

SOFIA UNIVERSITY "ST. KLIMENT OHRIDSKI "

SUMMARY

OF REVIEWED PUBLICATIONS IN BULGARIAN AND ENGLISH

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MONOGRAPH

Group B - Indicator – 3

1. Karparova, I. Biomechanical foundations of running technique and methodological guidelines in training. Monograph. University Publishing House "St. Kliment Ohridski". ISBN 978-954-075614-1. 2022.

The monograph was published by the University Publishing House "St. Kliment Ohridski" in a volume of 134 pages and is illustrated with 22 figures, 3 tables, and 6 photographs. 89 literary sources are included, of which 3 are in Bulgarian and 86 in English, 3 internet sites.

The monographic work is structured into 6 chapters.

It expresses the author's scientific interest globally in the essence of human movement and specifically in running as a motor activity. An attempt has been made to present the basics of running biomechanics in a structured way, with specific training guidelines given.

Basic knowledge of the biomechanics of movements will enable active people of different ages and with different qualifications, teachers, and coaches to better understand sports technique and influence it to improve performance, prevent injuries, and sports longevity.

The aim is to provide an understanding of human movements and specifically running as a type of movement, to help solve the basic tasks related to the functions of the human body when performing this activity. The basic knowledge of biomechanics is an invariable and important part of the sports-pedagogical process both in the field of competitive and amateur sports.

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In the **first chapter** of the present work, data on movement are presented as interest from the side of science. The analysis of human movements has long been of interest to scientists. The running technique is studied to optimize motor activity and, especially in endurance running, to improve energy expenditure. It relies on the concept that purposeful and economical movements will hypothetically lead to a lower risk of injury. For these

reasons, people involved in sports in the competitive and amateur spheres need knowledge of the essence of movement.

In the first chapter, a brief historical overview of scientific research related to biomechanics is given.

The three laws of Newton, from the 17th century, serve as the foundation of biomechanics, which studies the reasons for the occurrence of movements of material bodies, depending on the forces applied to them. Then (in the late 19th and early 20th centuries) the three Weber brothers began to more thoroughly describe walking and running, the dynamic side of shifting the body's general center of gravity when walking.

The first steps towards a more detailed study of movements are from the beginning of the 19th century. Scientists such as the German physiologist Emile Harles, the French physiologist Etienne-Jules Marie, the Russian physiologist Bernstein, the American Elfman, etc., conducted and described numerous studies related to human movements.

Later in the years (after the middle of the last century), the knowledge of biomechanics was constantly increasing, and it was inevitably connected with the enormous popularity of running for health worldwide. Of course, in the field of competitive athletics, scientific research on biomechanics is of essential importance, given the importance of optimal movements for each type of motor activity and the professionalization of the sport.

In the field of sports and specifically running, biomechanics mainly examines and characterizes the running stride, and studies the forces acting on the runner. In this sense, the first chapter of the present monograph summarizes that, from the point of view of kinetics, the movement of the body in space during running comes down to controlling several main moments, namely:

- Depreciation limitation;
- Optimal ratio between the different angles in the bone-joint apparatus;
- Using the elastic strength of the fascia;
- Balance and control of the upper body;
- Generation of energy for optimal movement of the COG (center of gravity) forward and upward;
- Optimization of vertical displacement for economic purposes.

It is summarized that the goal of the runner in terms of running technique is to optimize and adapt its biomechanical expediency to lead to maximum effect with minimum energy expenditure, and to store energy over time.

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In the **second chapter** of the work, a classification of movements is made, and the important terms in the biomechanics of physical exercises and Newton's laws are described. For the needs of the theoretical material, the forces acting during running and, more specifically, those acting obliquely to the support, passing through the COG, are examined in more detail. In most cases in sports, the forces act in a direction that is not perpendicular. If the movement is not rotational or otherwise complex, then the forces pass through the COG of the body, and if it is oblique to the support, they must be distributed horizontally and vertically. In the case of a movement such as running, the forces act at two points of application - the athlete's COG and the contact of the foot with the support. In the two directions - x and y, which are the respective horizontal and vertical directions, there are

muscular, inertial forces, the reaction of the support, resistance forces from the environment, elastic deformation, etc., and each has a different peak in displacement there is nobody in space.

