Ovidius University Annals, Series Physical Education and Sport / SCIENCE, MOVEMENT AND HEALTH
Vol. XII, ISSUE 2, 2012, Romania
The journal is indexed in: Ebsco, SPORTDiscus, INDEX COPERNICUS JOURNAL MASTER LIST, DOAJ DIRECTORY OF OPEN ACCES JOURNALS, Caby, Gale Cengace Learning

PHYSICAL ACTIVITY AND ITS RELATION TO HEALTH-RELATED PHYSICAL FITNESS IN STUDENTS

KAMINSKA IRĒNA[1], MIHAILOVA ANNA[1], BERNĀNE ANDA[1]

Abstract

Purpose. The trend in physical fitness assessment during the past 35 years instead of stress motor performance and athletic fitness evaluation (i.e. speed, agility, power, and balance) focuses on assessment of functional capacities related to overall good health and disease prevention. Thus, a term of health-related physical fitness became topical with four its components: aerobic and/or cardiovascular fitness, body composition, abdominal muscle strength and endurance, and lower back and hamstring flexibility. This study was undertaken to evaluate physical activity relation to health-related physical fitness in students.

Methods. All participants filled in physical activity questionnaire about duration of their daily activities of slow walking, fast walking, sport exercises at university and additional sport exercises. Health-related physical testing included several core components: 1) body composition evaluation (body weight, body mass index, waist-to-hip ratio, body fat, muscle mass), 2) abdominal muscles and hamstring muscles manual tests, 3) dynamometry, 4) hamstring muscles and *m. quadratus lumborum* elasticity evaluation tests, 5) Romberg balance test, 6) bicycle ergometer test.

Results. There were significant differences between physical activity level of Physical Education students and Physiotherapy students, and between men and women. Physical activity positively correlates with waist-to hip-ratio, muscle mass, grip strength and cardiorespiratory fitness parameters, and negatively with body fat.

Conclusions. Physical activity significantly affects body composition, grip strength and aerobic capacity.

Key words: Health-related physical fitness, physical activity, students.

Introduction

Health is defined as physical, mental, and social well-being, not simply absence of disease. Physical fitness includes attributes related to how well one performs physical activity (W.D. McArdle, 2006). Physical fitness refers to the full range of physical qualities, i.e. cardiorespiratory fitness, muscular strength, speed of movement, agility, coordination, and flexibility (J.R. Ruiz et al., 2006). The trend in physical fitness assessment during the past 35 years instead of stress motor performance and athletic fitness evaluation (i.e. speed, agility, power, and balance) focuses on assessment of functional capacities related to overall good health and disease prevention (W.D. McArdle, 2006). Thus, a term of health-related physical fitness became topical with four its components: aerobic and/or cardiovascular fitness, body composition, abdominal muscle strength and endurance, and lower back and hamstring flexibility.

Cardiorespiratory endurance is closely connected with lung, heart and muscle functions. A good level of aerobic capacity determines high economic and energetic processes (K. Gorner et al., 2009). Grip strength indicated general fitness, and is closely associated with chronic illnesses such as degenerative osteoarthritis. Abdominal muscular endurance, however, is linked to correct balance between the abdominal and lumbar muscles, and lumbar hyperlordosis may result in abdominal muscle weakness. With regard to balance, higher levels in this capacity reduce the possibility of falls (J.M. Saavendra et al., 2008). So, health-related physical fitness is defined as components of physical fitness associated with some aspect of good health and/or disease prevention (W.D. McArdle, 2006). Health-related physical fitness refers to the functionality of heart, lung, blood vessels, and muscles that are closely related to health (J.S. Cheng, 2011). Recent studies have shown that aerobic capacity and muscle strength are powerful predictors of cardiovascular and all-cause death and disease, both in men and in women (F. Ortega et al., 2005).

