NEW RENAISSANCE international scientific journal
ResearchBib IF - 11.01, ISSN: 3030-3753, Volume 3 Issue 5

THEORETICAL-PRACTICAL MODEL OF THE DEVELOPMENT OF ANAEROBIC FITNESS IN FOOTBALL PLAYERS

Mamatraimov Anvar Chorshanbiyevich
Lecturer. Toshkent state university of economics,
Department of physical culture and sports Activity.
Email: ***anvarmamatraimov9@gmail.com***

https://doi.org/10.5281/zenodo.20028897

Abstract. *This thesis is devoted to substantiating a theoretical–practical model for the development of anaerobic endurance. The aim is to define principles for the комплекс management of anaerobic power and capacity in the athlete's body. The methodology proposes the integration of physiological analysis, pedagogical modelling, and control testing. The scientific novelty lies in combining planning, work–rest ratios, and monitoring indicators within a unified system.*

Keywords: *anaerobic endurance, glycolytic power, lactate, interval training, load prescription, recovery, monitoring.*

Relevance. Modern football is a complex sport characterized by high speed, repeated maximal or submaximal efforts in a short period of time, sharp changes of direction, jumps and a sequence of hits. In recent decades, changes in the rules of the game (rally points system, introduction of the libero position, increased speed of play, improvement of combination attacks and blocks) have further exacerbated the physiological "cost" of the competition process: on the one hand, game episodes are short, but very intense; on the other hand, due to the lengthening of the duration of the entire match and the change in the nature of the breaks, the athlete's body is forced to repeatedly activate high-power energy supply mechanisms. From this point of view, the issue of the priority of developing anaerobic endurance in the practice of training football players is scientifically and methodologically relevant, and it occupies a special place in the system of factors determining the result of sports. Anaerobic endurance is manifested as the football player's ability to repeatedly perform short-term high-intensity actions, maintain strength, and continue "explosive" activity in game episodes without reducing technical-tactical accuracy. If the anaerobic capabilities of the football player are not sufficiently developed, against the background of fatigue near the end of the set, the height of the jump decreases, the speed of the shot decreases, the ability to "hold" time in the block decreases, errors in receiving and passing increase, and the speed of decision-making slows down; these situations have a direct impact on the effectiveness of the team game.

In modern sports competitions, the share of high-intensity movements is increasing. In many sports - including football, football, wrestling, boxing and some disciplines of athletics - the sports result depends on the ability to effectively perform short-term, but repetitive high-power movements. This is directly determined by the level of anaerobic endurance.

Anaerobic endurance determines not only physical performance, but also the stability of technical and tactical movements in conditions of fatigue. Lactate accumulation, acidification of the internal environment of the muscles, and impaired neuromuscular control limit the athlete's performance. Therefore, the development of anaerobic endurance is central to the sports training system.

Practice shows that in many training programs, the volume and intensity of the load are given, but the components of anaerobic power, anaerobic capacity and maintaining efficiency in conditions of fatigue are not systematically controlled.

As a result, development is uneven or excessive fatigue.

Therefore, the development of a theoretical and practical model based on the integration of sports physiology and sports pedagogy, combining load-recovery ratios and monitoring indicators into a single system, is an urgent scientific problem.

Anaerobic endurance is a decisive quality in many sports that determines performance outcomes. It is characterized by the ability to sustain high-intensity work, maintain resistance to metabolic stress, and preserve movement technique under fatigue conditions. Scientific literature often interprets anaerobic endurance in two directions: first, anaerobic power, meaning the rate of maximal energy production over a short time interval; second, anaerobic capacity, referring to the total volume of high-intensity work limited by metabolic resources [2].

Research goal. Aimed at the effective development of anaerobic endurance in athletes, physiological and p

Research objectives. Analysis of the physiological mechanisms of anaerobic endurance based on scientific sources.

Determining the place of the concepts of anaerobic power and anaerobic capacity in sports activities.

Developing pedagogical principles for planning anaerobic loads during training.

Determining the scientific basis for managing the load and recovery ratio.

Developing a system of indicators for assessing and monitoring the development of anaerobic endurance.

Inclusion of training blocks aimed at maintaining technical and tactical movements in fatigue conditions in the model.

Substantiating the practical effectiveness of the proposed modeling.

