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The Effect Of Aerobic Engagement On Coordination. Its Dynamics And Prognosis.

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ABSTRACT

The aim of the study was to test experimentally the level of influence of aerobic activities (cross training and basic aerobics) on the coordination of students. To test the results, the «somersault» exercise was used, which consisted of three somersaults for a while. The analysis of the data was analyzed using the Hurst method. 106 students of the first courses participated in the experiment (53 - control group and 53 - experimental). At the end of the experiment (May) the results of the students of the experimental group differed qualitatively from those of the control group. The results of the experiment indicate the need to include aerobic activities in the curriculum for physical education of students in groups with sports orientation (sectional occupations) ping-pong. The experimental program combines a curriculum in the field of sports (sectional occupations) in ping-pong - 75% of the total and aerobic exercise (cross training and basic aerobics) - 25%. On this experiment it was proved that the development and inclusion of ping-pong, aerobic exercises (cross training and elements of basic aerobics) in the sports program (sectional occupations), more qualitatively influenced the development of student coordination.

Keywords: Aerobic exercises, coordination, rollover forward, Hirst's method, fractal analysis.

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INTRODUCTION

The problem of improving the process of physical education of students for many years is the subject of attention of specialists [9, 11]. An analysis of literary sources shows that the level of physical training, mental and moral strength of the majority of students remains rather low [10, 13]. This indicates a deterioration in the physical, mental and moral development of the younger generation [7, 23], progress in motor activity deficit [12, 16, 25], which leads to a deterioration in student health.

All this requires finding new ways to improve the physical, psychological and moral condition of student youth [5]. According to the results of previous studies, students assessed the importance of development of physical qualities as follows: 1) endurance - 41.8%, 2) strength - 14.9%, 3) agility - 13.7%, 4) flexibility - 12.2%, 5) coordination - 9,8%, 6) speed - 7,6%. And their own level of physical fitness was estimated as follows: 1) strength - 22.3%; 2) coordination - 19.5%; 3) speed - 16.1%; 4) flexibility - 15.3%; 5) agility - 14; 9%, 6) endurance - 11,9% [4, 19]. The issues of improving the physical training of students have recently been considered in the work of a large number of researchers: V. Grin'ko investigated the effect of aerobic classes, S. Isaac conducted a monitoring of physical activity [20, 22]. There are a large number of works where such physical quality as coordination is studied [1, 17, 33]. But there is not enough work to improve this quality, in particular in groups with a sports orientation (sectional occupations) in table tennis. Based on this, the authors carried out a study whose purpose was to study the effect of aerobic activities on the coordination of students in groups with sports orientation (sectional occupations) ping-pong. This hypothesis is experimentally tested and analyzed the state of coordination of student movements on the basis of the exercise «somersault».

The purpose of the research: to experimentally identify, influence the coordination of students aerobic exercise (cross training and basic aerobics), which are included in the program of groups with a sports focus (sectional occupations) ping-pong at a higher educational institution and explore the need to include these classes in the curriculum on physical upbringing.

MATERIALS AND METHODS

Participants. The experiment was attended by 106 first-year students (53 control groups and 53 experimental ones). We received informed consent from all the participants to participate in this experiment. For the processing of experimental data, an R/S method was proposed.

Procedure (organization of research): a formative pedagogical experiment was conducted, the purpose of which was to identify the effects of aerobic training on the coordination of students in groups with sports orientation (sectional classes) ping-pong. For the pedagogical experiment participants were divided into control and experimental groups.

At the first stage, a confirmatory experiment was conducted. The purpose is to establish the identity of control and experimental groups. Determine the initial level of development of the experiment participants. As a result, there was no significant difference between them.