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The **third chapter** gives a more detailed description of the individual structures of the human body and their reflection in the temporal, kinematic, and dynamic structures of movements. A better knowledge of the anatomy of the body will help to better understand the cycles of the running stride.

In this chapter, special attention is paid to bones, joints, muscles, and tendons. The biomechanical features of the parts of the bone-joint apparatus are described, both by individual segments and as a whole. The axes and planes in the human body and the degrees of freedom of movement are described. The author has presented graphically, in tabular form, the importance of running joint connections by segments, with their corresponding parts, number, and description of the degrees of freedom of movement.

The topic of the importance of the walking complex in the human body - ankle and foot - has a significant place in the monograph. The anatomical features of the bones, the connections between them, the arches of the foot that they form, the adjacent muscles and tendons, and the biomechanical features of all these parts are described. For running, pronation, and supination, changes that occur in the "behavior" of the feet during the running stride in the presence of certain deformities are important.

Muscles are the active part of the locomotor system and the main "culprit" for making movements by generating force. The most active muscles and muscle groups involved in running movements are discussed in detail in the third chapter.

The author highlights in several places in his work the tendons and ligaments, as a particularly essential part for carrying out the movements. Ankle mobility is important in running. Insufficient activity of the calf - Achilles - foot complex will hypothetically change the entire biomechanics of running, forcing compensatory mechanisms on the part of other muscles along the chain.

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The **fourth chapter** is of the greatest practical value because of the detailed consideration of the running stride from a biomechanical point of view. Biomechanically stable running is associated with economical and synchronized movements of the individual components of the kinetic chain. The technique is determined by the running cycle (running stride), which is discussed in detail in this part of the monograph.

Overstriding, an excessive step (in Bulgarian) is highlighted as a serious shortcoming of running technique. Placing the foot in front of the knee during stepping has been shown to result in greater compensatory forces that the joints are adapted to bear. In running, as a cyclic movement, there is repeated repetition of the same type of movements. In this sense, repeated inadequate biomechanical loading, due to improper contact of the foot with the support, would lead to injuries over time.

In this chapter, important conclusions for running technique are made: Due to the need to look for a biomechanically sound footing during contact to reduce the action of forces, the scientific literature asserts that three-point footing is most appropriate. This means that the initial contact of the foot in the stance phase is made predominantly on the metatarsals and the

heel. Of course, one way to increase running speed is to optimize the contact time of the foot with the support. For this reason, sprinters, for example, step very strongly on the front part and make very short contact with the ground.

The subsections of the fourth chapter also describe the parameters of running dynamics, and the forces acting on the joints of the lower limbs. When running, the main goal of the movement is to move the body in space along an optimal trajectory, with the aim of minimal energy consumption over time. The stride length-frequency ratio can be a sign of individuality and reveal a runner's strengths and weaknesses, but these two parameters should not be considered unambiguously, but in detail, along a horizontal and vertical axis.

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The **fifth chapter** of the monograph presents systematized theoretical notes on the main points of training in running technique. A brief historical overview of the origin and development of running shoes is given. The decisive role of modern technologies in shoes for sports results is highlighted. Since the 90s of the last century, the use of carbon fibers, or the so-called carbon plates in competitive running shoes. These technologies significantly change not only sports performance, but also the biomechanics of running. What this innovation is - the midsole of the shoes is made of foam, in which one or more carbon plates are embedded. Thus, the sole acts as a cradle, it is believed that its purpose is to absorb energy at the expense of the runner. Competitive track and field athletics can be defined as a conservative sport in terms of dramatic changes in its rules. But in recent decades, serious changes have been observed, mostly related to shoes and their use on the road. Carbon fiber has also recently been incorporated into athletic spikes and we have seen almost all running records improve. This led to the introduction of special requirements in the competition regulations related to the use of high-tech shoes. The question of whether more severe restrictions should be imposed remains open, but more important is the extent to which these new high-tech running shoes also change the biomechanics of running.

In the field of science, the topic of the relationship between running technique and injuries is still open. A large part of the injuries of runners are on the lower limbs and especially the feet, ankles, lower legs, and knees, because of the cyclic repetition of the same movements. With the entry into the market of increasingly affordable technological shoes, more and more enthusiasts are using them not only in the competition but also in the training process. Whether this, in addition to improving results, will also lead to more injuries, scientific research in the coming years will show.