Anaerobic endurance in the context of football is best defined as “the ability to continue performing short-term high-intensity loads without decreasing power.”

This concept encompasses two main components: first, the power and capacity of the alactate (ATP–KP) system, i.e. the ability to generate maximum power during jumps and explosive blows; second, the power of the glycolytic (anaerobic lactate) system and resistance to metabolic stress (accumulation of H+ ions, decrease in pH, limitation of phosphocreatine resynthesis) resulting from the use of this system. Although episodes in football often appear to be alactate in nature, their high frequency and short recovery time also actively involve the glycolytic system, since phosphocreatine reserves do not have time to fully recover and the energy supply in the muscle cell switches to mixed mechanisms. In this sense, anaerobic endurance is methodologically closely related to the concepts of "repeated sprint ability", "repeated jumping ability", and "tolerance to high-intensity interval work".

The concept of anaerobic endurance is often defined as “the ability to sustain and repeat high-intensity work for a certain period of time.” This is not just about maximum power (e.g., a single jump height or acceleration of 5–10 meters), but also about the ability to qualitatively repeat this power without decreasing it during game episodes. Physiologically, this ability is determined by the speed and capacity of anaerobic sources of ATP resynthesis, resistance to metabolic acidosis, resistance to central and peripheral fatigue mechanisms, and the speed of recovery under intermittent (intermittent) work conditions (Kenney, Wilmore, & Costill, 2020).

The work regime in football is similar to the “repeated sprint-jump” model, in which the rapid recovery of the phosphagen system, the production of lactate when glycolysis is needed, and the ability to buffer against changes in the internal environment associated with HQ ions are crucial

In practice, these two components are interrelated. If training content, recovery режим, and control indicators are not aligned, development becomes uneven and unstable. Therefore, within the framework of specialty 13.00.04, the need is increasing for a theoretical–practical model that integrates pedagogical processes with physiological foundations.

In the scientific literature, the metabolic profile of football is often described as an interval-type exercise, with the predominant activation of the alactate (ATP-CF) and lactate (glycolytic) anaerobic systems during the game, while aerobic mechanisms provide resynthesis processes during the recovery phases. In this energy “mosaic”, repeated sprints and repeated jumps (repeated sprint/jump ability) are especially typical for football, where the harmonious development of anaerobic power and anaerobic capacity creates the physiological foundation for high sportsmanship. Most competitive episodes consist of high-intensity movements lasting 1–7 seconds, with short recovery periods between them; however, these episodes are repeated dozens, sometimes hundreds of times during sets and throughout the entire game. Therefore, a football player must possess not only maximal strength or speed, but also the ability to repeatedly perform these maximal movements under conditions of fatigue. This ability is directly related to the concept of anaerobic endurance, which is determined not only by muscle energy supply, but also by factors such as neuromuscular control, motor unit recruitment, central fatigue resistance, and psychophysiological stability.

The theoretical basis of the proposed model relies on concepts of sequential and simultaneous activation of energy supply systems. During high-intensity movements, the ATP-PC mechanism activates rapidly but has limited reserves; subsequently, the glycolytic pathway becomes dominant, leading to lactate and hydrogen ion accumulation. This increases the acidity of the internal environment, affecting enzymatic activity and muscle contraction mechanisms [4].

Thus, developing anaerobic endurance is not merely “repeating many efforts,” but includes precisely dosed воздействия on energy systems, regulation of recovery intervals, and maintaining technical-tactical requirements under fatigue. The pedagogical component of the model involves purposeful planning of load parameters, dividing the training process into stages, receiving feedback through control tests, and implementing individual corrections [1].

The theoretical–practical model functions at three levels: macrocycle planning, mesocycle stage management, and microcycle operational adjustment.

At the macrocycle level, the sport-specific “profile” of anaerobic endurance is defined.

For example, in combat and team sports, repeated sprints and short explosive episodes dominate, while in rowing or 400–800 m running, glycolytic stability and pace maintenance are more important. Accordingly, a set of target indicators is determined: 30-second maximal performance, fatigue dynamics during 3–5 minutes of high-intensity work, lactate tolerance tests, and heart rate recovery speed. These indicators are selected based on the athlete’s qualification and specialization, since universal tests often do not match real competition demands [5].

At the mesocycle level, loads are divided into three blocks: a block for increasing anaerobic power, a block for expanding anaerobic capacity, and a block for strengthening effectiveness “under fatigue conditions.”