At the second stage - introducing aerobic training into a curriculum on ping-pong. With the help of exercise «somersault», experimentally validate and scientifically substantiate the impact of these exercises on such physical quality as coordination. The experiment was conducted during the school year from October 2015 to June 2016. Students of the control group were engaged in the program of a higher educational institution for groups with a sports orientation (sectional classes) ping-pong [15, 32]. The program consists of the following distribution of educational material: theoretical training, general-physical and special-physical training, technical training, calibration and control standards, competitions. The classes were held four hours a week during the school year. And students of the experimental group on the method we have developed, which combines a program for special sports training (ping-pong - 75%) and aerobic classes (cross training and elements of basic aerobics - 25%). By mid-December, students of the experimental group were engaged in cross-training in the fresh air every fourth lesson. Then they went to the hall, where within the framework of the experiment, every fourth lesson was continued with basic aerobics. At the end of March, they went out to fresh air, where they continued to engage in every fourth session of cross training.

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In the third stage a repeated comparative experiment was conducted, the purpose of which was to check the degree of influence of aerobic exercises on the coordination of students.

Given that the results of the exercise are nothing but time series, Hurst's algorithm was used for fractal analysis [36]. The use of fractal analysis was studied in the works of foreign and domestic scholars such as B. Mandelbrot [6], E. Peters [8, 31], M. Afanasov [14], V. Dubnitsky [21], N. Novikova [30], E. Naiman [29] et al. Despite the large number of studies, the issue of prediction of time series of physical education, taking into account their fractal properties, is inadequately studied, remains controversial and requires further research.

For the analysis of the dynamics of the «somersault» exercises, data from the control and experimental groups were used. The calculation system was used and shown in the publications No. 2017, No. 2 and 2018, in the example of the definition of special and general endurance [3, 4].

For fractal analysis, the Hurst algorithm was used which is given in the papers [3, 24, 27].

R / S analysis algorithm:

1. Based on the output series Yt we calculate the logarithmic relationship:

$$N_t = Ln\frac{Y_t}{Y_{t+1}} \quad (1)$$

2. Divide the series N_t into A of adjacent subperiods ($A \le N_t / 2$) with length n, so that $A * n = N_t$. We will note each subperiod as Ia, where a = 1,2,3.. A. Determine for each Ia the average value:

$$E(I_a) = \frac{1}{n}\sum_{k=1}^{n} N_{k,a} \quad (2)$$

3. Calculate deviations from the mean for each sub-period I_a:

$$X_{k,a} = \sum_{i=1}^{k}(N_{i,a} - E(I_a)) \quad (3)$$

4. 4. Calculate the scale within each period:

$$R_{I_a} = \max(X_{k,a}) - \min(X_{k,a}) \quad (4)$$

5. Calculate the standard deviation for each period:

$$S_{i,a} = \sqrt{\frac{1}{n}\sum_{k=1}^{n}(N_{k,a} - E(I_a))^2} \quad (5)$$

6. Everyone R_{I_a} to share on S_{I_a}. Then calculate the average value of R / S:

$$R/S(n) = \frac{\sum_{a=1}^{A} R/S(A)}{A} \quad (6)$$

7. We build a dependency schedule $\log(R/S(n))$ from $\log(n)$ we find regression of the species:

$$\log(R/S(n)) = H \cdot \log(n) + c, \quad (7)$$

where H – is the Hurst index, C – is a constant value.

8. The process (steps 2-7) repeats with increasing n to the value N_t ($n \le N_t$).

According to the algorithm of finding the Hurst index, the statistical parameters for the time series Y1, which are shown in Table 1, were first found. 1 and are needed to find the Hurst index [2, 26].

Table 1: Hurst statistical indicators

Length (n) of adjacent subperiods of a series Nt=lnY1(t+1)/Y1t	7	14	21	28	35	42	49
Average value=	-0,036	0,014	-0,012	0,004	0,004	0,000	0,0000
Max=	0,441	0,525	0,618	0,602	0,602	0,606	0,606
Min=	-0,570	-0,633	-0,607	-0,623	-0,623	-0,619	-0,619
R=Max-Min=	1,012	1,158	1,225	1,225	1,225	1,225	1,225
S=	0,358	0,353	0,332	0,316	0,307	0,309	0,294
R/S=	2,829	3,279	3,688	3,872	3,992	3,971	4,164
Average value R/S=	2,829	3,054	3,265	3,417	3,532	3,605	3,685
Ln(R/S)=	1,040	1,116	1,183	1,229	1,262	1,282	1,304
Ln(n)=	1,946	2,639	3,045	3,332	3,555	3,738	3,892

