A Comparative Study on Adolescents' Physical Fitness and Its Influencing Factors

Zhishuang Liu[1,2] ,BAT-OCHIR[3] ,Ganbat Danaa[1*]

1.Center for Open Education, Mo ngolian University of Science and Technology, Ulaanbaatar, 15160, Mongolia
2.Department of Physical Education, Hebei International Economic and Trade Vocational College, Qinhuangdao,066000, China
3.Department of Physical Education and Sport, School of Applied Sciences, Mongolian University of Science, Ulaanbaatar, 15160, Mongolia
[*]Corresponding author：ganbatda@must.edu.mn

Abstract: *Adolescents' physical fitness is a vital indicator of their health status and comprehensive development, directly impacting their physical and mental well-being and social adaptability. However, the recent decline in adolescents' physical fitness has raised widespread concerns, with influencing factors demonstrating complexity and diversity. This study systematically reviews the concept and measurement indicators of adolescents' physical fitness, explores the specific impacts of biological factors, social environmental factors, and health behaviors on physical fitness, and employs stratified comparative analysis to reveal the relative effects and interaction mechanisms of these factors. The findings show that adolescents' physical fitness is influenced by a combination of multidimensional factors: biological characteristics such as gender and age determine the foundational differences, while social environment and behavioral patterns play a crucial role in shaping dynamic changes.*

Keywords: *Adolescents; Physical Fitness; Influencing Factors; Stratified Comparison; Health Behavior*

Introduction

Adolescents represent an essential resource for a nation's future development. Their physical fitness not only pertains to individual health but also serves as a critical indicator of societal progress and education levels. However, in recent years, a global trend of declining physical fitness among adolescents has become increasingly apparent, with issues such as obesity and insufficient physical ability posing significant threats to their growth. Furthermore, disparities in physical fitness across regions and groups highlight the complexity and diversity of influencing factors. A systematic study of adolescents' physical fitness and its influencing factors is thus of great significance.

Theoretically, investigating the measurement systems and influencing factors of physical fitness helps deepen the understanding of adolescent health development. Practically, identifying the relative impact of various factors provides data support for optimizing education, sports, and health policies. Current research on adolescents' physical fitness predominantly focuses on single-factor analyses, lacking multidimensional comparisons and comprehensive evaluations. Conducting stratified comparative studies can fill this academic gap, offering both practical significance and theoretical value.

1. The Concept and Measurement Indicators of Adolescents' Physical Fitness

1.1 Definition and Theoretical Basis of Physical Fitness

Physical fitness is a key indicator of an individual’s health status and physical ability, reflecting their comprehensive adaptability in growth, daily activities, and environmental challenges. Its core components include health-related indicators (such as strength, endurance, speed, flexibility, and balance) and skill-related indicators (such as agility, coordination, and reaction time). Health-related physical fitness focuses on promoting health and preventing diseases, such as cardiovascular endurance, muscular strength, and flexibility, directly influencing long-term health. Skill-related physical fitness pertains to the demands of specific activities, affecting sports performance and the execution of motor skills. [1]

The theoretical foundation of physical fitness development is guided by interdisciplinary theories:

Biological and Genetic Theories posit that genes determine physiological characteristics such as muscle types and bone structure, significantly influencing physical fitness performance.

Ecological Systems Theory emphasizes the shaping effects of family, school, and community environments on physical fitness development, such as the impact of family health culture and school physical education on exercise habits.

Exercise Science Theories reveal the physiological mechanisms through which different types of exercise enhance physical fitness, such as strength training fortifying skeletal muscles and aerobic exercise improving cardiovascular function.

These theories provide a scientific basis for studying the formation mechanisms of adolescents' physical fitness and underscore the importance of a multidimensional perspective.

Moreover, modern scientific advancements have integrated social psychology theories and behavioral science models into the theoretical framework of physical fitness research. For example, Motivation Theory examines the driving forces behind health behaviors that improve physical fitness, while Behavior Change Models offer pathways for transitioning from irregular to habitual exercise. These emerging theories enrich the theoretical foundation of physical fitness research.

1.2 Measurement Systems and Evaluation Standards for Physical Fitness

A scientific and comprehensive measurement system is fundamental to studying and improving physical fitness. Commonly used international systems include the EUROFIT Health-Related Fitness Test Battery and integrated health assessment models combining indicators like BMI, cardiovascular fitness tests, and muscle strength evaluations. These systems cover metrics such as sprint speed, jumping ability, balance, and grip strength, enabling multidimensional assessments of adolescents' physical fitness.