The anaerobic power block includes 6–12 second maximal or near-maximal efforts with nearly full recovery and a number of repetitions that ensure technique is not impaired. The key criterion is avoiding sharp power decline and preserving movement structure; otherwise, the session accumulates fatigue rather than developing anaerobic power.

The anaerobic capacity block is structured through 20–60 second or 1–3 minute interval efforts with short recovery periods. Lactate accumulation is natural and purposeful here, but if uncontrolled, excessive acidosis prolongs recovery and reduces the quality of subsequent sessions [3].

The third block incorporates sport-specific combinations, such as performing a technical element, making decisions, or interacting with an opponent after repeated sprints. This approach facilitates the transfer of anaerobic endurance to actual competitive activity [6].

Studies on anaerobic endurance also highlight age and skill factors. High glycolytic loads should be used with caution in growing athletes, as their recovery systems, musculoskeletal system, and neuromotor control may not yet be fully developed. Therefore, when working with young people, it is methodologically appropriate to focus more on the basics of technique, general physical fitness, agility, and coordination, and to gradually increase the elements of anaerobic endurance through game forms and short series of exercises. This approach is also found in the literature on sports education and physical training methodology in Uzbekistan: it emphasizes the standardization of training loads by age, protecting the athlete from excessive fatigue, and prioritizing injury prevention (Kerimov, 2018). The pedagogical aspect of developing anaerobic endurance is that the trainer should control the load not only by physiological indicators, but also by the quality of movement, technical violations, the athlete's subjective state, and the dynamics of recovery.

At the microcycle level, the practical value of the model is revealed through monitoring and operational correction mechanisms. Monitoring integrates three groups of indicators: external load, internal response, and recovery signs.

External load includes work duration, number of repetitions, distance, power or speed, and work–rest ratios. Internal response includes heart rate dynamics, rate of perceived exertion (RPE), and, if available, post-exercise lactate values measured 3–8 minutes after training. Recovery indicators include morning heart rate, sleep quality, muscle soreness, and short functional tests (e.g., jump tests).

Based on these data, a “risk zone” is identified: if power decline increases within one microcycle, perceived exertion rises sharply, and recovery indicators worsen, training volume or intensity is redistributed. Such an approach protects athletes from excessive fatigue and promotes stable development of anaerobic qualities [2].

1st table

Training loads are divided into three blocks:

Block	**Purpose**	**Load Characteristics**
Anaerobic Power	Increase maximal output	6–12 s maximal efforts, near-full recovery
Anaerobic Capacity	Expand glycolytic tolerance	20–60 s or 1–3 min intervals, short recovery
Fatigue Resistance in Technique	Maintain efficiency under fatigue	Sport-specific combinations after intense work

2st table

Monitoring integrates three groups of indicators:

Indicator type	Indicators
External Load	Duration, repetitions, speed, power, work–rest ratio
Internal Response	Heart rate dynamics, RPE scale, lactate values
Recovery Markers	Morning HR, sleep quality, muscle soreness, jump tests

If performance drops, fatigue markers rise, and recovery worsens, the load is adjusted.

The methodological core of the model lies in selecting appropriate load дозage and recovery ratios. In anaerobic power training, recovery is longer; in capacity training, controlled incomplete recovery is applied. Adaptation to metabolic stress enhances glycolytic enzyme activity, buffering systems, and ion exchange mechanisms. At the same time, the athlete’s individual “response profile” is considered: some accumulate lactate quickly but also recover quickly; others show lower lactate but stronger neuromuscular fatigue. Therefore, identical training can produce different effects, and the model’s practical value lies precisely in its capacity for individual adjustment [4].

Nutrition and recovery factors are also considered key moderators in many studies of anaerobic endurance. High-intensity exercise accelerates muscle glycogen depletion; when glycogen is depleted, glycolytic capacity and repetitive work capacity are reduced. Consensus sources on sports nutrition suggest that adequate carbohydrate intake, a post-exercise “carb Q protein” strategy, prevention of dehydration, and sleep hygiene support endurance during repeated sprints and jumps (Thomas, Erdman & Burke, 2016). However, in practice, these recommendations need to be tailored to individual tolerance, body composition goals, and the stress of competition. There are meta-analyses that suggest that ergogenic aids (e.g., creatine monohydrate, beta-alanine, bicarbonate) may have a positive effect on anaerobic power and buffering, but their use should be strictly limited to the athlete's age, health status, anti-doping requirements, and physician supervision (McArdle et al., 2015). In this sense, it is consistently noted in scientific sources that developing anaerobic endurance is not just a training protocol, but a comprehensive training system.