Statistical parameters of Hurst for the time series Y_1

Note: Y1 - results of the test of forward gear dynamics for the control group; Nt1 - the time series is converted into a time series of length Nt1 = Y1-1 from the logarithms Nt1 = lnY1 (t + 1) / Y1t, which is divided into subperiods; Average value is the average value of the corresponding adjacent subperiod; Max is the maximum value of the length of the corresponding adjacent subperiod; Min - minimum value of the length of the corresponding adjacent subperiod; R - swing within each subperiod; S - standard deviation for each subperiod; R / S - ratio of magnitude within each period to standard deviation; Average value R / S:

$$R/S = \frac{\sum_{i=1}^{m} R/S}{m},$$

where m - number of subperiods; Ln (R / S) - natural logarithm of the average value of R / S; Ln (n) is the natural logarithm of the length of the adjacent subperiod of the series Nt1.

The Hurst statistical parameters allow to determine the time series for its persistence, anti-persistence or stochasticity. This makes it relatively simple and reliable to choose the method of forecasting the further development of the investigated process. On the basis of the obtained statistical indices (Table 1), the Ln (R / S) graph from Ln (n) was originally constructed for the dynamics of the «somersault» exercise of the time series Y1, the control group, which was investigated in October (Fig. 1), and the inclination of the linear approximation line was found. The tangent of the angle of this inclination is the Hurst index. The Hurst index can take values from 0 to 1 [5, 28].

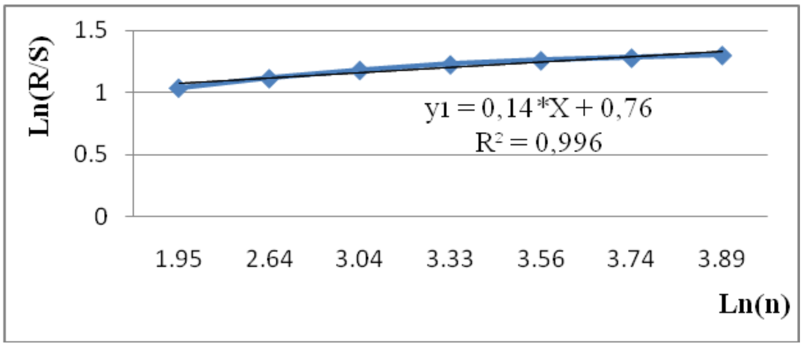

Fig 1: The ratio of Ln (R / S) to Ln (n) for the tdynamics of the exercise «somersault» of the control group (october month).

To evaluate the obtained equation y1 = 0,14 * X + 0,76, we will use the Analysis of Excel table processor data with the Regression tool. The results of regression statistics and dispersion analysis are shown in Table.

Table 2: Summary of regression statistics and dispersion analysis of time series Y1

CONCLUSION OF THE RESULTS						
Regression statistics						
Multiple R	0,997702					
R-square	0,995409					
The normalized R-square	0,99449					
Standard Error	0,007119					
Observations	7					
Dispersion analysis	df	SS	MS	F	significancy F	
Regression	1	0,05493652	0,05493652	1083,989017	4,85801E-07	
Balance	5	0,0002534	5,068E-05			
Total	6	0,05518992				
	Coefficients	Standard Error	t-statistics	P- Value	Lower 95%	The upper 95%
Y-intersection	0,760301	0,013693848	55,52134734	3,58505E-08	0,72509972	0,7955020
Variable X 1	0,139727	0,004243926	32,92398848	4,85801E-07	0,128817626	0,1506363

As can be seen from Table. 2 parameters of the regression equation y1 = 0,14 * X + 0,76 are statistically significant. Thus, the Hurst index H = 0.14 for the time series Y1 falls in the interval 0 ≤ H <0.5 and therefore we conclude that the time series being investigated is anti-persistent or ergodic, which tends to continually change the trend (growth is shifted by descending and vice versa). The lack of a trend in the investigated process and the characteristics of the studied indicators allow you to choose exponential smoothing or moving average as forecasting methods. Similar studies have been done for the time series Y2, Y3, Y4 and the following equations have been obtained for the determination of the Hurst parameter: y2 = 0.417 * X + 0.229, R2 = 0.997; y3 = 0.113 * X + 0.888, R2 = 0.995; y4 = 0.178 * X + 0.52, R2 = 0.999.

