

ORIGINAL ARTICLE

Relationship between physical development and coordinative abilities in adolescent girls with low adaptive capacity

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ABSTRACT

Aim: To investigate the relationship between physical development and coordinative abilities in adolescent girls aged 16-17 with low adaptive capacity.

Materials and Methods: The research involved 48 female students aged 16-17 from general secondary schools with low adaptive capacity (Ruffier test scores ranging from 10.1 to 15.0 c. u.). The girls' physical development was assessed using the following indicators: 30-meter sprint (speed), standing long jump (speed and strength), push-ups (strength), 4x9-meter shuttle run (agility), and Harvard step test (endurance). Coordinative abilities were assessed using the following tests: the "Flamingo" balance test – standing on one leg on a limited surface (static balance), walking in a straight line with eyes closed (spatial orientation), jumping rope (motor coordination), target-throwing accuracy test with a tennis ball (spatial-dynamic accuracy), and the tapping test (movement frequency). To achieve the research aim, Pearson's linear correlation analysis was applied.

Results: Significant correlations of varying degrees were established between individual parameters of physical development and the coordinative abilities of 16- to 17-year-old girls with low adaptive capacity. These findings indicate that, due to the phenomenon of positive transfer, it is possible to contribute to improving the physical fitness of girls with medical restrictions on certain exercises, specifically by enhancing endurance, speed, and speed and strength qualities through coordination training.

Conclusions: The results obtained allow for the use of more accessible physical exercise parameters to improve physical qualities that are otherwise limited for girls with low adaptive capacity, specifically by developing the most informative types of coordinative abilities based on the phenomenon of positive transfer.

KEY WORDS: girls aged 16-17, adolescents, low level of adaptive capacity, physical education, physical fitness, physical development, coordinative abilities

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INTRODUCTION

The low level of adaptive capacity in modern adolescents is a pressing issue, leading to insufficient adaptation to physical exertion, reduced physical fitness and development, and a decline in functional status, often manifested through cardiorespiratory criteria [1, 2]. Low adaptive capacity of the body results in the inability of the cardiovascular, respiratory, and muscular systems to effectively respond to physical exertion and recover quickly afterward, thereby reducing the health-promoting, developmental, and training benefits of physical exercise [3, 4]. A low level of the body's adaptive capacity is often a direct consequence of physical inactivity – an extremely low level of motor activity, which is a side effect of modern conditions of

distance learning and excessive gadget use, is typical of the leisure time of modern children and youth, and can lead to deteriorating health, serious impairments in the functions of the musculoskeletal system, circulation, respiration, metabolism, hormonal status, and more [5]. Unfortunately, a sedentary lifestyle has become prevalent among modern adolescents, affecting, according to various data, between 75 % and over 80 % of students who do not meet the recommended level of motor activity [6, 7]. However, for a fulfilling life and education, today's youth must have sufficient health reserves to cope with the negative impacts of the physical and social environments.

Physical education in general secondary schools, in various organizational forms, offers certain opportu-

nities to address the deficit in students' motor activity [8]. However, it is known that for schoolchildren with low adaptive capacity (classified into special medical groups), restrictions on the volume and intensity of physical exertion are mandatory. In particular, endurance, high-intensity, and certain strength exercises should be used cautiously and in moderation [9].

It is possible to develop certain physical qualities and indirectly enhance students' physical development through positive transfer, whereby targeted development of one physical quality contributes to increased manifestation of another [10-12]. The task of developing physical qualities, the influence of which is limited for schoolchildren with low adaptive capacity, can be addressed by studying the interrelationships between them and other motor abilities available for development, in particular coordinative abilities.

AIM

The aim is to investigate the relationship between physical development and coordinative abilities in adolescent girls aged 16-17 with low adaptive capacity.

MATERIALS AND METHODS

PARTICIPANTS

The research, conducted during the 2025-2026 academic year, involved 48 girls aged 16-17 who were enrolled in grades 10-11 at Lyceum No. 17 "Kyrylivskiy," Lyceum No. 183 "Fortuna," and Lyceum "Dominanta" in Kyiv (Ukraine). All girls had low adaptive capacity: a low level of adaptive capacity was defined as a Ruffier test score of 10.1-15.0 c. u. according to age norms. Girls with a Ruffier test score above 15.0 c. u. were not allowed to participate in the research, as this level of adaptive capacity indicates serious problems with the cardiorespiratory system.

