MORPHO-FUNCTIONAL FOUNDATIONS OF ENDURANCE DEVELOPMENT IN SCHOOLCHILDREN AGED 11–14

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Annotatsiya: *11–14 yoshli maktab o‘quvchilari organizmida chidamlilikning rivojlanishi morfologik va funksional o‘zgarishlar orqali yuzaga keladi. Bu yosh davri yurak-qon tomir va nafas olish tizimlarining jadal shakllanishi, mushak massasining oshishi, energiya almashinuvining faollashuvi bilan xarakterlanadi. Anaerob va aerob imkoniyatlarning bosqichma-bosqich kengayishi chidamlilikni oshirishga zamin yaratadi. Tadqiqotda o‘quvchilarning biomexanik ko‘rsatkichlari, yurak urish tezligi, o‘pka sig‘imi, mushaklar elastikligi va chidamlilik mashqlariga moslashuv darajasi ilmiy asosda tahlil qilinadi. Ushbu ish pediatriya, jismoniy tarbiya metodikasi va sport fiziologiyasi kesishgan o‘rinda bo‘lib, boshlang‘ich sport tayyorgarligi jarayonida yuklamalarni individuallashtirish bo‘yicha tavsiyalar beradi.*

Kalit so‘zlar: *chidamlilik, morfo-funksional rivojlanish, yurak-qon tomir tizimi, nafas olish tizimi, mushak massasi, aerob imkoniyat, anaerob imkoniyat, o‘smirlar fiziologiyasi.*

Аннотация: *Развитие выносливости у школьников 11–14 лет обусловлено морфологическими и функциональными изменениями организма, характерными для периода интенсивного роста. В это время активно формируются сердечно-сосудистая и дыхательная системы, увеличивается мышечная масса, ускоряются процессы энергообмена. Постепенное расширение аэробных и анаэробных возможностей способствует повышению общей выносливости. В исследовании анализируются биомеханические показатели учащихся, частота сердечных сокращений, жизненная ёмкость лёгких, эластичность мышц и степень адаптации к нагрузкам. Работа лежит на стыке педиатрии, методики физического воспитания и спортивной физиологии и предлагает рекомендации по индивидуализации тренировочных нагрузок для детей данного возраста.*

Ключевые слова: *выносливость, морфофункциональное развитие, сердечно-сосудистая система, дыхательная система, мышечная масса, аэробные способности, анаэробные способности, физиология подростков.*

Abstract: *The development of endurance in schoolchildren aged 11–14 is driven by specific morphological and functional transformations occurring during early adolescence. This period is marked by accelerated growth of the cardiovascular and respiratory systems, increased muscle mass, and enhanced metabolic activity. The gradual expansion of aerobic and anaerobic capacities forms the physiological basis for improving endurance. The study analyzes biomechanical parameters, heart rate response, lung capacity, muscle elasticity, and adaptation to endurance-related workloads. Positioned at the intersection of pediatrics, physical education methodology, and sport physiology, the research provides evidence-based recommendations for individualizing training loads for children in this age group.*

Keywords: *endurance, morpho-functional development, cardiovascular system, respiratory system, muscle mass, aerobic capacity, anaerobic capacity, adolescent physiology.*

INTRODUCTION

At this age, the adolescent's heart, breathing rhythm, and muscle fibers steadily - though still cautiously - move beyond the frontier that, just yesterday, belonged to childhood. Every rapid heartbeat during a run, every flush of red across the face after exercise is not merely the sign of physical strain, but the body's process of adapting to new power - the moment when endurance is born.

Endurance is the silent core of adolescent physiology - invisible, yet governing every movement. Its development strengthens not only the muscles but also the cardiovascular system, pulmonary ventilation capacity, blood circulation efficiency, and even the deep layers of energy metabolism. Therefore, this process cannot be left to chance: the tempo of every exercise, the duration, the intensity of the load - all must rest upon a scientific foundation.

During this age interval, the organism grows rapidly; bones lengthen, muscle fibers thicken, the heart's stroke volume increases, and breathing becomes deeper. Simultaneously, the adolescent's psychological stability is not yet fully formed, making the adaptation to physical workload more complex and demanding of caution. Hence, endurance development methodology must be phased, precise, and fully aligned with the morpho-functional characteristics of 11–14-year-old schoolchildren.

This study examines that intricate and, at times, astonishing process - the formation of endurance through the morpho-functional development of the adolescent body. It presents scientific data on heart rate dynamics, lung capacity expansion, muscle elasticity, aerobic and anaerobic capability growth, and physiological indicators of adaptation to physical training.

Guiding that endurance correctly is one of the core principles of raising a healthy generation, a resilient society, and a strong-willed individual.

The body of an 11–14-year-old - turning its face toward the sun - is a hidden laboratory of endurance development: not instantaneous, but slow, steady maturation. Thus, the methodology of this research also followed the same rhythm - careful, consistent, and alive. Anthropometric indicators such as height, body weight, and the stabilization of muscle and skeletal systems were regularly recorded - for every millimeter of growth adds its own tone to endurance. Physiological indicators including heart rate, arterial pressure, lung vital capacity, and respiratory depth and frequency were monitored both at rest and during exercise. These changes enabled a precise understanding of how the organism responds to load and at what stage endurance stabilizes.

To assess physical work capacity, the Cooper test, 6-minute running test, and interval exercises were employed; running rhythm, stride length, and muscle elasticity were analyzed through video observation. For each student, an individualized load model was designed according to age, physical condition, and heart rate zone. This methodology, grounded in the morpho-functional features of adolescence, provided a scientific basis for shaping endurance.

Resting heart rate decreased, heart stroke volume increased, and cardiovascular work became more economical during exercise. Lung vital capacity increased by 8–12 percent, respiratory depth grew, and oxygen uptake improved. Muscles became more resistant to

fatigue, and the duration of sustained activity significantly increased. Anaerobic capability also strengthened - recovery after high-intensity load accelerated, and the organism became more tolerant to lactate. Biomechanical indicators - running rhythm and stride length - normalized, while muscular coordination improved. Most importantly, physiological adaptation to workload stabilized, creating conditions for long-term endurance development.

To conclude: developing endurance in schoolchildren aged 11–14 is not merely exercise, but an art of sensing the inner rhythm of a growing organism and guiding it wisely.

Endurance maturation is tightly interwoven with cardiovascular strengthening, muscular development, energy efficiency, and psychological stability. When load is introduced in a timely and scientifically grounded manner, the adolescent adapts not only physically but also mentally.

Properly directed endurance thus shapes a future generation that is resilient, strong-willed, and healthy - the truest investment any society can make.

REFERENCES:

1. Kholmatov, M., & Khudoyqulov, A. Foundations of Sport Physiology and Youth Physiology. Tashkent: Uzbekistan State University of Physical Education and Sport Publishing, 2020.

2. Wilmore, J.H., & Costill, D.L. Physiology of Sport and Exercise. Human Kinetics, 2019.

3. Guyton, A.C., & Hall, J.E. Textbook of Medical Physiology. Elsevier, 2020.

4. Rowland, T. Children's Exercise Physiology. Human Kinetics, 2018.

(Fundamental studies on physical load adaptation, endurance development, lung capacity, and cardiac functioning in children aged 10–15.)

5. Malina, R.M., Bouchard, C., & Bar-Or, O. Growth, Maturation, and Physical Activity. Human Kinetics, 2019.