Health-related physical fitness cannot be viewed without taking into account the aspect of physical activity. Physical activity is defined as any bodily movement, produced by skeletal muscles, which requires energy expenditure (WHO, 2012; W.D. McArdle, 2006). Physical inactivity has been identified as the fourth leading risk factor for global mortality causing an estimated 3.2 million deaths globally (WHO, 2012). The real data show, that nearly one half of those between ages 12 and 21 do not exercise vigorously on a regular basis and 14% report no recent physical activity – more prevalent among females (W.D. McArdle, 2006). Though, regular moderate intensity physical activity – such as walking, cycling, or participating in sports – has significant benefits for health. For instance, it can reduce the risk of cardiovascular diseases, diabetes, colon and breast cancer, and depression. Moreover adequate levels of physical activity will decrease the risk of a hip or

[1]The Faculty of Natural Sciences and Mathematics, Department of Anatomy and Physiology, Daugavpils University, LATVIA
E-mail: anna.mihailova@du.lv
Received 28.02.2012 / Accepted 02.05.2012

vertebral fracture and help control weight (WHO, 2012).

In adults aged 18–64, physical activity includes leisure time physical activity (for example: walking, dancing, gardening, hiking, swimming), transportation (e.g. walking or cycling), occupational (i.e. work), household chores, play, games, sports or planned exercise, in the context of daily, family, and community activities. In order to improve cardiorespiratory and muscular fitness, bone health, reduce the risk of NCDs and depression adults aged 18–64 should do at least 150 minutes of moderate-intensity aerobic physical activity throughout the week or do at least 75 minutes of vigorous-intensity aerobic physical activity throughout the week or an equivalent combination of moderate- and vigorous-intensity activity. For additional health benefits, adults should increase their moderate-intensity aerobic physical activity to 300 minutes per week, or engage in 150 minutes of vigorous-intensity aerobic physical activity per week, or an equivalent combination of moderate- and vigorous-intensity activity (WHO, 2012).

Complex evaluation of health-related physical fitness and physical activity may show a wider insight in health promotion and disease prevention.

Current data on the physical fitness of Latvian students are not available, thus, this study aimed to evaluate physical activity relation to health-related physical fitness in students of Daugavpils University.

Methods

A total of 91 students of Daugavpils University were recruited. The participants were students of two study programs: Sport Education and Physiotherapy. During the analysis phase, 9 participants were excluded because they didn't fit the required age range (adolescents with age from 19 to 25 years) or had missed health-related physical fitness tests or hadn't filled in the questionnaire. Thus, the final study group consisted of 82 students (54 women and 28 men) with an age range of 19 to 23 years. The anthropometric profiles of the study sample are shown in Table 1.

Table 1. Antropometric Profile for the Study Sample

Variables	Average (SD) for:		
	Women (n=54)	Men (n=28)	Total (n=82)
Age (y)	20.6 (0.9)	20.8 (1.1)	20.7 (0.9)
Height (cm)	166.5 (5.6)	180.7 (8.8)	171.3 (9.6)
Weight (kg)	62.3 (9.7)	78.1 (12.4)	67.7 (13.1)
Body Mass Index (kg/m2)	22.5 (3.1)	23.8 (2.8)	22.9 (3.0)
Waist-to-hip Ratio	0.73 (0.04)	0.83 (0.06)	0.77 (0.06)

Each participant attended several measurement sessions at Daugavpils University. During the first visit they filled in the questionnaire about their physical activity: duration of daily activities and sport activities and type of additional sport classes. Additionally to questionnaire, body composition and dynamometry measurement (see "Health-Related Physical Fitness Assessment") were taken on that day. During the second visit, individual assessment of muscle strength, elasticity and balance test (see "Health-Related Physical Fitness Assessment") was done. Final visit was devoted to aerobic fitness test on cycle ergometer.

Health-Related Physical Fitness Assessment

Health-related physical testing included a set of tests: 1) body composition evaluation (body weight, body mass index, waist-to-hip ratio, body fat, muscle mass), 2) abdominal muscles and hamstring muscles manual tests, dynamometry and hamstring muscles and *m. quadratus lumborum* elasticity evaluation tests for musculoskeletal fitness of the upper trunk and lower extremities, 3) Romberg balance test for motor fitness, 6) bicycle ergometer test for cardiorespiratory fitness.

Body composition was determined using medically approved portable body composition monitor with visceral fat indicator TANITA BC-420 using bioelectrical impedance analysis method. Body weight, body mass index, waist-to-hip ratio, body fat (%) and muscle mass (%) variables were received. Body height that was required to fill in the TANITA measuring protocol was measured to the nearest 1.0 cm. Waist and hip circumferences were measured to the nearest 1.0 cm with a flexible leather tape measure. Waist circumference was measured midway between the lowest rib and the iliac crest when participants were in standing position. Hip circumference was measured at the highest points of gluteal muscles when participants were in standing position (G.M. Adams, W.C. Beam, 2008).