The inclusion criteria for girls in the study group were age 16-17 years (10th-11th grades of secondary schools), and a low level of adaptive capacity. The research was open-ended; the girls and their parents were informed in advance and consented to participate. Testing of the girls' coordinative abilities and physical qualities was conducted in a gym in October-December 2025 by a physical education teacher in the presence of the school physician. The exclusion criterion was the girls' own desire to withdraw from the research at any time.

METHODS

Analysis and generalization of the literature, testing of physical development indicators and coordinative

abilities, and methods of mathematical statistics. A total of 22 scientific sources from various scientometric databases were reviewed on the selected research topic.

The physical development of the girls was assessed using the following tests: 30-meter sprint (speed qualities), standing long jump (speed and strength qualities), bench push-ups (strength qualities), 4x9-meter shuttle run (agility), and a modified (simplified) Harvard step test (endurance) [13]. Coordinative abilities were assessed using the following tests: the "Flamingo" balance test – standing on one leg on a limited surface (static balance), walking in a straight line with eyes closed (spatial orientation), jumping rope (motor coordination), target-throwing accuracy test with a tennis ball (spatial-dynamic accuracy), and the tapping test (movement frequency) [14]. The "Flamingo" balance test was used to assess the level of static balance. The starting position is standing on a limited surface on one leg, with the other leg bent at the knee and pulled up to the buttocks, held by the corresponding arm. Using the other hand to hold onto a support, the girl assumes a stable position. As soon as the girl removes her hand from the support and can maintain the static pose on her own, the stopwatch is started. The stopwatch is stopped when balance is lost and restarted as soon as the girl regains a stable position. The number of attempts the girl made to maintain stable balance on the surface within 1 minute is counted. The fewer attempts required to maintain balance, the better the test result. The test is performed once. The level of spatial orientation was assessed by having participants walk in a straight line. The girls were asked to walk at a normal pace along a path, first with their eyes open and then with their eyes closed. Normally, when walking with eyes closed, deviation from a straight line does not exceed 10-15 cm. With insufficient vestibular stability, a zigzag gait is observed with deviations from a straight line of up to 30-50 cm or more. The level of motor coordination was assessed using two-footed jumping with a jump rope. The level of spatial-dynamic accuracy (precision) was assessed by throwing a tennis ball at circles of varying diameters. The width of each circle was 10 cm, and the diameter ranged from 10 to 30 to 50 cm. The quality of ball throws at circles of various diameters, drawn on a wall at a height of 2 m from a distance of 3 m, was scored as follows: 3 points for hitting the center, 2 points for the second sector, 1 point for the third sector, and 0 points for landing outside the third circle. The level of movement frequency was assessed using the tapping test. It consisted of the girls, upon the command "go," using a pencil to make as many taps as possible with

Table 1. Relationships between physical development indicators (level of physical qualities development) and coordinative abilities in 16- to 17-year-old girls with low adaptive capacity (n = 48)

Physical development indicators	Coordinative abilities				
	Static balance	Spatial orientation	Motor coordination	Spatial-dynamic accuracy	Movement frequency
Speed	-0.349	0.119	0.425	-0.016	-0.524
Speed and strength qualities	0.086	-0.015	-0.179	0.235	0.193
Strength	-0.016	-0.122	-0.116	-0.214	0.045
Agility	0.467	0.247	0.397	-0.042	-0.319
Endurance	-0.034	0.019	-0.389	-0.001	-0.081

Notes: Statistically significant correlations are indicated in bold

Source: compiled by the authors of this study

their dominant hand within 10 seconds in two squares (50 cm apart), moving as quickly as possible from one square to the other.

METHODS OF MATHEMATICAL STATISTICS

To determine whether there is a relationship between physical development indicators and coordinative abilities in adolescent girls with low adaptive capacity, we used Pearson’s linear correlation analysis. The existence of a relationship and differences between individual variables were considered significant at a 95 % significance level ($p \leq 0.05$). The data were analyzed at the Department of Theory and Methods of Physical Education of Dragomanov Ukrainian State University.

COMPLIANCE WITH ETHICAL STANDARDS

The participants and their parents were informed of the research aim and voluntarily agreed to participate. The research results were reviewed and approved by the Academic Integrity Committee of Dragomanov Ukrainian State University (Approval Protocol No. 4, issued on March 18, 2026).

AI STATEMENT

The author states that no AI tools were used in writing this article.

