



FUNCTIONAL CHARACTERISTICS OF THE CARDIORESPIRATORY SYSTEM AND SOMATIC DEVELOPMENT OF YOUNG ATHLETES UNDER PHYSICAL LOAD

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Abstract:

This study provides an extensive scientific examination of the physical development of young athletes, focusing particularly on the functional condition of the respiratory and cardiovascular systems and the physiological effects of consistent sports training on these systems. Current research indicates that regular physical activity accelerates morphofunctional growth, improves cardiorespiratory performance, and supports adaptive physiological responses in the developing body. The results highlight the essential role of structured training in enhancing somatic growth, functional potential, and overall health outcomes among youth participating in sports.

Keywords: young athletes, somatic growth, cardiorespiratory function, physiological adaptation, sports science, functional performance.

INTRODUCTION

Encouraging healthy growth and balanced development in younger generations is a strategic priority for sustainable social progress. In this regard, systematic participation in sports acts as a key factor in improving physical fitness, functional stability, and long-term well-being.

From a physiological standpoint, the respiratory and cardiovascular systems are the most responsive to physical load, demonstrating a high degree of adaptability. Their rapid adjustments ensure effective oxygen delivery, metabolic balance, and maintenance of homeostasis during exercise. Consequently, the development of these systems in young athletes is a major focus in sports physiology and pediatric exercise science [1;3;6].

Furthermore, the level of physical development directly affects athletic performance, while well-organized training strengthens adaptive capacity, leading to greater endurance, efficiency, and resistance to fatigue [8].

1. Somatic and Physical Development in Young Athletes

Physical (somatic) development refers to the age-related progression of morphological and functional characteristics of the body [1]. In sports science, it is evaluated through a combination of anthropometric and functional indicators, including:

- body height and weight;
- chest circumference and thoracic mobility;
- muscular strength and endurance;
- body composition and proportionality.

Regular training stimulates bone formation, muscle fiber hypertrophy, and neuromuscular coordination, promoting improved posture and biomechanical effectiveness. Research shows that physically active children display better fitness indicators than their sedentary counterparts [2;6].

Balanced and proportional physical development serves as a marker of optimal growth. In contrast, disproportional development may indicate excessive training loads, insufficient recovery, or inappropriate training strategies [2].

2. Functional State of the Respiratory System Physiological Role

The respiratory system plays a crucial role in maintaining gas balance by enabling oxygen intake and carbon dioxide removal. During physical activity, metabolic demands rise significantly, requiring increased pulmonary ventilation and diffusion efficiency [3;5].

Effects of Sports Training

Systematic training leads to notable respiratory adaptations in young athletes, including:

- increased vital lung capacity;
- greater tidal volume and breathing depth;
- improved alveolar–capillary gas exchange;
- higher maximal oxygen uptake (VO₂ max).

These changes enhance aerobic performance and support sustained activity during prolonged physical exertion [3;5;8].

Adaptive Mechanisms

Training-related respiratory adaptations include:

- strengthening of respiratory muscles;
- optimization of breathing patterns;



- improved efficiency of oxygen transport and utilization.

Together, these mechanisms improve metabolic efficiency and delay fatigue onset[3;5;8].

3. Functional State of the Cardiovascular System **Physiological Importance**

The cardiovascular system maintains systemic circulation, supplying tissues with oxygen and nutrients while removing metabolic waste. In young athletes, this system exhibits a high adaptive capacity in response to both dynamic and static loads[3;4].

Cardiovascular Adaptations to Training

Regular sports participation promotes several physiological changes, such as:

- physiological myocardial hypertrophy;
- increased stroke volume and more efficient cardiac output;
- lower resting heart rate (training-induced bradycardia);
- improved vascular elasticity;
- enhanced peripheral circulation.

These adaptations reflect more economical cardiac function and improved endurance[3;4;8].

Adaptive Characteristics

Major adaptive responses include:

- rapid heart rate increase during exercise;
- faster recovery after exertion;
- expansion of capillary networks (angiogenesis);

- improved oxygen delivery to tissues[3;4;8].

4. Integrated Effects of Sports Training

Sports training produces a systemic and integrative impact on the growing organism.

