юных теннисисток.

Внедрение научных результатов: результаты исследования были внедрены в тренировочный процесс юных теннисисток ССШТ и специализированных теннисных спортивных клубах Республики Молдовы. Они могут быть применены в качестве методического материала для тренеров по теннису на юниорском уровне, в процессе профессиональной подготовки студентов высших учебных заведений, а также в национальных и международных турнирах, в которых участвуют юные теннисистки.

ANNOTATION

Anghel Alexandru: The influence of biological rhythms on the 11-13-year-old female tennis players' competitive activity, PhD thesis in education sciences, specialty 533.04. Physical education, sport, kinetotherapy and recreation. Chisinau, 2023.

Thesis structure: introduction, 3 chapters, general conclusions and recommendations, references (197 titles), 113 pages of basic text, 7 appendices, 35 tables, 36 figures. The obtained results are published in 8 scientific papers.

Keywords: biological rhythms, tennis, junior female tennis players, physical training, psychic training, sports performance, competitive activity.

The aim of the research consists in optimizing the training process of 11-13-year-old female tennis players, focused on the biological rhythms of athletes at that age.

Research objectives: 1. Analysis of the modern theory and practice of the competitive activity process of female tennis players. 2. Studying the characteristics of individual biorhythms of athletes and determining their chronobiological type. 3. Elaboration of the structure and methodological content of the sports training program project (STPP). 4. Experimental verification and confirmation of the effectiveness of the training system for junior tennis players based on STPP.

Novelty and scientific originality of the research consists in the elaboration, experimental validation of a sports training program (STPP) focused on biological rhythms and their influence on the competitive activity of 11-13-year-old female tennis players. The practical application of the given program will contribute to the optimization of the training process of junior female tennis players, expressed by increasing the level of motor and technical training, as well as the quality of sports training as a whole.

The theoretical significance consists in the elaboration and experimental argumentation of the content of the experimental program focused on the influence of biological rhythms on the competitive activity of female tennis players - aspects based on which a methodical-didactic guide was developed for coaches "The impact of biological rhythms on sports performance".

The applicative value of the work is determined by the possibilities of implementing the results of research on competitive activity focused on age-specific biological rhythms and the tennis game (11-13 years). As a result of the research, the practical-methodical guide "Impact of biological rhythms on sports performance" was developed and implemented as a new training method for female tennis players.

Implementation of scientific results: the results of the research were implemented in the training process of junior female tennis players from the SSST and the specialized tennis sports clubs of the Republic of Moldova. They can be applied as methodological material for tennis coaches at the junior level, also in the process of professional training of students from higher education institutions of physical education and sports in the "Tennis" specialty, as well as in national and international tournaments and competitions.

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ANGHEL ALEXANDRU

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