Abdominal muscles and hamstring muscles manual tests were performed on the basis of guidelines on muscle testing of Palmer M. Lynn and Marcia E.Epler «Fundamentals of Musculoskeletal Assessment Techniques» (1998) (P. M. Lynn, M. E. Epler, 1998). *M. rectus abdominis* upper and lower parts, *m. obliquus abdominis externus et internus*, *m. semitendinosus et semimembranosus*, *m. biceps femoris* were tested for strength (evaluated from 0 to 5 points) and *m. quadratus lumborum* and hamstring muscles were tested for elasticity in terms of flexibility. The grip strength of both hand was measured with hydraulic hand dynamometer (Saehan Corp., Korea, Model SH5001, SN 11010449) while the participants stood with their elbows extended (G.M. Adams, W.C. Beam, 2008). The best score of 3 trials was recorded for analysis.

Romberg balance test for static balance assessment was performed barefoot on the rough surface with subjects' eyes closed, hands being held in front of the body and one foot being placed in front of the other on one line. Total time of standing without staggering and opening eyes was recorded in seconds (maximal 60 seconds). Test was performed bilaterally changing the position of feet.

Cardiorespiratory fitness was assessed using cardiopulmonary testing system MasterScreenCPX (JAEGER) and cycle ergometer Ergoselect 100P (Ergoline, SN 2008000567) with breath-by-breath analysis of expired air. Subjects performed submaximal test with three power stages each of 5 minutes (G.M. Adams, W.C. Beam, 2008). Start power for both women and men was 50W. Then power was increased by 25W in women and 50W in men. 1 minute before the test rest cardiorespiratory variables were recorded. Basic variables (heart rate, ventilation, breathing frequency, tidal volume, oxygen uptake, carbon dioxide output, respiratory coefficient etc.) were recorded at every respiratory cycle while test and recovery stages. Systolic and diastolic blood pressure was measured every second and fifth minute while performing the test and every minute while recovery. Anaerobic threshold and maximal oxygen consumption were calculated in MasterScreenCPX program automatically. They were taken as basic variables for aerobic capacity evaluation.

The level of physical activity was evaluated using self-assessment questionnaire, the 7-day recall physical activity questionnaire. This questionnaire asked questions about duration of their daily activities of sitting, slow walking, fast walking, sport exercises at university and additional sport exercises. Duration was expressed in hours and minutes. Physical activity duration score was calculated evaluating hour per week spent in vigorous activities and moderate activities. All participants were divided into 4 groups according to a physical activity score: 1st group (low physical activity) included those, who do sport exercises at least 30 minutes per week, 2nd group of moderate physical activity – those who perform sport activities average 30 minutes to 2 hours per week, 3rd group of high physical activity – average 3 hours of sport exercises per week and 4th group of vigorous physical activity – 4 or more hours of sport activities per week.

Data analysis

The data were analyzed with the IBM SPSS statistical program (version 19.0 for Windows). An independent samples *t* test and two independent samples nonparametric test with Mann-Whitney coefficient were used to examine sex-related differences. Pearson Chi-Square was used to examine differences between body mass index, body fat, muscle mass and physical activity level groups. The Pearson correlation coefficient was used to find associations between health-related physical fitness variables and physical activity. Univariate analysis (General Linear Model) was used to test independent and complex influence of two factors: sex and physical activity level on health-related physical fitness components.

Results

Mean (SD) body mass index (BMI) was 22.5 (3.1) in women and 23.9 (2.8) in men (p=0.045) (see Table 2). 9.3% of women was underweight (BMI < 18.5 kg/m2), 68.5% of women and 71.4% of men had a normal BMI (BMI = 18.5-24.9 kg/m2), 20.4% of women and 21.4% of men was overweight (BMI = 25-29.9 kg/m2), and 1.9% and 7.1% of women and men respectively were obese (BMI > 30.0 kg/m2). The difference between BMI groups in women and men was not significant (Pearson Chi-Square $p = 0.258$).

Mean (SD) body fat (BF) (%) was 25.4 (6.7) in women and 12.2 (5.0) in men (p<0.0001). 22.2% of women and 21.4% of men had decreased BF. The most numerous group of BF in both women and men was with good range of BF with 61.1% and 71.4%, respectively. 14.8% of women and 3.6% of men had increased BF and 1.9% and 3.6% were obese, respectively. BF groups did not differ among women and men (Pearson Chi-Square $p = 0.448$).