Positive Physiological Outcomes

- improved physical performance and work capacity;
- strengthened immune response;
- stabilization of the nervous system;
- enhanced stress resistance;
- development of lasting healthy lifestyle habits[1;6;8].

Metabolic and Functional Adaptations

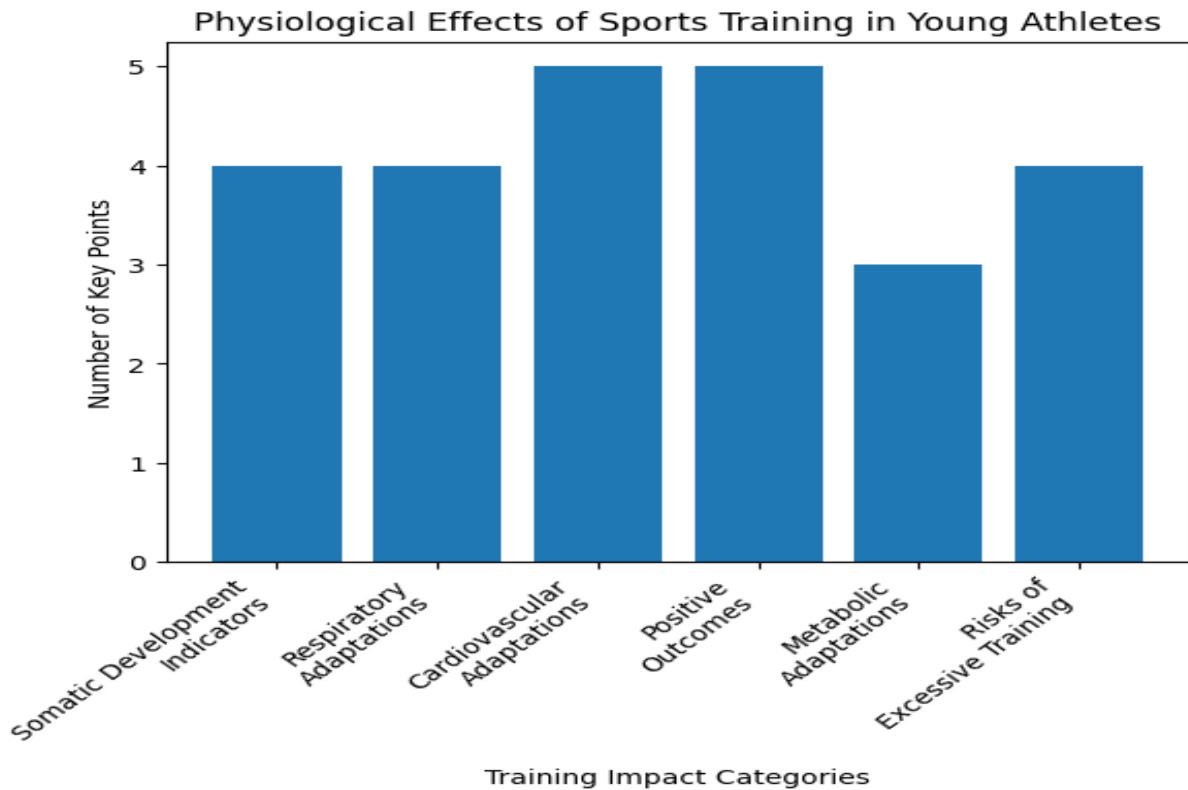
- accelerated energy metabolism;
- increased muscular oxygen utilization;
- improved coordination between cardiovascular and respiratory systems[3;8].

Risks of Excessive Training

Poorly designed training programs may lead to negative consequences, including:

- overtraining syndrome;
- cardiovascular disturbances;
- exercise-induced shortness of breath;
- weakened immune function.

Therefore, training programs should be individualized and based on scientific principles, considering age, biological maturity, and health status [1;2;4;5;6].



Picture: 1. Components contributing to physiological effects of sports training in young athletes

CONCLUSION

Regular sports training in young athletes plays a vital role in promoting somatic growth and enhancing the functional capacity of the cardiorespiratory system. Improvements in lung capacity, myocardial efficiency, and circulatory function represent key physiological benefits of consistent physical activity. Optimizing training loads according to age-specific and individual characteristics is essential for ensuring safe adaptation, preventing overtraining, and supporting long-term athletic development.

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