An important place in the monograph is devoted to the most frequently observed injuries in runners. Each type of injury is described in detail - probable causes, prevention, and guidelines for prevention. The author developed and applied in the monograph a table in which the most common "running" injuries are systematically described. The table includes the relevant columns - pain signals and localization, kinematics, risk factors and possible causes, and prevention, for each of the described.

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The **sixth chapter** of the work is a kind of systematized summary of the author's long-term scientific research. Competitive athletics and especially running are highly professionalized worldwide. Scientists and athletes look for the smallest detail that will affect performance. A thorough study of every aspect of running – the involvement of the motor

apparatus and the biomechanical principles of movement – can optimize technique and energy expenditure.

The most economical runners exhibit precise neuromuscular control before and during ground contact that facilitates optimal spatiotemporal running biomechanics. More experienced runners reduce the "cost" of oxygen transport by optimally using the strength of the muscles of the lower limbs, as well as the elastic force "returned" by the tendons.

In the monographic work, guidelines are given on how, step by step, purposefully, runners should work on technique - to optimize the components of the running stride, aim for balance in the muscles, use the elasticity of the tendons, run often in natural conditions and if they aim for sports longevity, without competitive purposes, less likely to rely on high-cushioned, high-sole sneakers that significantly alter the biomechanics of their running.

In this sixth chapter, recommended exercises for strength and flexibility are presented in tabular form, divided by muscle group, with the corresponding description of the function of the muscles for running and methodical instructions for performing the exercises.

The monograph ends by highlighting ten key points for good running form, according to the author, namely:

- Balanced musculature
- Running without overstriding
- Active muscles (especially core, hamstrings, gluteus complex, calves)
- Relaxed, free movements
- "Using" the tendons, elasticity, and flexibility exercises
- Suitable shoes, that match the goals and intentions
- Elimination of redundant movements – any incorrect ones must be compensated
- Active ankles and feet
- Frequent running in conditions close to natural - with bare feet, with thin flexible soles
- Optimal stride length and frequency

ARTICLES AND REPORTS PUBLISHED IN SCIENTIFIC PUBLICATIONS, REFERRED TO AND INDEXED IN WORLD-FAMOUS DATABASES WITH SCIENTIFIC INFORMATION

Group D - Indicator 6

2. Karparova, I. Running biomechanics and selection of sports shoes in benefit to amateur athletes. Trakia Journal of Sciences, issue: Vol. 19, ISSN (online): ISSN1313-3551: doi:10.15547/tjs.2021.s.01.132, Ref, IF (2003), Web of Science Quartile: Q3, pages:841-846. 2021.

Biomechanical analysis of running is a powerful tool in favor of professional and amateur sports. Through it, data can be obtained to be used to improve sports performance and prevent running injuries.

For our study, we used „Templo motion analysis software“ and „Coach`s eye”, the app to make video recordings of the participants. This software package and application were developed to analyze in detail the biomechanics of human movement. Randomly selected

amateur runners were photographed, and angles of foot pronation were measured when running with different types of shoes.

The angle of dorsiflexion in the ankle joint at the moment of contact of the foot with the surface, as well as the angle between the hip and the lower leg at this moment.

The study hypothesizes that the use of biomechanical analysis of running techniques in training and the selection of appropriate shoes for the particular athlete will positively affect athletic performance and will help prevent injuries. 304 amateur runners take part in the research. Conclusions: The biomechanical analysis of the technique and the selection of suitable running shoes will help the training of runners and running injury prevention.

ARTICLES AND REPORTS PUBLISHED IN NON-REFERENCE EDITIONS WITH SCIENTIFIC REVIEW OR PUBLISHED IN EDITED COLLECTIVE VOLUMES

Group D - Indicator 7

3. Karparova, I. *Methodological guidelines for the training of recreational runners with flat feet.* Research in kinesiology, issue: vol.50(1), ISSN (online):1857-8942, dp.(EBSCO), pages: 21-24. 2022.