In China, the "Physical Health Standards for Students" has become an essential tool for measuring adolescents' physical fitness. Its test items include a 50-meter sprint, standing long jump, sit-and-reach, and pull-ups, comprehensively reflecting core abilities like speed, strength, and flexibility. These items evaluate both single aspects of physical fitness and composite indicators, such as endurance and cardiovascular fitness through long-distance running tests. [2]

Standardized testing methods and reliability-validity checks ensure the scientific accuracy of evaluations. Standardized procedures and scoring criteria minimize subjective interference, while reliability-validity tests ensure data accuracy and stability. Stratified evaluation methods are widely used to account for differences in age and gender. For instance, during adolescence, when rapid physical development and hormonal changes occur, stratified assessments provide more scientific reflections of individual fitness levels.

With advancements in big data and artificial intelligence, dynamic monitoring of physical fitness is now possible. Wearable devices can continuously track adolescents' fitness changes by collecting real-time exercise data, offering personalized exercise intervention plans through data analysis. This dynamic evaluation system enhances measurement efficiency and intervention precision, providing a robust complement to traditional assessment models.

1.3 Dynamic Characteristics of Adolescents' Physical Fitness

Adolescence is a critical period for the rapid development and stabilization of physical fitness, influenced by biological growth, social environments, and behavioral patterns.

From a biological perspective, the rapid increase in sex hormone levels during puberty promotes the development of bones, muscles, and cardiovascular functions, resulting in significant improvements in strength, endurance, and speed. Gender differences become more pronounced during this stage: males exhibit greater muscular strength and cardiovascular endurance due to increased testosterone, while females excel in flexibility and balance.

Environmental and behavioral factors also profoundly affect the dynamic changes in adolescents' physical fitness. School physical education and extracurricular activities are primary drivers of physical fitness development. Studies show that adolescents engaging in high-intensity and regular exercise demonstrate significantly higher levels of cardiovascular endurance and muscular strength than those with insufficient activity.

However, factors such as urbanization, academic pressure, and increased screen time have reduced the time adolescents spend exercising, particularly in urban populations. This lack of physical activity has directly contributed to rising obesity rates and declining endurance.

Dynamic changes also reveal significant regional and group disparities. Rural adolescents often perform better in muscular strength and endurance due to more physical labor but show relative deficiencies in coordination and flexibility due to limited access to diverse and professionally guided activities. Urban adolescents, benefiting from resource advantages, excel in flexibility and skill-related indicators but lag in endurance due to academic pressures and sedentary lifestyles. Additionally, adolescents from high-income families generally exhibit superior physical fitness trajectories, attributed to better access to professional training and nutritional support.

2. Major Factors Influencing Adolescents' Physical Fitness

2.1 Fundamental Impact of Biological Factors

Biological factors serve as the innate foundation for the development of adolescents' physical fitness, primarily encompassing genetic characteristics, gender differences, and individual developmental traits. Genetic factors provide a crucial physiological basis for physical fitness, such as the potential of muscle fiber types, bone structure, and cardiovascular function, which directly affect the performance of strength, endurance, and flexibility. Studies have shown that genetic factors contribute to over 50% of physical fitness, particularly in strength and speed indicators.

Gender differences become particularly prominent during adolescence. Due to the significant increase in androgen secretion, males experience rapid development in muscular strength and cardiovascular function, while females tend to excel in flexibility and coordination. Additionally, individual growth and developmental stages significantly impact physical fitness. The rapid growth during adolescence promotes the development of bones, muscles, and cardiovascular systems, but premature or delayed growth may cause temporary imbalances in physical fitness, further contributing to group differences. [3]

2.2 Multidimensional Analysis of Social Environmental Factors

Social environmental factors are critical external conditions affecting adolescents' physical fitness, encompassing multiple dimensions such as family, school, and community.

Family economic status and health awareness directly influence the opportunities and frequency of adolescents' participation in physical exercise. Research indicates that adolescents from high-income families are more likely to access professional sports training and nutritional support, thereby demonstrating superior physical fitness. However, a lack of health education within the family may result in weak exercise awareness, preventing full utilization of resource advantages.

Schools, as the central environment for adolescent growth, have a direct impact on physical fitness development through their allocation of sports resources and curriculum design. The diversity and frequency of physical education courses, the adequacy of sports facilities, and the professional competence of teachers significantly affect students' participation in sports and the development of their physical fitness.