Mean (SD) muscle mass (%) was 70.5 (6.8) in women and 83.4 (4.7) (p<0.0001). In both women and men most people met the criteria of good muscle mass range – 61.1% and 82.1% respectively. The difference between groups of muscle mass in women and men was not significant (Pearson Chi-Square $p = 0.151$).

Men had higher values for *m. semitendinosus et semimembranosus* strength, handgrip strength, aerobic threshold, absolute and relative maximal oxygen consumption but lower values for flexibility (hamstring elasticity) than women (see Table 2). No sex-related differences were noted in abdominal muscle strength, *m. biceps femoris* strength, *m. quadratus lumborum* elasticity and static balance.

Table 2. Descriptive Statistics of Health-Related Physical Fitness Components in Study Sample

Variables	Mean (SD)		*P-value adjusted by age*
	Women (n=54)	Men (n=28)	
Body composition			
Body mass index (kg/m2)	22.5 (3.1)	23.9 (2,8)	p = 0.045 [a]
Waist-to-hip ratio	0.73 (0.04)	0.83 (0.06)	p < 0.0001 [a]
Body fat (%)	25.4 (6.7)	12.2 (5.0)	p < 0.0001 [a]
Muscle Mass (%)	70.5 (6.8)	83.4 (4.7)	p < 0.0001 [a]
Musculosceletal fitness			
m. rectus abdominis (upper part) (points)	3.8 (0.8)	3.8 (0.7)	p = 0.776
Rotation to the right (points)	3.6 (0.8)	3.3 (0.8)	p = 0.131

Rotation to the left (points)	3.6 (0.8)	3.5 (0.8)	p = 0.481
m. semitendinosus et semimebramosus			
Right leg	4.78 (0.4)	5.00 (0.0)	p = 0.007 [a]
Left leg	4.81 (0.4)	5.00 (0.0)	p = 0.016 [a]
m. biceps femoris			
Right leg	4.76 (0.4)	4.82 (0.4)	p = 0.522
Left leg	4.83 (0.4)	4.86 (0.4)	p = 0.781
Hamstring muscles elasticity (°)			
Right leg	76.4 (10.9)	72.7 (8.3)	p = 0.04 [a]
Left leg	76.4 (11.4)	72.0 (10.6)	p = 0.093
Grip strength (kg)			
Right hand	29.6 (6.1)	53.0 (16.2)	p < 0.0001 [a]
Left hand	26.2 (5.8)	52.0 (11.7)	p < 0.0001 [a]
Cardiorespiratory fitness			
Anaerobic threshold (ml O2)	809.0 (244.9)	1402.0 (304.3)	p < 0.0001 [a]
Maximal oxygen consumption (l/min)	1.4 (0.3)	2.2 (0.2)	p < 0.0001 [a]
Relative maximal oxygen consumption (ml/min/kg)	21.9 (4.3)	29.3 (5.8)	p < 0.0001 [a]
Physical activity duration (hours per week)	1.0 (1.2)	3.3 (2.6)	p < 0.0001 [a]