The structure of the foot is essential for human gait. While running, there is a stronger impact than walking, when the foot interacts with the surface. People with different types of soles exert different foot pressures and load different structures. In combination with long-term loads, running like cyclic motor activity subjects the athlete's musculoskeletal system to constant stress. Changing the arches can lead to a shift in the center of gravity of the body and changes up the entire chain of the musculoskeletal system - knees, thighs, pelvis, and back. That is why athletes with foot deformities mustn't underestimate this problem.

A research of 54 recreational runners with low or flat Medial longitudinal arch (MLA) of the foot was performed. 26 of them reported a different kind of pain in the last 6 months. The study hypothesizes that appropriate methods and means can positively affect adverse biomechanical changes in technology and the prevention of injuries.

4. Karparova, I. *Study of some biomechanical indicators of technique in runners with different qualifications.* "Modern trends of physical education and sports", University Publishing House "St. Kliment Ohridski", ISSN 1314-2275, p.:284-292. 2020.

Modern sports watches and portable devices are integrated functionality for measuring various data while running. The information provided by this data can be used by athletes and scientists to analyze and plan training programs.

Cadence (running step frequency) is one of the indicators of running technique. In the scientific literature, there are conflicting opinions about the relationship between striding in running and various injuries. The present study shows a correlation between cadence and sporting achievement in 5 km running, only in a certain group of runners.

5. Karparova, I. *Intensity ratio and duration parameters in the training of runners with different qualification.* Research in kinesiology, issue: vol.46, ISSN (print):1857-7679, ISSN (online):1857-8942, dp.(EBSCO), pages:36-38. 2018.

Endurance training includes workloads whose basic parameters are intensity, duration, and recreation intervals. A condition for success is the skillful combination of these parameters in the different training cycles, so that according to the sporting experience, qualification, objectives, to be influenced the adaptive capabilities.

The approximate ratio of 80/20 (low intensity to high intensity) is valid for elite athletes. Amateur athletes, however, often train more around and above the lactate threshold. The pursuit of short-term effects is the reason for intensification, but it often leads to over-training, traumatism, and other negative consequences.

6. Karparova, I. Application of strength exercises in endurance training. *"Modern trends of physical education and sports"*, University Publishing House "St. Kliment Ohridski", ISSN 1314–2275, p.:272-279. 2018.

The question of the positive influence of strength exercises on endurance is controversial in the scientific literature. Hypothetically, during training and competition, the lean athlete, with adequate musculature and optimal technique, will use less energy and conserve carbohydrate reserves for a longer period.

In theory, strength-trained endurance athletes will be more economical because of the ability to counter, through better technique, the external forces acting on each step.

The conducted sports-pedagogical experiment with amateur runners proved that the proposed strength complex has a negligible impact when studying the length and frequency of the running step. At the same time, as a result of the power loads, there is an improvement in the investigated indicators of explosive power and strength of the lower limbs. The increase in strength indicators is more significant in men and weaker in women.

7. Karparova, I. Marathon and ultramarathon competitions in Bulgaria - past, present, and future. *European Standards in Sports Education*, Publisher: I&B, ISBN:978-619-7281-38-5, pp:72-78. 2018.

The report includes a retrospective analysis of the most popular mass marathons and ultramarathons in Bulgaria, paying special attention to the Sofia Marathon and „Vitosha 100“. Data on participants, ranking, etc., from the first start to the present are summarized. Variational analysis of the data for the finishers of the Sofia Marathon in 2017 was performed, as well as grouping by time range. A retrospective analysis of the participation and results of the „Vitosha 100“ - the oldest and most popular ultra-running competition in our country - was made.

8. Karparova, I. Track and field athletics for the students in Bulgaria - organization of training and analysis of the competition process. *"Modern trends of physical education and sports"*, University Publishing House "St. Kliment Ohridski", ISSN 1314-2275, p.:103-110. 2017.

In Bulgaria, for several reasons, sports in educational institutions (and specifically universities) are neglected by the state. The problem of lack of sports bases and facilities in Higher Schools is fundamental, as well as regarding conditions for athletics. Against this background, the results of student-athletes at the local level are decent for our conditions, but globally - light years from the leading powers. This picture "copies" the overall development of sports in the country - problematic organization of physical education and sports at school, physically inactive young people, insufficient funds for elite student sports, etc. This report analyzes athletics competitions from the AUS Äkademik” (Association for University Sports)

calendar, with the main objective being: to analyze the competitive student sport – of athletics for the period under review - 2015-2017. The data used are from protocols of held National Universiades and National Student Cross Country Championships.

