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Health-Promoting Effects of Participation in Physical Activity by Female UMCS Students

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Abstract

The present study attempted to assess the health-promoting effects of young women's participation in 8 weeks of physical activity, at different intensities. Sixty women, divided into three subgroups, participated in the study. The highest health-promoting effects were obtained by participants in the AFD group, who performed physical activity in the form of interval training. Variable load, high-intensity training measures, were characterised by a better physiological effect compared to exercise with a constant load and moderate intensity, expressed both in a more favorable modification of anthropometric parameters, cardiovascular parameters, tissue components and an increase in the value of maximum oxygen consumption.

Keywords: Physical activity; Health indicators; Health outcomes; Female students

Abbreviations: HIE: High Interval Training; CME: Continuous Moderate Exercise; AIT: Aerobic Interval Training; BPs: Systolic Blood Pressure; BPd: Diastolic Blood Pressure; HR: Heart Rate; SD: Standard Deviations

Introduction

Systematic physical activity has a beneficial effect on the body and helps to produce health promoting values. Among the potential values mentioned are, for example, an increase in the body's physical capacity, the occurrence of vagotonia symptoms such as slowing down the resting heart rate or sparing the respiratory system, maintaining the desired haemoglobin concentrations in the blood, reducing excessive body weight and subcutaneous adipose tissue, as well as the strength of the muscles stabilising the spine [1]. An increase in physical fitness, an increase in antioxidant system activity, and a calming effect in people who exercise are also benefits of systematic physical activity that are important in cardiovascular prevention [2]. The results of clinical and epidemiological studies indicate a significant effect of systematic exercise on the inhibition of the development of diseases such as: cardiovascular disease [3], obesity [4], impaired glucose tolerance [5], cancer [6], degenerative changes of the spine, osteoporosis, osteoarthritis or postural defects [7-9].

The results of studies on students' physical activity are not optimistic [10]. A study by [11] shows that about 10% of students do not undertake any physical activity in summer and more than 40% in winter - when there are no physical education classes at universities, during sessions and the inter-semester break. Physical activity is an important causal factor in students achieving the desired state of positive physical health. Data from the literature indicate that supplementing physical education classes with a single session of HIE (High Interval Training) or CME (Continuous Moderate Exercise) positively influences the effectiveness of the academic physical education programme, has the additional benefit of improving somatic and performance indices, and thus is the basis for a positive prognosis of the health status of female participants in the programme [12]. Studies reported in the literature confirm that the effects of Aerobic Interval Training (AIT) are similar or superior, compared to constant moderate intensity training (CME), in shaping VO_2 max [13,14].

The aim of this study was to evaluate the effects of physical activity in the form of AIT and CME training sessions on selected physiological indices characterising health, including anthropometric parameters, body tissue components, physical capacity, and cardiovascular indices. An additional aim of the

study was to evaluate the comparative effects of 2 months of structured and intensity organised physical activity (ZAF) on the somatic, performance and cardiovascular indices analysed.

Purpose of the Study

The main aim of this study was to evaluate the effects of systematic, structured physical activity in the form of HIT and CME training sessions, on selected physiological indices characterising health, including anthropometric parameters, body tissue components, physical performance and cardiovascular indices.

Research questions

a) What was the participation of first-year female students of the UMCS in physical activity?

b) What effects on anthropometric indices did the female students participating in the two-month structured physical activity achieve?

c) How does the capacity for maximal oxygen consumption (VO_2 max) develop under the influence of 8 weeks of structured exercise?

d) What changes in cardiovascular indices occurred after two months of exercise in the female students studied?

e) How did the type of exercise and its intensity affect the training effects?

Recruitment for participation in organised physical exercise

Recruitment of study participants was conducted during physical education classes of the first year of study, at the Maria Curie-Skłodowska University in Lublin. Participation in the study was voluntary. The prerequisite for participation in organised physical activity was the declaration of being healthy and not using pharmacological treatment. Sixty women were included in the study. Those who declared participation in the research programme were informed about the topic, the purpose of the study, the methodology and the expected results. Those qualified for the ZAF programme, provided written consent to participate in the study. The characteristics of the subjects are shown in Table 1.

Table 1: Characteristics of respondents.

