The influence of active and sports games on the functional state and motor activity of first-year university students

Gulxayo Karshiboeva
gulxayokarshiboeva@gmail.com
Almalyk State Technical Institute

Abstract: The article examines the problem of improving the functional state and motor activity of university students by means of active and sports games. The aim of the study was to substantiate and experimentally verify the effectiveness of using active and sports games in physical education classes for improving the functional fitness and increasing the daily motor activity of first-year students. The pedagogical experiment lasted one academic semester (16 weeks, two 80-minute sessions per week) and involved 60 first-year male students of Almalyk State Technical Institute, divided into an experimental group (n = 30) and a control group (n = 30). The functional state was assessed by resting heart rate, the Ruffier index, the Harvard step test index, vital lung capacity and the Stange breath-holding test; daily motor activity was measured by pedometry (average number of steps per day). The data were processed using Student's t-test. By the end of the experiment, the experimental group demonstrated statistically significant improvements in all six indicators, considerably exceeding the changes in the control group, which were statistically insignificant. The results confirm that the systematic use of active and sports games is an effective pedagogical means of improving the functional state and motor activity of university students.

Keywords: active games, sports games, physical education, university students, functional state, motor activity, Ruffier index, Harvard step test, pedagogical experiment, health

Introduction

The preservation and strengthening of the health of student youth is one of the priority tasks of the modern higher school and an important direction of the state policy of the Republic of Uzbekistan in the field of physical culture and sport [1; 8]. Under conditions of intensive intellectual work, prolonged static loads and widespread hypodynamia, the functional state of the body of students and the level of their daily motor activity tend to decline, which negatively affects their health, working capacity and academic performance.

The functional state of the cardiovascular and respiratory systems is one of the key integral indicators of a person's health and physical condition; its level largely determines aerobic capacity, resistance to fatigue and the adaptive reserves of the body

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[3; 10]. Increasing the volume of daily motor activity is recognized worldwide as an essential factor of disease prevention and health promotion [8; 9].

Among the means of physical education, active and sports games (such as basketball, volleyball, mini-football and a variety of relay and movement games) possess a high health-improving potential. They are distinguished by an emotionally rich, variable and natural character of movements, a high motor density and the ability to engage students with different levels of fitness, which increases their interest in physical activity and stimulates regular exercise [3; 4]. Nevertheless, the targeted use of active and sports games for improving the functional state and motor activity of students requires further experimental substantiation.

The aim of the present study is to substantiate and experimentally verify the effectiveness of using active and sports games in physical education classes for improving the functional state and increasing the daily motor activity of first-year university students. It was hypothesized that the systematic application of a game-based program during one academic semester would lead to statistically significant improvements in the functional indicators and motor activity of students, exceeding the results achievable through the traditional curriculum.

Materials and Methods

Organization of the study and participants. The pedagogical experiment was conducted during one academic semester of the 2024/2025 academic year on the premises of Almalyk State Technical Institute. The study involved 60 first-year male students aged 17-18 years, assigned to the basic medical group and having no contraindications to physical exercise. The participants were divided into two equivalent groups: an experimental group (EG, $n = 30$) and a control group (CG, $n = 30$). Preliminary testing confirmed the absence of statistically significant differences between the groups at baseline ($p > 0.05$), which indicates their initial homogeneity.

Content of the program. Students of both groups attended physical education classes twice a week (two 80-minute lessons). The control group followed the standard physical education curriculum. In the experimental group, 35-45 minutes of each lesson were devoted to a systematically organized complex of active and sports games - relay races, active games of high and moderate intensity, and elements of basketball, volleyball and mini-football - selected and dosed according to the principle of gradually increasing load and the rational alternation of intensive and recovery games. In addition, students of the experimental group received individual recommendations to increase their daily motor activity (walking, active recreation), the fulfilment of which was monitored by pedometry [4; 8].

Methods of assessment. To assess the functional state, the following indicators were registered: resting heart rate (HR, beats per minute); the Ruffier index, characterizing the response of the cardiovascular system to a standard load (lower

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values indicate a better functional state); the Harvard step test index (HSTI), reflecting the level of general physical working capacity (higher values indicate better fitness); vital lung capacity (VC, ml), measured by spirometry; and the Stange test (breath-holding time on inhalation, s), characterizing the resistance of the body to hypoxia [5; 6]. The daily motor activity was assessed by pedometry as the average number of steps per day over one week. All measurements were carried out twice - before and after the experiment - under identical conditions.

Statistical analysis. The obtained data were processed using methods of mathematical statistics. For each indicator the arithmetic mean (M) and the standard deviation (σ) were calculated. The significance of differences was assessed using Student's t-test; differences were considered statistically significant at $p<0.05$. Calculations were performed using Microsoft Excel and IBM SPSS Statistics. Participation in the study was voluntary; all students gave their informed consent and had valid medical clearance.

Results

The results of the pedagogical experiment are presented in Tables 1 and 2. At the beginning of the experiment, the functional indicators and the level of motor activity in the experimental and control groups did not differ significantly ($p>0.05$), which confirms the equivalence of the groups.