Additionally, community environments play an essential role. The accessibility and availability of community sports facilities directly determine the convenience of extracurricular exercise, while the reach and effectiveness of health promotion campaigns influence adolescents' health behavior choices to some extent.

2.3 Direct Impact of Health Behaviors and Lifestyles

Health behaviors and lifestyles are dynamic factors determining adolescents' physical fitness, with rapid and highly malleable effects.

Physical exercise is the most direct method to enhance physical fitness, with exercise frequency, intensity, and type showing a significant positive correlation with various physical fitness indicators. Regular high-intensity exercise effectively improves cardiovascular endurance and muscular strength, while flexibility and coordination are enhanced through diverse forms of exercise.

Dietary habits also play a critical role in influencing adolescents' physical fitness. A balanced diet

provides adequate energy and nutritional support to promote physical development, whereas high-sugar and high-fat diets are strongly associated with obesity and cardiovascular health risks. Furthermore, sleep quality and mental health, as integral components of health behavior, indirectly influence physical fitness. Research indicates that sleep deprivation can lead to a decline in reaction time and athletic performance among adolescents, while a positive mental state enhances exercise motivation and the efficiency of physical fitness improvements. [4]

In recent years, the regional and demographic differences in health behaviors have drawn significant attention. Urban adolescents, burdened by academic pressure and increased screen time, exhibit reduced exercise duration, whereas rural adolescents participate in higher levels of physical activity. However, due to a lack of scientific guidance, their efforts often fail to fully translate into improved physical fitness. These behavioral patterns highlight the need for more targeted and adaptive health intervention strategies.

3. Stratified Comparison of Influencing Factors on Adolescents' Physical Fitness

3.1 Comparative Differences in Biological Factors

Biological factors play a fundamental and decisive role in adolescents' physical fitness, with differences primarily reflected in two key dimensions: gender and developmental stage. Gender differences persist throughout the development of adolescents' physical fitness and are particularly pronounced during puberty. Due to the significant increase in testosterone secretion, male adolescents experience rapid development of their skeletal and muscular systems, leading to superior performance in strength, speed, and explosive power. For example, studies show that post-pubertal males achieve higher scores in pull-up tests and 100-meter sprints. In contrast, female adolescents benefit from estrogen's role in enhancing bone density and ligament flexibility, resulting in advantages in flexibility, balance, and agility, particularly evident in sit-and-reach and balance tests.

Developmental stages also lead to heterogeneity in adolescents' physical fitness. During early puberty, increased growth hormone secretion generally results in lower endurance and strength but greater flexibility. In mid-to-late puberty, physical fitness indicators such as strength, speed, and endurance rise sharply, often reaching their peak. However, individual differences in developmental pace and sexual maturation timing create significant variations in physical fitness distribution among adolescents, which are particularly noticeable in fitness tests and athletic performance.

3.2 Stratified Comparison of Social Environmental Factors

Social environmental factors profoundly influence adolescents' physical fitness through resource allocation and support systems. One prominent stratification dimension is the urban-rural divide. Rural adolescents, due to their engagement in physical labor, exhibit better performance in muscle strength and endurance. For instance, studies reveal higher scores among rural adolescents in long-distance running and grip strength tests. However, due to limited sports resources in rural areas, their physical activities are less diverse, and they often lack professional guidance, resulting in comparatively lower performance in flexibility and coordination tests.

Urban adolescents, on the other hand, benefit from richer sports resources and more diverse training opportunities, excelling in flexibility and balance. However, urban adolescents face constraints such as academic pressures and increased use of electronic devices, resulting in insufficient exercise time and weaker performance in strength and endurance tests. [5]

Family economic status is another critical social environmental factor influencing adolescents' physical fitness. Adolescents from high-income families often have access to better sports equipment and professional training, which significantly enhance their physical performance. For example, these adolescents are more likely to participate in activities such as swimming and tennis, which require higher financial investment and contribute positively to endurance, coordination, and flexibility. Conversely, adolescents from low-income families often lack necessary sports support, potentially limiting their physical fitness development. However, research also indicates that free sports programs provided by schools and communities can effectively mitigate this gap.

3.3 Group Differences in Health Behavior Patterns

Differences in health behavior patterns are important moderating factors in adolescents' physical

fitness development, with core variables including exercise participation, dietary habits, sleep quality, and mental health.