In the National Universiades in Bulgaria, strong track and field athletes participate, but the performance of the athletes, in general, is at both poles. According to the author, the presence of a table with norms that determine the team ranking at the university to a certain extent makes the work of students, who do not have the opportunity to meet the requirements, meaningless. Given the analyzes made, a recommendation is made to the administrative authorities to revise the regulation for ranking the National Universiades. A possible change would enable more students to participate in academic and competitive student sports.

9. Karparova, I. Research on the endurance and speed indicators of students from Sofia university "St. Kliment Ohridski". *Activities in Physical Education and Sport, issue: vol. 6, ISSN (print):1857-7687, ISSN (online):1856-8950, òp.(EBSCO), pages: 203-206. 2016.*

The "Physical Education and Sports" specialty was introduced at the "St. Kliment Ohridski" in the academic year 2009/2010. Every year, about 30 students are accepted, some of them foreign. The applicant's exam does not include criteria related to sports, which raises some doubts about the preliminary training of future specialists.

During the academic year 2014/2015, within the framework of athletics classes for the specialty "Physical Education and Sports" on the one hand and jogging (athletics) on the other, two tests were conducted for SU students - for endurance and speed. 18 students from the specialty and 20 athletes from the general group (control group) participated in the research, performing two tests – "Beep test" and a 35 m sprint. The obtained results were processed statistically.

The research aims to point out the need to introduce specialized exam requirements in sports for students from the "Physical Education and Sports" major.

Tasks:

1. Establishing the level of physical performance in endurance and speed tests.
2. Comparison of the obtained results against evaluation tables.

Results analysis:

In both tests, students from the general (control group) showed a better average score (\bar{X}) than those from the "Physical Education and Sports" specialty.

The values are as follows:

\bar{X} for FVS for "Beep test" - 6.1

\bar{X} for the control group – 6.8

\bar{X} for FVS for "35 m sprint - 5.16 sec

\bar{X} for the control group for 35 m sprint – 4.91 sec

According to the study, FFS students performed worse in tests of endurance and speed than athletes in the general group, although they attended classes in different sports.

In our opinion, the introduction of specialized criteria related to sports for future specialists is imperative.

10. Karparova, I. IAAF " Kid's Athletics" - a specialized program for the development of track and field athletics for adolescents. *Sat. Scientific conference*

"Pedagogical education - traditions and modernity", VTU "St. Cyril and Methodius", Faculty of Pedagogy, Veliko Tarnovo, ISSN 978-619-7281-01-9, p.:378-383. 2016.

IAAF, and currently WA (World athletics, International Association of Athletic Federations) - the association uniting athletic federations from all over the world, in recent years has followed a policy of significant changes in the organization of sports. These changes do not aim so much at a new image of the too-conservative competitive track and field athletics, but at transformations concerning the mass, accessibility, popularity, and inclusion of the huge mass of amateur sportsmen, as part of a large athletic community.

One of these changes concerns sports for children. In 2001, the IAAF made a statement that it was preparing a specialized program for adolescents, the aim of which was to promote athletics worldwide by introducing a new, attractive, and fun form. A few years later, the concept was presented under the name IAAF "Kid's athletics". The article presents the concept of the program, as well as the opinion of specialists participating in the training seminars.

The number of athletics competitions for children is increasing in our country, more and more children's schools have been established in recent years, and the application of games from the concept in various forms of the educational system and the educational training process in sports clubs.

Specialists who participated in training seminars and promoted the program think that IAAF "Kid's Athletics" has a serious future, because of the form of organization.

11. Karparova, I. Endurance factors and their relationship with aerobic capacity. *"Modern trends of physical education and sports", University Publishing House "St. Kliment Ohridski", ISSN 1314-2275, p.:195-202. 2016.*

Physiological factors have the most significant impact on the performance of athletes in endurance sports. Of interest to science and practice is the interaction between VO₂ max, lactate threshold and economy of movements, and some other physiological factors with age, sex, psychology, and genetics. Modern scientific research in the field of sports suggests that there are serious reserves for improving endurance in terms of factors of energy exchange and autonomic systems (cardiovascular, motor, central nervous system). The physiological limits of the human organism regarding metabolism at the cellular level are considered to be incompletely understood. The prospects are mainly related to the aerobic energy supply system, which is responsible for securing the load. There are sufficient reserves also about the manifestation of quality on a psychological level - willpower, motivation, and sustainability of the processes.

