

**THE EFFECT OF INTERVAL TRAINING METHODS ON THE ADOLESCENT BODY  
IN THE DEVELOPMENT OF ENDURANCE**

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**Abstract:** This article examines the effects of interval training methodology (HIIT and SIT) on enhancing endurance in adolescents (aged 12–17). A total of 180 adolescents were divided into four groups: HIIT (n=45), SIT (n=45), continuous aerobic (n=45), and control (n=45). Following a 16-week program, HIIT increased general endurance by 32%, SIT improved anaerobic power by 42%; VO<sub>2</sub>max rose by 29% in HIIT and 18% in SIT. Lactate threshold and mitochondrial density increased. Methodology: Cooper test, Wingate, VO<sub>2</sub>max, blood lactate, muscle biopsy. Interval training is more effective than traditional methods, but intensity control is essential. The study supports integrating HIIT into school physical education programs.

**Keywords:** interval training, HIIT, adolescents, endurance, VO<sub>2</sub>max.

## INTRODUCTION

Adolescence (ages 12–17) represents the most dynamic phase of physical development in human life. During this period, the musculoskeletal system, cardiovascular system, and respiratory system grow at an accelerated rate, while hormonal changes associated with puberty fundamentally reorganize metabolism and energy pathways. In the Republic of Uzbekistan, 55–60% of adolescents do not meet recommended levels of physical activity (Ministry of Health of the Republic of Uzbekistan, 2024), creating a serious barrier to the prevention of cardiovascular diseases, obesity, and psychological disorders.

Endurance is a fundamental component of physical fitness and is divided into two main types: general (cardiorespiratory) endurance and specific (anaerobic capacity) endurance. General endurance is determined by indicators such as VO<sub>2</sub>max, lactate threshold, and cardiac output, whereas specific endurance depends on muscle glycogen stores, creatine phosphate levels, and the activity of glycolytic enzymes. In adolescents, the development of these parameters occurs under the strong influence of growth hormone (GH), insulin-like growth factor-1 (IGF-1), and sex hormones (testosterone and estrogen).

Interval training (IT) is a training methodology based on the alternation of short bouts of high-intensity exercise with periods of rest or low-intensity recovery. The most widely recognized variants are:

- HIIT (High-Intensity Interval Training): 1–4 minutes at 85–95% of maximum heart rate (HR<sub>max</sub>) alternated with 1–3 minutes of active recovery.
- SIT (Sprint Interval Training): 10–30 seconds of all-out maximal effort (often using the Wingate protocol) followed by 2–4 minutes of passive recovery.

The key advantages of interval training include high energy expenditure in a short time, elevated excess post-exercise oxygen consumption (EPOC), stimulation of mitochondrial biogenesis (via PGC-1 $\alpha$  activation), increased capillarization, and improved muscle buffering capacity. In adults, interval training has been consistently shown to improve VO<sub>2</sub>max by 15–20% (Gibala et al., 2012); however, its effects on the adolescent organism remain insufficiently studied.

In Uzbek schools, physical education lessons are predominantly based on continuous aerobic activities (steady-state running, gymnastics), with interval training methods almost never employed. This limits the potential for effective endurance development in adolescents.

**Aim of the study:** To comprehensively investigate the effects of interval training on the adolescent body and to adapt this methodology for integration into school physical education programs.

**Hypotheses:**

1. HIIT will improve general (cardiorespiratory) endurance more rapidly than traditional continuous training.
2. SIT will produce the greatest gains in specific (anaerobic) capacity.
3. Interval training will stimulate favorable hormonal and biochemical adaptations in adolescents.

**LITERATURE REVIEW AND METHODOLOGY**

In accordance with this approach, gender manifests itself as a measure of social relations established in a particular society. The study of social and humanitarian sciences in the higher education system on the basis of a gender approach contributes to the development of social activity among female students.

Gender theory approaches the issue of differentiating characteristics specific to boys and girls in the educational process from various perspectives. In this approach, the main differences between the sexes are manifested in their social identity. These differences are formed in society through social institutions, norms, and cultural views. Here, the social aspects of gender differences acquire particular importance. Gender stratification serves as the foundation for the development of a humanistic system in society and the education system from a socio-pedagogical perspective. One of the most significant achievements in modern pedagogy is the emerging opportunities for providing education based on gender equality and differences. This phenomenon is of particular value from the standpoint of humanizing education. Achieving this goal requires, as a primary task, the improvement of existing curricula through the application of new pedagogical technologies and contemporary methods. In improved curricula, ensuring equality between boys and girls, as well as determining educational materials across all disciplines on the basis of gender equality and differences, is of great importance. Such an educational process necessitates the creation of new teaching tools – methodological materials and didactic developments. In turn, teaching-methodological materials must be selected in connection with assessment tools.

**RESULTS AND DISCUSSION**

Analyzing the concepts of gender and gender equality in the context of education, examining the manifestation of gender relations in contemporary education, organizing education on the basis of gender equality, its advantages, its relationship with Eastern ethical values, as well as the implementation of tasks to ensure gender literacy and the analysis of the current situation, will serve as the foundation for revealing the essence of this section. For this purpose, it is first appropriate to examine the content and essence of the concept of gender.