FRAMEWORK

This study was carried according to the research plan of the Faculty of Physical Education, Sports and Health of the Dragomanov Ukrainian State University in 2023-2027 in accordance with the theme “Monitoring, control and evaluation of learning results in physical culture, the basics of healthy lifestyle” (state registration number 0113U009185).

RESULTS

The relationship between physical development indicators and coordinative abilities in adolescent girls is complex and interdependent, and it plays a decisive role in the effectiveness of any motor activity. Coordinative abilities serve as the foundation for providing targeted and safe pedagogical guidance in the development of physical qualities. The correlation analysis revealed varying degrees of relationship between specific physical qualities and coordinative abilities in 16- to 17-year-old girls. Thus, in adolescent girls with low adaptive capacity, certain relationships were found between various types of coordinative abilities and physical qualities (Table 1).

Significant relationships were found between the level of speed and indicators of static balance ($r = -0.349$), motor coordination ($r = 0.425$), and movement frequency ($r = -0.524$) at $p \leq 0.05$. It was established that the agility level significantly correlates with indicators of motor coordination ($r = 0.397$), spatial orientation ($r = 0.247$), static balance ($r = 0.467$), and movement frequency ($r = 0.319$) at $p \leq 0.05$. It was found that the level of endurance is associated with motor coordination ($r = 0.389$) at $p \leq 0.05$; no other relationships were found between these physical qualities and any of the types of coordinative abilities ($p > 0.05$).

At the same time, a weak but significant correlation was observed between speed and strength ability levels and the spatial-dynamic orientation indicator ($r = 0.235$; $p \leq 0.05$); no statistically significant correlations were found between strength performance and indicators of various types of coordinative abilities ($p > 0.05$).

These relationships between physical development indicators and coordinative abilities in 16- to 17-year-old girls with low adaptive capacity can be interpreted as follows: an increase in running speed occurs in parallel with the development of motor coordination;

to improve endurance, motor coordination should be developed; to develop speed and strength qualities, spatial-dynamic accuracy should be improved. Regarding the 4x9 m shuttle run, this test requires running short distances at high speed with multiple changes in direction; therefore, its result depends on the combined level of speed, agility, and speed and strength qualities. Therefore, to improve performance in the shuttle run, it is advisable to promote the development of spatial orientation, movement frequency, and motor coordination. Regarding balance, this indicator has an inverse relationship with speed and agility: in the “Flamingo” balance test, the lower the result, the more points the participant receives; therefore, the better the result in the speed run, the poorer the display of static balance.

The data reveal the nature of positive transfer of physical qualities, where the development of certain aspects of motor skills contributes to the improvement of others. This allows for the rational planning of physical exercise sessions for 16- to 17-year-old girls with low adaptive capacity, by planning physical activity parameters appropriate to their capabilities and ensuring the best health-promoting and developmental effects in line with their functional abilities.

Thus, to develop speed in 16- to 17-year-old girls with low adaptive capacity, it is advisable to include exercises aimed at developing motor coordination, balance, and movement frequency, specifically dance exercises, exercises on limited support, maintaining a stable posture, shuffling, intense arm and leg swings while standing, exercises on a coordination ladder, and, to a limited extent, jumping rope, etc. To develop speed and strength in physical education, accuracy exercises should be planned, such as throwing and tossing balls of various sizes and weights at horizontal and vertical targets. To improve endurance, it is advisable to include dance exercises, simultaneous movements of different body parts in various directions, walking in place, and walking while moving with random changes in direction. In addition to these exercises, given the wide variety of motor actions and the accessibility of these activities for individuals with varying levels of fitness, it is advisable to use a variety of sports games to develop the physical fitness of 16- to 17-year-old girls with low adaptive capacity.

DISCUSSION

The direction, magnitude, and level of the significant correlation coefficients indicate that several physical development indicators – on which direct pedagogical influence is limited due to girls’ low

adaptive capacity – can be improved through the indirect development of coordinative abilities. This is explained through the biomechanical and physiological mechanisms underlying various aspects of motor function [15, 16].

Thus, the strength of the correlation between different types of coordinative abilities and speed depends on the specifics of the movements. Motor coordination is the foundation for speed, as it ensures precise muscle contractions, reduces resistance from antagonist muscles, and allows the nervous system to transmit impulses accurately. From a biomechanical perspective, as the demands on movement speed increase, the coordination complexity of their execution rises; therefore, higher motor skill is required to maintain accuracy [17]. This is explained by the inhibition factor (Fitts’ law): speed and accuracy are inversely proportional; the higher the movement speed, the greater the likelihood of coordination errors [18]. To act quickly, the brain must coordinate muscle activity effectively. High speed is impossible without coordination (the ability to control one’s body movements and to coordinate muscle activity to perform precise, complex movements). The better one’s coordination is developed, the less effort and attention the nervous system expends on performing a motor act. This allows one to safely increase speed without losing quality. The development of these aspects of motor skills occurs in parallel: from slow, conscious execution of exercises (building neural connections and perfect coordination) to a gradual increase in speed to consolidate high-intensity automated movement [19].