[a] $p < 0.05$ compared between women and men

Table 3. Sample Characteristics by Physical Activity Level

Variable Mean (SD)	Physical Activity Level								*P*-value between the groups
	Low		Moderate		High		Vigorous		
	Women (n=26)	Men (n=3)	Women (n=22)	Men (n=10)	Women (n=3)	Men (n=5)	Women (n=3)	Men (n=10)	
Body composition									
Body mass index (kg/m2)	21.7 (2.9)	23.4 (4.0)	23.2 (3.0)	22.7 (2.0)	24.0 (5.9)	26.6 (4.4)	22.6 (0.8)	23.8 (1.4)	0.207
Waist-to-hip ratio	0.72 (0.1)	0.87 (0.1)	0.74 (0.03)	0.80 (0.06)	0.71 (0.03)	0.85 (0.05)	0.74 (0.04)	0.82 (0.03)	0.517
Body fat (%)	24.4 (6.6)	13.7 (10.9)	26.2 (6.3)	10.7 (3.3)	26.8 (13.7)	15.6 (4.0)	27.8 (0.5)	11,6 (4,5)	0.744
Muscle Mass (%)	71.8 (6.2)	82.0 (10.3)	69.3 (7.1)	84.8 (3.1)	69.7 (12.8)	80.2 (3.8)	68.5 (0.4)	84.0 (4.3)	0.866
Musculosceletal fitness Hamstring muscles elasticity (°)									
Right leg	74.0 (9.4)	64.7 (5.0)	78.4 (11.7)	72.1 (9.2)	90.0 (8.7)	72.6 (6.6)	86.7 (5.8)	75.1 (8.2)	0.025 [a]
Left leg	73.5 (10.5)	61.7 (7.6)	77.3 (11.8)	71.1 (10.2)	88.3 (5.8)	69.8 (7.1)	83.3 (11.5)	77.1 (11.5)	0.043 [a]
Grip strength (kg)									
Right hand	30.1 (6.3)	50.7 (9.5)	29.0 (5.9)	43.4 (19.7)	25.7 (1.2)	53.6 (14.0)	34.0 (7.6)	63.0 (8.9)	0.015 [a]
Left hand	26.2 (6.1)	47.3 (11.0)	25.8 (5.7)	46.9 (11.6)	23.0 (1.7)	53.2 (14.2)	31.3 (4.6)	58.0 (9.0)	0.050 [a]
Cardiorespiratory fitness									
Anaerobic threshold (ml O2)	805.1 (273.1)	1218.7 (220.1)	786.8 (218.1)	1406.9 (276.7)	845.7 (240.2)	1593.2 (402.1)	969.0 (233.4)	1356.4 (291.2)	0.378
Maximal oxygen consumption (l/min)	1.3 (0.3)	2.1 (0.2)	1.4 (0.3)	2.2 (0.3)	1.7 (0.4)	2.4 (0.1)	1.6 (0.3)	2.2 (0.3)	0.025 [a]
Relative maximal oxygen	21.7 (4.0)	30.1 (8.6)	21.4 (4.9)	29.3 (4.8)	24.6 (4.0)	29.9 (7.9)	24.7 (1.7)	28.8 (5.8)	0.747

Ovidius University Annals, Series Physical Education and Sport / SCIENCE, MOVEMENT AND HEALTH
Vol. XII, ISSUE 2, 2012, Romania
The journal is indexed in: Ebsco, SPORTDiscus, INDEX COPERNICUS JOURNAL MASTER LIST, DOAJ DIRECTORY OF OPEN ACCES JOURNALS, Caby, Gale Cengace Learning

consumption (ml/min/kg)									

[a] $p < 0.05$ compared between PAL groups

When the participants were grouped according to their physical activity level (PAL) 48.1% of women and 10.7% of men belong to low level of physical activity, 40.7% of women and 35.7% of men to moderate level of physical activity, 5.6% of women and 17.9% of men to high level of physical activity and 5.6% of women and 35.7% of men to vigorous physical activity level. Men were more physically active than women (*p*<0,0001) having a prevalence of vigorous, high and moderate PAL, comparing with prevalence in women of low and moderate PAL. The mean (SD) physical activity in women was 1.0 (1.2) hours per week, but in men 3.3 (2.6) (*p*<0.0001). Additionally, 29.6% of women and 75% of men did additional exercises apart obligatory sport activities at studies (*p*<0.0001). Men spent more time on their additional leisure time sport activities than women (Mann-Whitney p < 0.0001).

BMI, BF and muscle mass did not differ among the PAL groups adjusting by gender. However, using One-Way ANOVA analysis results showed significant differences between PAL groups for BMI, WHR, BF and muscle mass. Students with higher PAL had higher BMI (low PAL vs high PAL p=0.032 and low PAL vs vigorous PAL p=0.006, moderate PAL vs vigorous PAL *p*=0.048). Students with higher PAL had lower BF (low PAL vs vigorous PAL *p*=0.007 and moderate PAL vs vigorous PAL *p*=0.036) and higher muscle mass (low PAL vs vigorous PAL *p*=0.009 and moderate PAL vs vigorous PAL *p*=0.027).

The proportion of hamstring muscle elasticity and grip strength increased with increasing PAL (see Table 3). The same relation was observed in maximal oxygen consumption. Other cardiorespiratory fitness and musculoskeletal fitness parameters did not differ among PAL groups adjusting by gender.