From a pedagogical standpoint, coordination between anaerobic endurance development and technical-tactical training is central. Under high lactate conditions, movement coordination deteriorates, decision-making slows, and force distribution errors increase. Therefore, the model introduces a “technical stability criterion”: if technique deteriorates beyond a critical threshold at a given intensity, training should be adjusted rather than continued. This is important in sports pedagogy, since performance is determined not only by physiological indicators but also by maintaining movement quality in competition [1].

Additionally, the model considers the sequence of integrating anaerobic loads with strength and speed training. Excessive glycolytic intervals after strength-power work may increase neuromuscular fatigue, so priorities within the microcycle must be clearly defined [6].

The scientific novelty of the proposed model lies in three aspects:

-managing anaerobic endurance through separate target indicators for power and capacity components;

-interpreting work–rest ratios not as general recommendations but as mechanisms continuously adjusted through monitoring;

-linking anaerobic training with technical-tactical stability criteria to enhance transfer effectiveness.

As a result, the model allows step-by-step optimization of athlete preparation, reduction of overtraining risk, and stable maintenance of high-intensity performance under competition conditions.

In conclusion, the most important conditions for developing anaerobic endurance are purposeful load orientation, consideration of individual response, and continuity of pedagogical control. This triad ensures the model’s practical effectiveness.

Conclusion

The results of the study show that the development of anaerobic endurance is most effectively carried out not through random high-intensity loads, but based on a systematically controlled training model.

The developed theoretical and practical model has the following advantages**:**

Allows separate control of anaerobic power and anaerobic capacity components

Adjusts the load and recovery ratios to the individual response of the athlete

Reduces the risk of overfatigue through monitoring

Serves to form technical and tactical stability in conditions of fatigue

Provides direct transfer to competitive activities

The model allows pedagogical management of the sports training process based on physiological laws.

Practical recommendations

Anaerobic power and anaerobic capacity exercises should be planned separately in training programs.

6–12-second maximum efforts should be performed with full recovery (for anaerobic power).

Use 20–60 second intervals with short recovery (for anaerobic capacity).

Include at least one “technique under fatigue” exercise in each microcycle.

Exercises should be measured by heart rate, RPE scale, and, if possible,

Monitor morning pulse, sleep quality, and muscle soreness regularly to assess recovery.

If technique declines significantly, reduce the volume of the exercise or extend recovery.

Do not overdo anaerobic exercise after strength training.

Adjust the exercise load based on the individual physiological responses of the athletes.

From the model to the team

References

1. Cabinet of Ministers of the Republic of Uzbekistan. (2018, October 25). *Resolution on further improvement of the system of Republican sports competitions among pupils and students*.
2. President of the Republic of Uzbekistan. (2021, November 5). *On comprehensive preparation of Uzbek athletes for the XXXIII Summer Olympic and XVII Paralympic Games to be held in Paris, France in 2024* (No. PQ-5281). *Xalq So‘zi,* November 11, p. 4.
3. Игамбердиев О. Р. Кўп йиллик тайёргарликнинг дастлабки босқичларида футболчиларни саралаб олишнинг илмий-назарий асослари //Fan-Sportga. – 2022. – №. 8. – С. 31-34.