Movement frequency is a basic manifestation of speed. At the same time, movement frequency is determined by the ability to control movement and by a high level of coordination between alternating excitation and inhibition processes in the cerebral cortex, thereby enabling the muscles to contract rapidly and relax instantly [20]. At the same time, in the context of human biomechanics, there is a relationship between movement speed and static balance. As the speed of any movement increases, the body’s center of mass moves beyond the base of support more rapidly, which critically reduces static balance and requires a transition to dynamic balance. That is, the higher the movement speed, the less important static balance is for successful task completion [21].

The comprehensive expression of physical qualities during shuttle runs requires an understanding of the physiological mechanisms underlying various forms of coordinative ability. Thus, performing the shuttle run exercise involves running short distances at high speed, repeated abrupt stops, rapid 180° turns, and

rapid muscle re-engagement [8]. These phases require a high level of movement frequency and motor coordination. At the same time, the sudden change in direction forces the body to balance and maintain equilibrium, which contributes to the exercise's effectiveness. At the same time, to perform the exercise effectively, the brain must constantly calculate the distance to the turning line, assess speed, and select the optimal angle for the turn. This requires spatial orientation – the ability to assess and differentiate the spatial characteristics of movements [10].

There is a weak positive correlation between long jump results and accuracy test scores (spatial-dynamic accuracy), which can be explained by the fact that both tests are based on the demonstration of coordination – the ability to synchronize movements. The long jump requires a quick takeoff and the ability to maintain balance in space during the flight phase. This same control helps in making precise movements when throwing or aiming at a target. From a physiological perspective, the development of explosive strength, as a component of speed and strength qualities, simultaneously influences improvements in the overall coordination of the central nervous and peripheral neuromuscular systems [1, 22]. Accuracy requires a delicate balance, precise aiming, and excellent muscle control; therefore, the lack of a direct correlation with strength is explained by the fact that strength can reduce movement precision, as strength exercises induce physiological arousal that interferes with fine motor skills and movement precision [9].

A significant correlation has been observed between endurance and motor coordination, which can be explained as follows: a high level of motor coordination reduces the body's energy expenditure. In contrast, high endurance enables the maintenance of precision and coordination of movement even under fatigue, thereby optimizing overall performance.

Thus, the research results confirm that performance in exercises requiring unidirectional or complex man-

ifestations of speed, speed and strength abilities, and endurance can be improved through the targeted development of specific types of coordinative abilities. Although the observed correlations are statistically significant, they are relatively weak, indicating a specific pattern of physical development among 16- to 17-year-old girls with low adaptive capacity.

CONCLUSIONS

Significant correlations were found between the level of speed and the indicator of motor coordination ($r = 0.425$), balance ($r = -0.349$), and movement frequency ($r = -0.524$) at $p \leq 0.05$; the level of agility with the indicator of motor coordination ($r = 0.397$), the indicator of spatial orientation ($r = 0.247$), the indicator of balance ($r = 0.467$), and the indicator of movement frequency ($r = 0.319$) at $p \leq 0.05$; the level of endurance with the motor coordination indicator ($r = 0.389$) at $p \leq 0.05$. At the same time, a weak but significant correlation was found between the level of speed and strength abilities and the spatial-dynamic orientation indicator ($r = 0.235$) at $p \leq 0.05$; no statistically significant correlations were found between strength performance and indicators of various types of coordinative abilities ($p > 0.05$).

The results obtained allow for the use of more accessible physical training parameters to improve the level of those physical qualities (speed, strength, endurance, speed and strength qualities), the influence on which is limited for adolescent girls with low adaptive capacity, particularly to develop the most informative types of coordinative abilities based on the phenomenon of positive transfer.

PROSPECTS FOR FURTHER RESEARCH

Future research will focus on developing a comprehensive program to improve the physical qualities of 16- to 17-year-old girls with low adaptive capacity.

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CONFLICT OF INTEREST

The Authors declare no conflict of interest

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