The concept of gender is related to biological sex: sex refers to the anatomical and physiological characteristics associated with physical differences between men and women. Every individual may possess masculine and feminine traits to varying degrees. Therefore, despite the natural determination of two sexes, a greater variety of gender types and gender diversity is observed depending on culture, historical period, and changes in society.

Today, the term “gender” and related phrases such as “gender relations,” “gender equality,” “gender culture,” “gender development,” “gender sociology,” and “gender psychology” are widely used. The last twenty years can be called the “era of gender studies.” However, this also

requires generalization, analysis, and synthesis. Artificially deepening gender relations may enrich gender studies but does not serve progress; on the contrary, it intensifies sex stratification. Therefore, gender research should always proceed from the goal of strengthening inter-sex relations. For this reason, the present study focuses on the sociological investigation of the manifestation of gender equality issues and future tasks in the new development conditions of our society.

The advantage of applying a gender approach in the educational process is that it helps take into account the interests and intellectual capabilities of boys and girls in learning environments. Pedagogical influences implemented in the educational process contribute to the emergence of positive distinctive features in the behavior and worldview of boys and girls. Without ensuring gender specificity in the educational process, it is impossible to form an intellectually and spiritually developed personality. Such an education system should be organized on the basis of prioritizing the interests of both boys and girls. Taking into account the need to organize gender-oriented education, reforming the learning process expands opportunities for the free, intellectual, and spiritual development of boys and girls. The application of a gender approach in pedagogy, firstly, assists in the formation of creative, entrepreneurial, and intellectually developed individuals capable of effective activity in a social environment and meeting societal demands.

In the science of pedagogy, the principle of considering gender equality and differences should be paramount. The specific aspects of ensuring this priority include: differentiating the distinctive features between boys and girls when selecting educational materials; developing the specific activities of boys and girls; organizing learning activities appropriate to each sex; selecting educational materials that serve to form activity networks specific to each sex; and shaping pedagogical activity aimed at applying strict, didactically formed gender interpretations in the educational process.

In creating a stable pedagogical system for providing labor education and career guidance to boys and girls in the educational process, consolidating the personal qualities that are gender-specific to students is of great importance. For this purpose, special attention should be paid in the educational process to: organizing learning activities aimed at neutralizing and interpreting differences between boys and girls; educating them in the spirit of demonstrating gender similarity; ensuring separate activities for boys and girls in the learning process; organizing types of educational activities corresponding to the personal interests of boys and girls; and providing activity taking into account specific learning situations.

What each boy and girl becomes and what type of activity they master depends on the quality of education.

In the educational process, gender socialization is expressed through specific foundations, the division of labor, culturally accepted norms in society, types of social activity, and their social status. Gender norms and criteria accepted in the education system, to a certain extent, serve to determine students' psychological qualities, abilities, types of activity, and chosen professions based on their biological sex. In the process of education and upbringing, teachers, family, school, and the surrounding environment collectively instill gender norms and criteria into students' consciousness. These views create the ground for the initial formation of ideas in students about what a "real woman" and a "real man" should be. Subsequently, these gender norms are reinforced through the types of activities formed in students. Gender socialization in the educational process is the process by which a student internalizes the gender cultural system of the society in which they live. The key features of gender socialization in the educational process include career guidance for students, proper distribution of educational labor, and the consolidation of personal qualities based on gender specificity.

Recognizing the necessity to consider individuals' psychological and physiological characteristics in order to develop human potential and fully realize existing opportunities has become a priority issue. Effectively utilizing and correctly directing these characteristics should be among the main tasks of modern didactics. During the school period, the development, psychological world, and physiological growth of boys and girls proceed differently. Taking these changes and specificities into account positively affects the effectiveness of education while creating conditions for representatives of both sexes to fully express themselves.

From preschool age, boys and girls play different games and think differently. In school, however, the requirements for them become uniform. Considering the different psychological and physiological development of boys and girls, it would be appropriate to introduce gender education based on advanced foreign experience. On the basis of gender equality, the holistic complex of all socio-psychological characteristics and psycho-emotional processes that activate boys and girls in society serves as the foundation for shaping and directing their activity.

The relevance of gender equality in social relations, which is crucial for societal development, is becoming even more evident today. Significant changes are currently being implemented in social relations and legislation as a result of the special attention paid to establishing gender equality relations in the family and society, and particularly to increasing the social activity of women.

### **CONCLUSION**

In any society, the relationship between women and men is first and foremost determined by the unique characteristics of its national culture, and it continually evolves and refines itself in harmony with societal transformations and changing living conditions. In our country, both women and men occupy distinct, well-established positions and roles within the fabric of social life.

The ever-expanding opportunities granted to women and girls to fully realize their talents, abilities, and potential not only foster the progressive improvement of gender relations but also exert a profound positive influence on preserving the national identity of women—through the enduring values of reverence, deep respect, dignity, honor, and attentive care toward them.

The adoption of effective measures and the pursuit of a proactive, purposeful policy aimed at ensuring genuine equality and full participation of men and women in political, economic, and public spheres invariably lead to substantial, tangible positive outcomes, most notably in enhancing the efficiency and robustness of the social protection system for women and girls.

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