No difference between PAL groups was found for abdominal muscles and hamstring muscles strength, static balance and *m. quadratus lumborum* elasticity.

Physiotherapy men had lower grip strength values than men of Sport Education study program (see Table 4). In women Physiotherapy students had lower hamstring muscles elasticity and *m. obliquus externus et internus abdominis* strength than women of Sport Education study program. No differences between study programs were noted in BMI, WHR, body fat, *m. quadratus lumborum* elasticity, *m. rectus abdominis* and hamstring muscles strength, static balance, and cardiorespiratory parameters. Physical activity duration was significantly higher in Sport Education students (*p*<0.0001). Only 35% of Physiotherapy students comparing with 72.2% of Sport Education Students had additional sport activities in their leisure time (*p*<0.0001). Respectively, Sport Education students spent more time on additional sport activities in leisure time than Physiotherapy students (Mann-Whitney *p*<0.0001).

Table 4. Health-related Physical Fitness of Physiotherapy and Sport Education students

Variables	Mean (SD)				*P*-value adjusted by gender	
	Physiotherapy students (n=60)		Sport Education students (n=22)			
	Women (n=51)	Men (n=9)	Women (n=3)	Men (n=19)	Women	Men
Body composition						
Body mass index (kg/m2)	22.5 (3.2)	23.8 (4.0)	22.5 (1.0)	23.9 (2.2)	p = 0.972	p = 0.954
Waist-to-hip ratio	0.73 (0.04)	0.81 (0.08)	0.74 (0.04)	0.83 (0.04)	p = 0.885	p = 0.444
Body fat (%)	25.4 (6.8)	13.3 (6.6)	25.1 (5.0)	11.8 (4.2)	p = 0.934	p = 0.467
Muscle Mass (%)	70.4 (0.8)	82.4 (6.3)	71.1 (4.8)	83.9 (3.9)	p = 0.866	p = 0.451
Musculosceletal fitness						
Rotation to the right (points)	3.6 (0.8)	3.2 (0.6)	4.5 (0.5)	3.4 (0.9)	p = 0.039 [a]	p = 0.496
Rotation to the left (points)	3.5 (0.8)	3.3 (0.8)	4.5 (0.5)	3.5 (0.8)	p = 0.035 [a]	p = 0.557
Hamstring muscles elasticity (°)						
Right leg	76.7 (10.8)	70.0 (7.8)	90.0 (0.0)	73.6 (8.5)	p = 0.014 [a]	p = 0.288
Left leg	75.6 (11.2)	69.0 (9.0)	90.0 (0.0)	73.4 (11.3)	p = 0.022 [a]	p = 0.313
Grip strength (kg)						
Right hand	29.5 (5.8)	42.4 (10.5)	32.0 (10.8)	58.0 (16.2)	p = 0.492	p = 0.015 [a]
Left hand	26.1 (5.6)	41.7 (11.5)	28.0 (10.4)	57.0 (8.2)	p = 0.579	p = 0.0001 [a]

Cardiorespiratory fitness						
Anaerobic threshold (ml O2)	794.9 (238.2)	1419.8 (341.2)	1049.0 (281.4)	1397.8 (295.2)	p = 0.081	p = 0.918
Maximal oxygen consumption (l/min)	1.33 (0.3)	2.18 (0.3)	1.65 (0.2)	2.26 (0.3)	p = 0.060	p = 0.451
Relative maximal oxygen consumption (ml/min/kg)	21.7 (4.4)	29.4 (6.8)	24.8 (1.7)	29.3 (5.5)	p = 0.242	p = 0.971
Physical activity duration (hours per week)	0.86 (1.0)	1.43 (1.0)	3.59 (1.2)	4.22 (2.6)	p < 0,0001 [a]	p = 0.005 [a]

[a] $p < 0.05$ compared between women and men of Physiotherapy and Sport Eduacation

Correlations between physical activity and health-related physical fitness components are shown in Table 5. Physical activity was correlated positively with waist-to hip-ratio (r=0.349, p=0.001), muscle mass (r=0.344, p=0.001), grip strength (right hand: r=0.587, p<0.0001, left hand: r=0.575, p<0.0001) and cardiorespiratory fitness parameters: anaerobic threshold (r=0.451, p<0.0001), absolute (r=0.551, p<0.0001) and relative (r=0.347, p=0.001) maximal oxygen consumption values. Physical activity was correlated negatively with body fat (r= - 0.354, p=0.001).