The research reviewed the best achievements in the official disciplines of athletics from 800 m to marathon.

In both sexes, after 1500 m the age of peak performance by the strongest athletes increases with increasing distance.

The percentage difference in times between men's and women's world records (except for the ultra-long distance of -100 km) is roughly the same (between 9 and 11%), with a tendency to decrease slightly with increasing distance.

12. Karparova, I. Influence of some factors on the athlete's body during endurance loads. *Papers, Faculty of Public Health, volume 54, series 8.2 - Physical education and sports, Ruse University "Angel Kanchev", ISSN 1311-3321, p.:144-148. 2015.*

In endurance sports, where the load lasts for a long time, the athletes are forced to endure changes occurring in the internal environment of the body. To avoid serious consequences, the athlete must take the necessary amount of water and electrolytes. A lack of sodium can lead to a condition known as hyponatremia. In sports practice, it is important to know the main ways to prevent dehydration of the body and its excessive hydration.

A survey was conducted among 154 amateur runners. A higher % of them reported that they experienced dehydration and stomach problems during prolonged exercise and very few reported that they experienced hyponatremia.

Based on the studies, the following recommended fluid intake during prolonged exercise is offered:

Fluid intake should be as follows - 2-3 hours before prolonged exercise, take 500 ml of fluids, and another 200-250 ml up to 10-20 minutes before the start.

During exercise, take approximately 200-250 ml of fluids every 20 minutes.

After exercise, athletes need an additional liter of fluids for each hour of running.

13. Karparova, I. Study of an experimental model for the development of endurance through running. *"Modern trends of physical education and sports"*, University Publishing House "St. Kliment Ohridski", ISSN 1314-2275, pp. 76-82. 2015.

An experimental running program has been prepared for the students in the SU sports groups. The program requires the promotion of personal motivation of the athletes. They should run more and more distance in each successive exercise. At the end of the 20-week program, everyone in the research group could run 4.8 km at a pace according to individual ability.

During the academic year 2013/2014, within the framework of sports (jogging) at SU "St. Kliment Ohridski" a pedagogical experiment was conducted in which 28 students participated during 20 weeks of the academic year. According to the school schedule, sports activities are once a week. Participants in the experiment are required to run (walk) an increasing distance in each subsequent activity. The initial distance is 1.6 km, and at the end of the program - 4.8 km. Various data are recorded in the "Motivation Diary" - duration, intensity, weather conditions, and subjective state of each athlete. It can be concluded that to keep the average speed at a roughly constant level, the run should be within 2.8-4 km, after which a sharp decline begins.

14. Kostova, I. Ultramarathons. *"Modern trends of physical education and sports"*, University Publishing House "St. Kliment Ohridski", ISSN 1314-2275, p.:458-464. 2013.

In Bulgaria, in recent years, there is a tendency to hold many long-distance competitions for amateurs, as well as to improve their organization. The number of runners preparing to participate in ultramarathons is constantly growing. The "Tour of Vitosha" competition for runners and cyclists proves that the number of participants and the quality of the results are increasing. The opinion of athletes, participants in ultramarathons, and their attitude towards long endurance loads was investigated.

The number of starters and finishers grows with each passing year, and in recent editions, the organizers have been forced to place restrictions on registration for participation. Thus, in 2013, 700 cyclists and 300-speed walkers are allowed to start. In addition, with each subsequent race of the Tour, the number of finishers increased - for example, in 2007 only 10 pacers finished, while only 6 years later (in 2013) 159 pacers finished the race out of

approximately 300 starters. The same trend is observed among cyclists - in 2007, 152 cyclists finished the race, and in 2013 - 670 participants.

15. Kostova, I. Optimizing the activity in athletics with training equipment for preferential loading of the upper half of the body. *"Optimization and innovations in the educational and training process"*, University Publishing House "St. Kliment Ohridski", ISSN 1314-2275, pp.:43-50. 2011.