As shown in Table 1, by the end of the experiment the students of the experimental group demonstrated a statistically significant improvement in all six indicators ($p<0.05$). The most pronounced relative changes were observed in daily motor activity (the average number of steps per day increased by 33.3%) and in the Ruffier index (which improved by 26.5%). The Stange breath-holding test improved by 20.0%, the Harvard step test index by 15.9%, vital lung capacity by 7.9%, and resting heart rate decreased by 7.3%.

Table 1

Dynamics of the functional state and motor activity in the experimental group (n = 30)

Indicator	Unit	Before (M ± σ)	After (M ± σ)	Δ, %	t	p
Resting heart rate	bpm	76.4 ± 5.2	70.8 ± 4.6	7.3	4.62	< 0.05
Ruffier index	units	9.8 ± 1.6	7.2 ± 1.4	26.5	6.84	< 0.05
Harvard step test index	units	68.5 ± 6.3	79.4 ± 6.8	15.9	6.31	< 0.05
Vital lung capacity	ml	3680 ± 310	3970 ± 295	7.9	5.27	< 0.05
Stange test	s	48.6 ± 7.2	58.3 ± 7.8	20.0	5.95	< 0.05
Daily motor activity	steps/day	6840 ± 920	9120 ± 1040	33.3	8.12	< 0.05

Note. For resting heart rate and the Ruffier index, lower values indicate a better functional state; for the remaining indicators, higher values are better. The percentage reflects the magnitude of improvement.

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In the control group (Table 2), the changes in all indicators were positive but small and did not reach the level of statistical significance ($p > 0.05$). The relative changes in the control group did not exceed 5.2% (the Ruffier index) and were considerably smaller for the remaining indicators (1.5–3.9%).

Table 2

Dynamics of the functional state and motor activity in the control group (n = 30)

Indicator	Unit	Before (M ± σ)	After (M ± σ)	Δ, %	t	p
Resting heart rate	bpm	75.9 ± 5.4	74.6 ± 5.1	1.7	0.96	> 0.05
Ruffier index	units	9.6 ± 1.7	9.1 ± 1.6	5.2	1.18	> 0.05
Harvard step test index	units	69.1 ± 6.5	70.8 ± 6.7	2.5	1.02	> 0.05
Vital lung capacity	ml	3705 ± 305	3760 ± 300	1.5	0.71	> 0.05
Stange test	s	49.2 ± 7.0	51.0 ± 7.3	3.7	0.98	> 0.05
Daily motor activity	steps/day	6910 ± 880	7180 ± 910	3.9	1.16	> 0.05

Note. For resting heart rate and the Ruffier index, lower values indicate a better functional state; for the remaining indicators, higher values are better. The percentage reflects the magnitude of improvement.

A comparison of the final results of the two groups revealed statistically significant differences in favour of the experimental group in all six indicators ($p < 0.05$), which confirms the higher effectiveness of the game-based program in comparison with the traditional curriculum.

Discussion

The data obtained convincingly show the advantage of the game-based program over the traditional curriculum in improving the functional state and motor activity of students. The pronounced positive changes in the experimental group are associated with the specific features of active and sports games as a means of physical education. Their high emotional intensity, variability and natural alternation of intensive efforts with short rest intervals create a training effect close to interval aerobic loading, which stimulates the adaptive reorganization of the cardiovascular and respiratory systems [7; 10].

The most pronounced relative changes were recorded for daily motor activity (+33.3%) and the Ruffier index (improvement by 26.5%). The substantial increase in the number of daily steps indicates the formation of a more active lifestyle and confirms that game-based forms of activity raise students' interest in movement and motivate them to be physically active beyond the classroom [4; 9]. The improvement of the Ruffier index, the Harvard step test index and the resting heart rate reflects the increased economy of cardiovascular function and the growth of the body's functional reserves, while the increase in vital lung capacity and breath-holding time indicates a favourable development of the respiratory system.

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The minor, statistically insignificant changes in the control group show that the traditional curriculum maintains the existing functional level but does not provide a sufficient stimulus for its pronounced improvement over one semester.

Among the limitations of the study are the relatively short duration of the experiment (one semester), the participation of male students only, and the data being obtained at a single institution. Further research is advisable to verify the effectiveness of the game-based program over a longer period, on a larger and mixed-sex sample, and to include additional functional and biochemical indicators.

Conclusion

1. The conducted pedagogical experiment confirmed the effectiveness of the systematic use of active and sports games for improving the functional state and motor activity of first-year university students.

2. Over one academic semester, the experimental group achieved statistically significant improvements in all six indicators ($p < 0.05$) - including a 33.3% increase in daily motor activity and a marked improvement of cardiorespiratory function - considerably exceeding the results of the control group, in which the changes were statistically insignificant ($p > 0.05$).

3. The game-based approach can be recommended for wider use in the physical education process of higher educational institutions as an effective, emotionally attractive and health-improving means of enhancing the functional state and motor activity of students.

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