Table 5. Associations among Physical Activity and Health-Related Physical Fitness Components

Parameter	Correlation coefficient for Physical Activity	
	r	*P*-value
Body mass index	0.212	0.056
Waist-to-hip ratio	0.349	0.001 [a]
Body fat	- 0.354	0.001 [a]
Muscle mass	0.344	0.002 [a]
m. rectus abdominis upper part strength	0.113	0.313
m. rectus abdominis lower part strength	0.075	0.502
Rotation to the right	0.152	0.173
Rotation to the left	0.159	0.153
Hamstring muscles strenght		
m. semitendinosus et semimebranosus		
Right leg	- 0.016	0.888
Left leg	0.044	0.693
m. biceps femoris		
Right leg	- 0.023	0.836
Left leg	0.049	0.665
Grip strength		
Right hand	0.587	0.0001 [a]
Left hand	0.575	0.0001 [a]
Static balance		
Right leg	- 0.075	0.504
Left leg	- 0.030	0.789
Hamstring elasticity		
Right leg	0.112	0.316
Left leg	0.142	0.204
Parameter	**Correlation coefficient for Physical Activity**	
	r	*P*-value
Anaerobic threshold	0.451	0.0001 [a]
Absolute maximal oxygen consumption	0.551	0.0001 [a]
Relative maximal oxygen consumption	0.347	0.001 [a]

[a] $p < 0.05$ (as determined by Pearson correlation)

Discussions and conclusions

The purpose of this study was to evaluate physical activity relation to health-related physical fitness in students. The result showed that physical activity duration and physical activity level (PAL) has an influence on health-related physical fitness components in the study sample. Specifically, the proportion of muscle mass, hamstring muscle elasticity, grip strength and maximal oxygen consumption increased with increasing PAL in both genders but BF was lower in higher PAL. Physical activity was correlated positively with waist-to hip-ratio, muscle mass, grip strength and cardiorespiratory fitness parameters, and negatively with body fat. However, abdominal muscles and hamstring muscles strength, static balance and *m. quadratus lumborum* elasticity did not differ among the PAL groups.

Our findings showed, that women were less physically active that men, and physical activity duration was higher in Sport Education students than Physiotherapy students. This finding is consistent with previous research. The female and male students of Physiotherapy characterized a much lower level of Physical Activity in comparison to the female and male students of Physical Education (K. Gorner, 2009). Additionally to this, our study showed that male Physiotherapy students had lower grip strength than Sport Education students, and female Physiotherapy students had lower hamstring muscles elasticity and *m. obliquus externus et internus abdominis* strength than Sport Education students. According to these findings, our results are different from Gorner et al. study. They found that the low level of physical activity among the male and female students of Physiotherapy was accompanied by a lower level of aerobic capacity, whereas high level of physical activity among the male and female students of Physical Education was accompanied by a higher level of aerobic capacity (K. Gorner, 2009). Differences of results in BMI, waist-to-hip ratio and muscle mass can be explained by the prevalence of good range of variables in Daugavpils University students in both study programs.

Taking into account the fact that greater physical activity generally implies a higher level of health-related physical fitness according to previous studies of Erickssen G. and Myers J. et al., the results of our studies are in agreement with this statement indicating that students with higher physical activity had higher muscle mass, hamstring muscle elasticity, grip strength and maximal oxygen consumption. Additionally, we have found that physical activity duration positively correlates with muscle mass, grip strength and cardiorespiratory fitness variables, and negatively with body fat. So, more physically active people tend to have better body fat level, grip strength and aerobic fitness.

With regard to body composition, muscle strength, grip strength and muscle elasticity, the results are also in agreement with Cheng Jen-Son et al. study results which showed that college students who routinely engaged in exercise tended to weigh more, have superior muscular strength and stamina, and greater flexibility than did those who did not exercise on a regular basis (J.S. Cheng, 2011). Our results showed that students with higher PAL had higher BMI values, hamstring muscle elasticity and grip strength.