In terms of exercise participation, rural adolescents, despite their higher rates of physical activity, often engage in labor-intensive activities that lack scientific and systematic approaches, limiting the improvement of certain dimensions of their physical fitness. Urban adolescents, who more frequently participate in organized activities (e.g., school sports and extracurricular clubs), benefit from scientifically targeted exercises but often have shorter total exercise durations, restricting their overall physical fitness enhancement.

Dietary structure also plays a critical role in the development of physical fitness. Urban adolescents tend to consume excessive amounts of high-calorie and high-fat foods, increasing the risk of obesity and negatively impacting cardiovascular function and endurance. In contrast, rural adolescents often consume higher proportions of carbohydrates, and although their overall energy intake may be insufficient, their diet is more natural, resulting in lower obesity rates. However, both groups experience issues with nutritional imbalances, highlighting the need for health education and dietary interventions.

Sleep quality and mental health are integral components of health behavior, and significant group differences exist in these aspects as well. Urban adolescents often experience sleep deprivation due to academic pressures and prolonged use of electronic devices, which affects their physical recovery and reduces athletic performance. Meanwhile, rural adolescents face limitations in their physical fitness development due to a lack of health awareness and inadequate access to information about mental health and sleep hygiene.

3.4 Interaction of Comprehensive Factors

The differences in adolescents' physical fitness are not the result of a single factor but rather the outcome of interactions among biological factors, social environment, and health behaviors. Research shows that biological factors provide the foundational differences in physical fitness, while social environment and health behaviors amplify or mitigate these differences through resource allocation and behavioral guidance.

For example, in urban areas with abundant sports resources, gender differences become more pronounced, as male adolescents benefit from participating in higher-intensity activities that further improve strength and endurance, while females gain an edge in flexibility and agility due to more diverse activity options. [6]

The interaction between family economic status and health behaviors is also noteworthy. Adolescents from high-income families typically enjoy superior sports resources and exhibit more proactive health behavior patterns due to family support, resulting in significant advantages in physical fitness development. However, adolescents from low-income families can narrow this gap by enhancing health awareness and participating in community sports programs. Research indicates that improved health behaviors can partially compensate for the disadvantages caused by limited resources, serving as a protective mechanism for physical fitness development.

Conclusion

This study reveals the characteristics and multidimensional influencing factors of adolescents' physical fitness. Adolescents' physical fitness encompasses core dimensions such as strength, endurance, and flexibility, shaped by the comprehensive effects of biological, environmental, and behavioral factors. Gender and age are key variables determining physical fitness differences, with biological factors providing genetic and physiological foundations, social environments significantly moderating developmental potential, and health behaviors directly influencing short-term performance and long-term trends.

Stratified comparisons highlight prominent group characteristics in urban-rural disparities, gender differences, and health behavior patterns. The interaction of comprehensive factors illustrates the complex relationships between individuals and their environments. Future research should focus on establishing long-term *monitoring* systems, deepening the exploration of influencing mechanisms, and identifying universal principles and personalized intervention strategies to provide a scientific basis for policymaking.

References

[1] Bian Zhenwu. Study on the Impact of Comprehensive Agility Training on Adolescents' Body Composition and Physical Fitness [J]. Journal of Hebei North University (Social Science Edition), 2024, 40(04): 89-92.
[2] Zhang Xueqing, Deng Junwen. Analysis of the Impact of Orienteering on Adolescents' Physical Fitness [J]. Track and Field, 2024, (05): 57-59.
[3] Wang Yunting, Bai Kaixiang. The Effect of Physical Training on Functional Movement Ability and Physical Fitness of Adolescents [C]//China Sports Science Society. Abstracts of the 13th National Sports Science Conference – Poster Session (Physical Training Section II), Wuhan Institute of Physical Education, 2023:3.
[4] Li Fei, Xu Jialin, Wang Jie. The Impact of Biological Age on Physical Fitness of Adolescent Soccer Players: Based on a Survey of U15 Elite Boys' Teams in Anhui Province [J]. Journal of Xiangnan University, 2023, 44(02): 81-84.
[5] Song Ziwei, Zhang Chunzhi, Zhou Rui. Current Status and Influencing Factors of Adolescents' Physical Fitness Development [J]. Innovative Research on Ice and Snow Sports, 2022, (03): 146-148.
*[6] Yu Yang. Exploration of the Impact of Physical Educatio*n on Comprehensive Quality Education of Adolescents in China [J]. *Youth Sports*, 2021, (03): 28-29.