Thus, the time series Y1, Y2, Y3, Y4 according to the Hurst index (0 ≤ H <0,5) relate to the antipersistent time series [18].

RESEARCH RESULTS

For comparative analysis of control and experimental groups, a graphical comparative analysis was performed, the results of which are shown in Fig. 2 and rice 3.

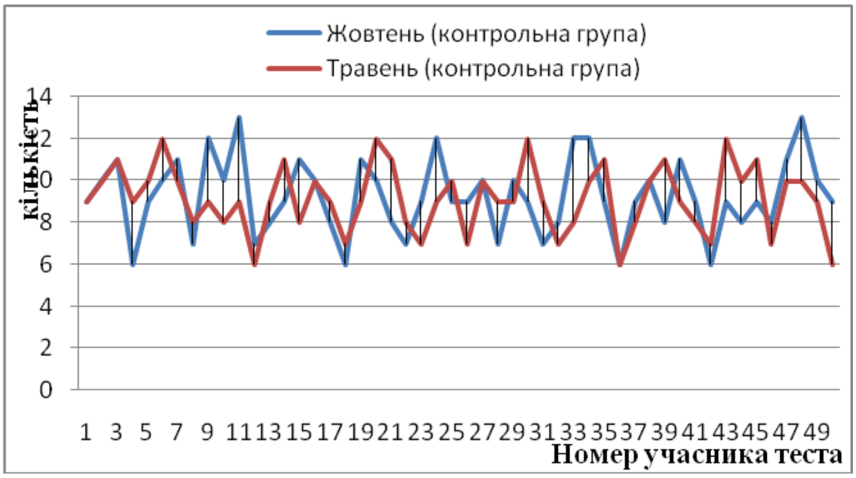

Fig 2: Results of the dynamics of the exercise «somersault» of the control group

Fig 3: Results of the dynamics of the «somersault» exercise of the experimental group

Fig 4: Results of the dynamics of the exercise «somersault» in October of the experimental and control groups

Fig 5: Results of the dynamics of the exercise «somersault» in May of the experimental and control groups

As can be seen from the data in Fig. 2 - rice. The average of 5 in October for the experimental group is 9.32 seconds, and the control group is 9.3, which is 0.02 seconds. more, for May 9.0 and 9.19 for 0.19 seconds. Less. This proves that the program we have developed for the inclusion of aerobic exercises (cross training and elements of basic aerobics) into the program of sectional exercises (ping-pong) to improve general and special endurance, also positively affects physical quality, such as coordination.

To predict such time series it is expedient to use the method of exponential smoothing. The method of exponential smoothing is most effective in developing medium-term forecasts. To predict the results of the dynamics of the «somersault» exercise using the exponential smoothing method, use the formula of Professor Brown (8): Ut + 1 = α * Yt + (1- α) * Ut, (8), where t is the period preceding the prediction; t + 1 - forecast period; Ut + 1 is a predicted value; α is the smoothing parameter; Yt - actual value of the researched indicator for the period preceding the forecast; Ut is the exponential weighted average for the period preceding the forecast. It is advisable to use this method for one period ahead. When forecasting with the exponential smoothing method, you must choose the smoothing parameter α and the initial value Ut. There is no exact method for selecting the optimal magnitude of the smoothing parameter α, so we choose α based on the smallest mean square deviation between the actual values Y1, Y2, Y3, Y4 and the theoretical, calculated by Brown's formula. The parameter α is chosen within (0,1-0,9) and the initial value of Ut is calculated as the average value of all observations (with a small number of observations it is expedient to choose the initial value of the first actual value). Calculated data for choosing the coefficient α is reduced to the table. 3, and the exponential weighted mean Ut for the predicted value to the table. 4.