Tested	Age	Body Height	Body Weight	BMI
n = 60	(years)	(cm)	(kg)	
x	19,56	167,46	62,31	22,21
SD	0,67	5,32	11,04	3,55
max	21,1	1841	99,78	40,32
min	18,9	155,2	42,65	17,9
Source: Own research				
The research tasks were carried out in March and June 2022				

Research methods used

a) Personal questionnaire plus IPAQ physical activity questionnaire [15].

b) Measurement of anthropometric parameters: height, weight, waist, and hip circumference

and body composition. Body composition was assessed by the bioelectrical impedance method (using a body composition analyser from Tanita SC 330, Japan) [16].

c) Estimation of maximal oxygen consumption (VO_2 max.) was performed based on the indirect Astrand-Ryhming method [17]. The test was performed on a Monark 874E cycloergometer, after a 5-min warm-up. The subject performed the exercise test with an initial load of 1 W/kg body weight, maintained for a period of 6 minutes. The criterion for physiological equilibrium was met at HR 130-150 bpm, i.e., at an exercise intensity of 65%-75% of HRmax, when the heart rate did not change by more than 5 bpm, for a period of 1 minute. In addition, systolic blood pressure (BPs) and diastolic blood pressure (BPd) were measured using the Korotkow method, while heart rate (HR) was measured with a Polar Electro T-31 sports tester: at rest after 5 minutes in the supine position, and during the physiological equilibrium test.

Statistical Processing Methods

The results obtained were statistically processed by calculating arithmetic means (x), standard deviations (SD), percentages (%) and minimum (min) and maximum (max) values. The significance of the differences between the mean values in measurements I initial) and II (control) was assessed using the student's t-test for dependent groups, taking the $p \leq 0.05$ level as significant. The conformity of the distribution of values to a normal distribution was assessed using the K-S (Kolmogorov-Smirnov) test. Significance of intergroup differences was performed using one-way ANOVA and post-hoc tests, with the test: Hochberg and Games-Howell, taking the $p \leq 0.05$ value level as significant. All

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calculations were performed using SPSS v. 19. software (Lewicki; Obodyńska; Obodyński, 1998; Stupnicki, 2000). Structure of the organised physical activity programme (Figure 1).

ZAF was implemented in the form of exercise on a HES spinning bike. The magnitude of the load was adjusted according to specific HR values read on a sports tester by the exercising subjects. For the AFU subgroup (constant load), the task was to maintain a value of 75% of HRmax. For the AFD subgroup (variable loads, moderate and very high intensity), the task was to aim for HRmax in 10s sequences and to maintain 75% HRmax in the intervals between very high intensity loads. Structure of a structured physical activity programme for the AFD group (Figure 2) & (Table 2-6).

Table 2: Energy expenditure associated with the declared physical activity of the female students studied (MET-min/week).

Variable/Subgroup		Preliminary Examination			Control Test		
		AFD	AFU	AFK	AFD	AFU	AFK
MET-min/week	x	2208,42	2243,26	2 064,97	3228,94**	2885,10*	2 854,18*
	SD	2093,86	1691,15	1408,59	1898,36	1165,64	2073,01
Source: Own research							

AFD - group implementing variable intensity training,

AFU - a group performing training at a constant exercise intensity,

AFK - control group,

* - significant difference p≤0,05; ** - significant difference p≤0,01

Table 3: Mean values of WHR and BMI indices

Variable/Subgroup		Preliminary Examination		Control Test			
		AFD	AFU	AFK	AFD	AFU	AFK
WHR (cm)	x	0,72	0,71	0,71	0,70**	0,71	0,72
	SD	0,04	0,04	0,05	0,04	0,05	0,05
BMI	x	21,53	22,92	21,57	21,02**	22,72*	21,39*
	SD	2,15	2,55	3,16	2,08	2,55	3,11
Source: Own research							

AFD - group implementing variable intensity training,

AFU - a group performing training at a constant exercise intensity,

AFK - control group,

* - significant difference p≤0,05; ** - significant difference p≤0,01

Table 4: Mean VO_2 max relative (ml/kg/min)

Variable/Subgroup		Preliminary Examination			Control Test		
		AFD	AFU	AFK	AFD	AFU	AFK
VO_2max (ml/kg/min)	x	36,51	36,54	37,29	41,77**	39,92**	38,41
	SD	7,20	6,64	5,96	7,09	6,64	7,13
Source: Own research							

AFD - group implementing variable intensity training,

AFU - a group performing training at a constant exercise intensity,

AFK - control group,

* - significant difference p≤0,05; ** - significant difference p≤0,01

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Table 5: Mean values of heart rate and blood pressure at rest and during the Astrand-Ryhming test.