4. Igamberdiev O. Scientific and theoretical principles of the mechanism of training of football players with priority considering physical preparation //Mental Enlightenment Scientific-Methodological Journal. – 2024. – Т. 5. – №. 08. – С. 105-112.
5. Igamberdiyev O. R. KO ʻP YILLIK TAYYORGARLIK BOSQICHLARIDA SPORTCHILARNI SARALAB OLISHNING ILMIY-NAZARIY TAHLILI //Inter education & global study. – 2024. – №. 9 (1). – С. 134-141.
6. Igamberdiyev O. R. Koʻp yillik tayyorgarlik bosqichlarida futbolchilarni tayyorlash mexanizmining ilmiy-nazariy asoslari //Fan-Sportga. – 2025. – №. 12. – С. 3-5.
7. Igamberdiyev O. R. Ko'p yillik tayyorgarlik bosqichlarida futbolchilarni saralab olishning ilmiy-nazariy asoslari (DSc dissertatsiyasi avtoreferati). – 2025.
8. Igamberdiyev O. R. Umumta'lim maktablaridagi 11-12 yoshli o'quvchilarni futbol bilan shug'ullantirish orqali jismoniy tayyorgarligini oshirish (PhD dissertatsiyasi avtoreferati). – 2022.
9. Igamberdiyev O. R. Ko'p yillik tayyorgarlik tizimida futbolchilarni saralab olish modelining ilmiy-nazariy asoslari //Sportda ilmiy tadqiqotlar,(3). – 2023. – С. 72-76.
10. Xoʻjamkeldiyev G. S. et al. AHOLI OʻRTASIDA OMMAVIY YUGURISHNING AHAMIYATI //Central Asian Research Journal for Interdisciplinary Studies (CARJIS). – 2022. – Т. 2. – №. 10. – С. 120-125.
11. Gʻaniboyev I. D. et al. UZUNLIKKA SAKROVCHILARNI TAYYORLASH SAMARADORLIGINI OSHIRISH //Educational Research in Universal Sciences. – 2023. – Т. 2. – №. 14. – С. 725-729.
12. Gʻaniboyev I. D. et al. YOSH YENGIL ATLETIKACHI SPORTCHILARNI UZUNLIKKA SAKRASH TURIGA SARALASHDA JISMONIY SIFATLARINI RIVOJLANTIRISH //Educational Research in Universal Sciences. – 2023. – Т. 2. – №. 14. – С. 736-741.
13. Ziyayev. F. Ch YENGIL ATLETIKACHILARNI UZUNLIKKA SAKROVCHANLIGINI MAXSUS MASHQLAR YORDAMIDA RIVOJLANTIRISH //PEDAGOGS jurnali. – 2022. – Т. 18. – №. 1. – С. 183-185
14. Olimov, M. S., Toʻxtaboev, N. T., Soliyev, I. R., & Ortiqov, X. T. (2016). *Methodology of middle- and long-distance running* (Educational manual). Tashkent: Fan va Texnologiya, 156 p.
15. Soliyev, I. R. (2018). Comparative analysis of the training process and competition of highly qualified female long-distance runners. *Bulletin of the National University of Uzbekistan*, 1(1), 171–174.
16. Shakirjanova, K. T., Soliyev, I. R., Latibova, L. V., Baratov, A. M., Akmanov, B. O., & Saydkulov, Z. V. (2020). Pedagogical technologies and interactive methods as a factor of increasing special knowledge of students. *Journal of Critical Reviews*, 7(6), 42–46. https://www.scopus.com/authid/detail.uri?authorId=57221666324
17. Ziyayev F. Ch. et al. OʻRTA MASOFAGA YUGURUVCHI YENGIL ATLETIKACHILARNI MUSOBAQA OLDI TAYYORGARLIGI SAMRADORLIGINI OSHIRISH //Central Asian Research Journal for Interdisciplinary Studies (CARJIS). – 2021. – Т. 1. – №. 4. – С. 78-90

18. KARIMOV F. BOSHLANG‘ICH TAYYORLOV BOSQICHIDAGI UZUNLIKKA SAKROVCHILARNI YILLIK MASHG‘ULOTLARINI REJALASHTIRISHDAGI MUAMMOLAR //News of the NUUz. – 2024. – T. 1. – №. 1.10. – C. 88-91.
19. Ziyayev F. Ch. et al. YENGIL ATLETIKA SPORT TURINI RIVOJLANTIRISHDA UMUMIY O’RTA T’ALIM MAKTABLARINING JISMONIY TARBIYA DARSLARIDA YENGIL ATLETIKA TURLARINI O‘RGATISH METODIKASINI TAKOMILLASHTIRISH SAMARADORLIGI //Central Asian Research Journal for Interdisciplinary Studies (CARJIS). – 2021. – T. 1. – №. 3. – C. 348-355.
20. Karimov F. M. UZUNLIKKA SAKROVCHILARNI CHIDAMLIK SIFATINI RIVOJLANTIRISH ME’ZONLARI //Educational Research in Universal Sciences. – 2023. – T. 2. – №. 1 SPECIAL. – C. 269-273.