Table 3: The mean square deviation of the actual and theoretical values of the dynamics of the «somersault» exercise, depending on the parameter α.

	α=	0,1	0,2	0,3	0,4	0,5	0,6	0,7	0,8	0,9
For the control group (October)	σ =	1,89	1,97	2,04	2,11	2,19	2,26	2,34	2,41	2,49
For the control group (May)	σ =	1,69	1,75	1,810	1,87	1,9	1,99	2,05	2,1	2,16
For the experimental group (October)	σ =	1,77	1,78	1,8	1,83	1,9	1,94	1,999	2,07	2,16
For the experimental group (May)	σ =	1,5	1,54	1,57	1,62	1,7	1,73	1,79	1,87	1,96

As can be seen from Table. The 3 least-mean-square deviations of the actual and theoretical values for control and experimental groups (σ) were obtained at α = 0.1.

Table 4: Exponential weighted mean Ut (kg) of «somersault» dynamics test for control and experimental groups

For the control group (October),Y1	23,194
For the control group (May), Y2	23,264
For the experimental group (October),Y3	22,272
For the experimental group (May),Y4	23,18

Using formula 8 and obtained data of the tables, we calculate the forecast data of the dynamics of the exercise «somersault». Data are summarized in Table. 5.

Table 5: Predictive values of the dynamics of the «somersault» exercise for the control and experimental groups (sec.)

For the control group (May)	For the experimental group (May)
8,961	8,901

The average relative error was calculated according to the formula:

$$\varepsilon = \frac{1}{n} \cdot \sum_{i=1}^{n} \frac{|Y_t - U_{t+1}|}{Y_t} \cdot 100 \quad ,(9)$$

where n – is the number of participants, Yt – is the actual values of the test of forward displacement dynamics, Ut + 1 – is the theoretical values of the dynamics of «somersault».

The average relative error of the theoretical and actual values for the control and experimental groups does not exceed 10%.

DISCUSSION

After statistical processing and comparison of the data with the given previous studies [22, 34], such physical quality as coordination, the students have become at a higher quality level. The authors of works [17, 33] in their studies are limited only by the influence of aerobic exercises on general health. Others [15, 35] apply aerobic exercise only at the beginning of the exercise and, finally, during general physical training. Our proposed method, fundamentally different from the ones developed earlier.

The obtained results are supplemented by scientific data on aerobic occupations and their influence on coordination [3, 4, 19].

***For the first time**:* the effectiveness of the methodological approach to developing a program of physical education for students of sports oriented groups has been experimentally proved, combining the commonly used means of development of physical qualities and the latest techniques for their improvement. The program of physical education for students of sports-oriented groups (sectional classes) is grounded. Ping-pong with the inclusion of aerobic exercises (cross training and basic aerobics) [3, 4, 19] is grounded.

CONCLUSIONS

It has been proved that the development and inclusion in the curriculum with a sports orientation (sectional classes), aerobic training (cross training and elements of basic aerobics), will significantly improve the students physical quality - coordination. And the method of exponential smoothing makes it possible to predict the results for the future. One of the advantages of the calculation method proposed in the article is that fractal analysis allows us to detect stochastic (random) time series. In such time series there is no long-term statistical dependence. Stochastic time series can not be predicted by known methods of extrapolation. Also, the fractal analysis of time series for the dynamics of the «somersault» exercises was made in the work and it was found that they relate to antipersistent time series which can be predicted. A graphical data analysis is performed that shows improvement of the results of the experimental group. The proposed forecasting method (exponential smoothing with the choice of smoothing factor in terms of root mean square deviation) and prediction of the dynamics of the «somersault» exercise. The relative error of the theoretical and actual values of the dynamics of the «somersault» exercise, which does not exceed 10%, is calculated.

Conflict of Interest: the authors state that there is no conflict of interest.

Prospects for further research. Therefore, further research is planned to be carried out in the direction of raising the level of development of physical qualities of students. Improvement and introduction into the educational process of higher educational institutions of the program of exercises with aerobic exercises (cross training and basic aerobics) for groups with sports orientation (sectional exercises) ping-pong.

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