Variable/Subgroup AFD		Preliminary examination			Control test		
		AFU	AFK	AFD	AFU	AFK	
Resting HR (ud/min)	x	73,79	71,41	71,03	71,75	69,91	72,05
	SD	11,12	9,52	9,63	11,00	9,07	10,11
HR during physiological equilibrium (ud/min)	x	147,67	142,68	145,28	139,29**	138,32*	144,33
	SD	12,37	10,90	11,99	12,40	10,38	11,99
Resting BPs (mmHg)	x	113,96	115,32	109,97	111,08	109,82**	106,18*
	SD	9,61	7,01	10,69	10,73	6,54	8,49
BPs at physiological equilibrium (mmHg)	x	133,13	135,05	129,41	131,00	132,36	127,44
	SD	12,68	9,35	14,42	14,11	11,05	10,55
Resting BPd (mmHg)	x	66,46	73,36	67,79	63,54	65,09**	60,51**
	SD	8,06	5,31	9,24	9,25	6,55	7,97
BPd during physiological equilibrium (mmHg)	x	76,42	75,23	73,56	69,21**	68,82**	67,23**
	SD	11,08	9,31	9,91	11,28	7,73	10,93
Source: Own research							

Table 6: Mean values of the product of systolic blood pressure and heart rate (BPs x HR) in the physiological equilibrium phase of the study subjects.

Variable/Subgroup		Preliminary Examination		Control Test			
		AFD	AFU	AFK	AFD	AFU	AFK
BPs x HR	x	19718,10	19276,45	18779,35	18318,34*	18278,62	18363,39
	SD	2937,76	1953,64	2409,72	3011,14	1852,56	1986,84
Source: Own research							

AFD - group implementing variable intensity training,

AFU - a group performing training at a constant exercise intensity,

AFK - control group,

* - significant difference p≤0.05; ** - significant difference p≤0.01

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Subgroup	Frequency of exercise per week	Exercise time min	Type of exercise load	Intensity % HRmax	Energy zone
AFD N=20	3	47	variables	75–100	anaerobic/ aerobic
AFU N=20	3	47	continuous	75	aerobic
AFK N=20	1	47	any/variable	60–65	unspecified

Figure 1: Structure of an organised physical activity programme.
Source: own research

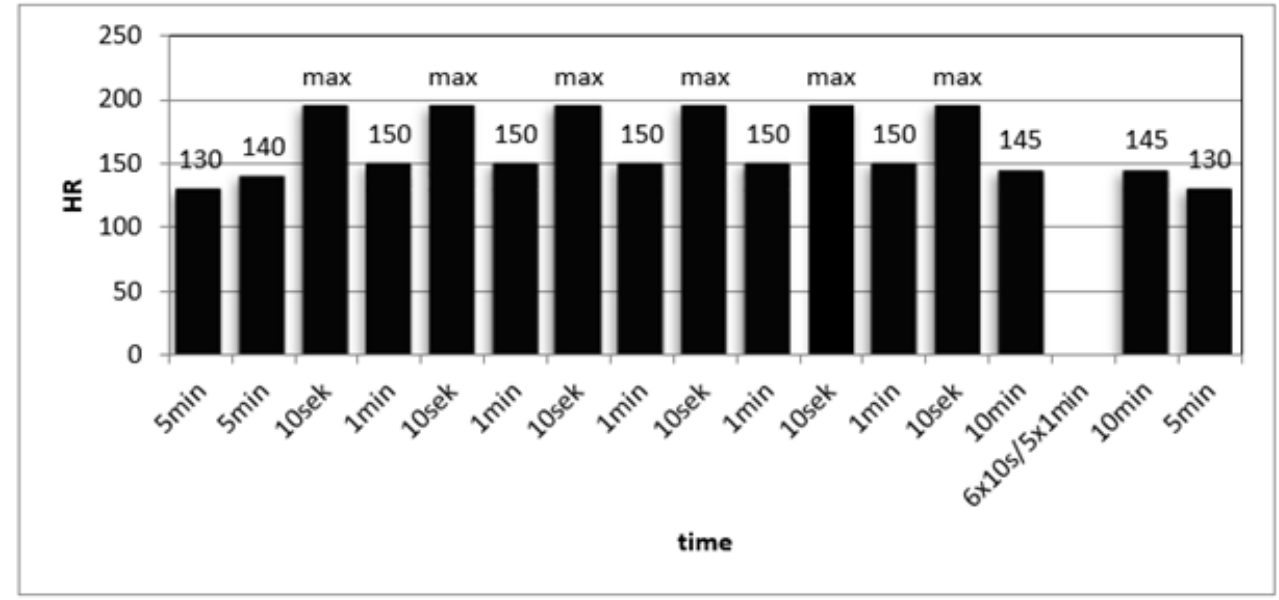

Figure 2: Structure of the training carried out with the use of the continuous variable intensity method (AIT) on a spinning bicycle.
Source: own research.