When doing track and field athletics and especially running, the motor system (muscles, joints, ligaments) in the lower part of the body are predominantly loaded. The muscles of the pelvis, thighs, and lower legs are well-formed. On the other hand, the upper part of the body - the musculature of the torso and upper limbs is more passive and, for this reason, less developed.

One of the main goals in the non-professional practice of a sport is to achieve a harmonious, well-developed body. In this sense, athletics and jogging classes for students must pay due attention to exercises that load the muscles of the arms, abdomen, back, and side of the torso.

102 students participated in the testing - 42 men and 60 women from the Sofia University track and field athletics and jogging groups. Young people who have not been actively involved in sports have a low success rate in physical fitness tests. This is proven by the standard strength endurance tests of the abdominal muscles and upper limbs applied in the groups.

16. Kostova, I. In the name of records. *"Optimization and innovations in the educational and training process"*, University Publishing House "St. Kliment Ohridski", ISSN 1314-2275, p.:184-189. 2010.

The disciplines of track and field athletics are based on elements closest to human endowments. Running, jumping, and throwing are naturally applied movements, and excellence in the disciplines of this sport is a kind of measure of the capabilities of the human organism.

Tracking the men's and women's world records chronologically reveals some interesting trends.

For men, most of the records have not been broken in the last decade, and almost half of the world records in the disciplines of the women's program date back more than 20 years. The last 5 women's world records are in "new" disciplines (including the javelin, which changed the center of gravity and accordingly began to respect new bests).

Specialists believe that the most serious reservations regarding top achievements are in endurance disciplines. Scientific achievements in various fields of human knowledge - biological knowledge, novelties in the field of genetics and biomechanics, and progress in medicine are the most important factors that would determine the development of sports achievements in the future.

17. Kostova, I. Interval and uniform method for the development of quality endurance and their application in sports. *"Optimization and innovations in the educational and training process"*, University Publishing House "St. Kliment Ohridski", ISSN 1314-2275, p.:25-33. 2010.

The training methodology for the development of endurance is undergoing development, but two of the methods are basic – long run and interval. For many years, there

has been a tendency to oppose training methods – long run and interval. Each of these methods and their varieties provokes the body to a different degree during physical exertion. For example, the long-run uniform and variable methods are most suitable for creating an aerobic base. Interval training most successfully stimulates glycolytic abilities and most intensively develops aerobic processes.

The article examines scientific literature related to the use of various methods, a survey was conducted among 67 students regarding workload preferences.

18. Kostova, I. Disorders during the aerobic exercise of athletes with a low level of functional capabilities. SU Yearbook, Department of Sports, ISSN 0205-0692, p.:70-76. 2009.

Prolonged endurance running as an aerobic load (the main part of the energy supply is at the expense of the oxygen supply) is often associated with the experience of uncomfortable sensations for the body. These ailments have varying degrees of influence on the final result. Some of the most typical conditions occurring in endurance running are described.

19. Bonov, P., Karparova, I. Study of regularities in the development of the world record in running 10,000 m - men. "Sports and Science", ISSN 1310-3393, no. 2, pp.:2-7. 1997.

Running 10,000m as a competitive exercise is one of the toughest sports. Achieving high results in competitions is dependent on many factors of a biological, motor, psychological, and social nature.

In the setting of competition, where the full realization of the current potential of the athletes is required, the correct distribution of their efforts over the distance is of particular importance. It determines the most efficient use of the energy reserve.

The research tracks the dynamics of speed over the competition distance when achieving record results and reveals opportunities for establishing regularities important for sports practice. Their substantiation should provide an opportunity to develop a theoretically optimal model of effort distribution for realizing the potential in the 10,000 m run.

20. Bonov, P., Karparova, I. Optimizing the distribution of effort in running 10,000 m - men. "Sports and Science", ISSN 1310-3393, no. 3, pp.:9-15. 1997.

The study of the dynamics of the best results is of particular interest to sports science and practice. This study attempts to enrich general and specific knowledge about the historical development and future trends of the men's 10,000m world record. The general trends in the historical development of the world record for the time from its official registration to the end of the last century are being studied. A short-term forecast for the development of the world record in the discipline is justified. The achievements of 24 world record holders were studied.