Cardiorespiratory fitness variables obtained from this sample showed a significant correlation with physical activity level and additional physical activities in leisure time. We found that maximal oxygen consumption, relative maximal oxygen consumption and anaerobic threshold values were higher in students with higher PAL and in those who spent more time on additional sport leisure time activities. The same findings were reported by Beets M. et al. and they noted a positive increase in cardiovascular fitness with the increase of taken sport activities. They found that adolescents enrolled in PE and participating in one or more school-sponsored sports exhibited greater cardiovascular fitness levels than adolescents participating solely in PE classes (M. Beets, 2005). This supports the fact that higher physical activity level contribute to better cardiorespiratory fitness and aerobic capacity. Adolescents should be motivated to take additional sport classes apart their studies and in particular those who have little physical activity during study process, e.g. Physiotherapy students.

Positive cardiorespiratory fitness and physical activity relation also were noted by the AFINOS study researchers, who examined the independent and joint associations of physical activity (PA), cardiorespiratory fitness (CRF) and muscular fitness (MF) with adiponectin and leptin in adolescents. They found that vigorous PA and moderate-to-vigorous PA were related to CRF, but only vigorous PA was related with MF after adjusting by age and sex (D. Martinez-Gomez et al., 2010). This supports our findings that the proportion of muscle mass and maximal oxygen consumption increased with increasing PAL in both genders.

This study had several strengths including its methodology and the simultaneous assessment of health-related physical fitness and physical activity. Current data on the physical fitness of Latvian students and its assessment in terms of health-related physical fitness were not recently available, so such a study has a basis for further investigations and study sample enlargement would be necessary. The work on study sample enlargement is now in progress in new research stage.

References

MCARDLE, W.D, 2006, *Exercise physiology: energy, nutrition, and human performance,* Lippincott Williams & Wilkins, USA, 886-887.

RUIZ, J.R., ORTEGA, F. B., GUTIERREZ, A., MEUSEL, D., SJÖSTRÖM, M., CASTILLO, M.J., 2006, *Health-related fitness assessment in childhood and adolescence: a European approach based on the AVENA, EYHS and HELENA studies,* J Public Health; 14: 270

GÖRNER, K., BORACZYŃSKI, T., ŠTIHEC, J., 2009, *Physical activity, body mass, body composition and the level of aerobic capacity among young, adult women and men,* Sport SPA; 6(2), 8-10

SAAVEDRAA, J.M., TORRES, S., CAROB, B., ESCALANTE, Y., DE LA CRUZ, E., DURAN M.J., RODRIGUEZ F.A. 2008, *Relationship between health-related fitness and educational and income levels in Spanish women.* Public Health; 122, 798

ORTEGA, F.B., RUIZ, J.R., CASTILLO, M.J., MORENO, L.A., GONZÁLEZ-GROSS, M., WÄRNBERG, J., GUTIÉRREZ, A., 2005, *Low Level of Physical Fitness in Spanish Adolescents. Relevance for Future Cardiovascular Health (AVENA Study).* Rev Esp Cardiol; 58(8): 899

WORLD HEALTH ORGANIZATION, Health topics, Physical activity, *2012.*

WORLD HEALTH ORGANIZATION, Programmes and projects, Global Strategy on Diet, Physical Activity and Health, *2012.*

ADAMS, G.M., BEAM, W.C., 2008, *Exercise physiology laboratory manual, 5th ed., McGraw-Hill, New York, 47-48, 153, 261-262*

LYNN, P. M., EPLER, M. E., 1998, Fundamentals of musculosceletal assessment techniques, *2nd. Ed., New-York: Lippincott, 243-244, 290-291.*

ERICKSSEN, G., 2001, *Physical fitness and changes in mortality: the survival of the fittest*, Sport Med; 31: 517-6.

MYERS, J., KAYKHA, A., GEORGE, S., ABELLA, J., ZAHEER, N., LEAR, S., 2004, *Fitness versus physical activity patterns in predicting mortality in men*, Am J Med 2004; 117: 912-8.

CHENG, J.S, YANG, M.C., TING, P.H., CHEN, W.L., HUANG, Y.Y., 2011, *Leisure, lifestyle, and health-related physical fitness for college students*, Social Behavior and Personality; 39: 324, 330-331

BEETS, W.M., PILETTI, K.H. 2005, *Contribution of Physical Education and Sport to Health-Related Fitness in High School Students*, Journal of School Health; 75 (1): 29.

MARTINEZ-GOMEZ D, ET AL., 2010, *Associations of physical activity and fitness with adipocytokines in adolescents: The AFINOS study,* Nutrition, Metabolism & Cardiovascular Diseases; 22 (3): 255.