Discussion

In line with previously cited statements gleaned from various publications, the female students studied, by increasing the value of their declared physical activity, achieved beneficial effects in the form of improvements in some health indicators [18,19]. The mean values of the WHR index of the female students studied, were in the range of 0.70-0.73 i.e. within the limits accepted as normal. WHR values of 0.74 were obtained in a study of female students of Rzeszów universities [20]. On the other hand, in a study of female students of the AWF Warsaw, WHR values at the level of 0.84 were observed [21]. When considering the degree of variation in the values describing the WHR index, in the respective groups of female students studied after the experiment, it was found that only in the AFD study group was there a statistically significant reduction in the value in relation to the baseline level. Assessing the magnitude of the changes observed in the control study in the respective groups, it was found that the greatest reduction in the

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values describing the WHR index occurred in the group of female students performing training with variable exercise intensity, where the range of change was 4.26%.

When assessing the degree of variation in the values describing the BMI of the female students at the end of the experiment, it was observed that in all groups there was a statistically significant reduction in the values in relation to the baseline level. Considering the scale of changes observed in the control study, it was found that the greatest reduction in the values describing the BMI index occurred in the group of female students performing training with variable exercise intensity, where the range of change was 2.41%. A study of female students of Rzeszów universities found an average BMI of -21.0 [20] female students of Poznań-21.9 [22], while female students of the Warsaw AWF were characterised by an average BMI of 21.8 [21].

The VO_2 max values obtained in the preliminary study, in the range 36.51-37.29 ml/kg/min, indicate average oxygen consumption according to the Astrand classification. In comparison, Slovakian female students from the Universities of Presov and Kosic, obtained VO_2 max values of 34.4 and 34.7 ml/kg/min, respectively [23]. Assessing the degree of variation in the values characterising VO_2 max., after the experiment, it was found that in the AFD and AFU study groups there was a statistically significant increase in the mean values of maximal oxygen consumption capacity, compared to baseline, in the ranges of: 15,12% i 8,88%.

Heart rate value, as the body's response to exercise intensity, is a source of much information for people participating in physical activity [24]. The results of the assessment are useful in planning optimal exercise intensities, both for healthy people and in the rehabilitation process, and the use of target heart rate as a tool for controlling exercise load is well known [25]. When assessing the degree of variation in heart rate, during the Astrand-Ryhming test performed in the follow-up study, a statistically significant reduction in its values during the physiological equilibrium phase was observed, but only in the groups participating in variable and constant exercise intensity [26-27] training. The relationship of the reduction in heart rate values, as influenced by training at different intensities, is known and described in the literature cited above.

When assessing the changes in systolic blood pressure (BPs) at rest, in the respective groups of female students, after the experiment, it was found that there was a statistically significant reduction in values in the AFU and AFK study groups compared to baseline. When analysing the changes in diastolic blood pressure (BPd), after the experiment, it was found that there was a statistically significant reduction in values at rest in the AFU and AFK study groups. Assessing the changes (BPd) of the subjects, during the Astrand-Ryhming test, in the physiological equilibrium phase, it was found that there was a statistically significant reduction in values in the control study in each group. On the basis of the occurring changes in the mean values of HR, BPs and BPd, observed in the control study, it can be concluded that, when confronted with the results of the studies of other authors cited in the earlier sections of the subsection, the female students participating in the 8-week ZAF had beneficial effects in terms of a reduction in the values of heart rate and blood pressure.

Conclusion

The results of the surveys and their analysis, is the basis for the following conclusions:

a) As a result of two months of structured physical activity, the female students studied achieved significant health benefits, expressed as a reduction in the values of the mean indices: BMI, WHR, FAT and an increase in the capacity for maximal oxygen consumption.

b) Variable-load, high-intensity exercise, compared to constant-load, moderate-intensity exercise, was characterised by a better physiological effect, expressed both in a more favourable modification of cardiovascular parameters, anthropometric parameters, tissue components and an increase in the value of maximal oxygen consumption.

c) The physiological and health-promoting effects obtained as a result of eight weeks of structured physical activity using stationary cycloergometer exercises provide grounds for considering this form of physical exercise as an effective means of influencing anthropometric indices and shaping aerobic capacity.

A programme of structured physical activity using variable intensity of effort, including high-intensity interval loading, can be recommended as an effective training programme for the beneficial modification of health indicators, both in academic adolescents and in other recreational activity programmes.

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