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Original Article

HEALTH-RELATED PHYSICAL FITNESS AMONG UNDERGRADUATE STUDENTS IN PHYSICAL EDUCATION

APTIDÃO FÍSICA RELACIONADA À SAÚDE DE ALUNOS DE GRADUÇÃO EM EDUCAÇÃO FÍSICA

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ABSTRACT
The aim of this study was to describe and analyze physical fitness of undergraduate students in Physical Education. The sample consisted of 110 women and 115 men. We evaluated weight, height, body mass index, percentage of body fat (BF), heart rate, systolic blood pressure (SBP), diastolic blood pressure, flexibility, strength and muscular endurance (ME). As main results we observed a higher percentage of women with body fat and ME above the ideal values for age when compared to men (BF: 37% vs 4%, p = 0.001; ME: 32% vs 13%, p = 0.001), while there were more men with changes in SBP when compared with women (22% vs 6%, p = 0.001). In conclusion, male students had higher levels of physical fitness than women, and a significant portion of undergraduate students in Physical Education showed results different than normal for anthropometric, hemodynamic and performance variables.
Keywords: Physical Fitness, Health Profile, Health. Students.

RESUMO
O objetivo desse estudo foi descrever e analisar o condicionamento físico de alunos de graduação do curso de Educação Física. A amostra foi composta por 110 mulheres e 115 homens. Foram avaliados peso, altura, índice de massa corpórea, percentual de gordura corporal (GC), frequência cardíaca em repouso (FCR), pressão arterial sistólica (PAS) e diastólica, flexibilidade, força e resistência muscular localizada (RML). Como principais resultados observou-se maior porcentagem de mulheres com gordura corporal e RML acima dos valores ideais para a idade quando comparados aos homens (GC: 37% *vs* 4%, p= 0,001; RML: 32% *vs* 13%, p= 0,001), enquanto houveram mais homens com alteração na PAS quando confrontado com mulheres (22% *vs* 6%, p= 0,001). Em conclusão, estudantes do sexo masculino apresentaram maiores níveis de aptidão física em relação às mulheres, e parcela expressiva de alunos de Educação Física apresentam alterações nos valores de referência à normalidade para variáveis antropométricas, hemodinâmicas e de desempenho motor.
Palavras-chave: Aptidão física. Perfil de saúde. Saúde. Estudantes.

Introduction

Physical fitness monitoring is important for assessing health-related aspects from childhood to adulthood[1-4]. Scientific evidence indicates that low levels of cardiorespiratory and muscular fitness are associated with global risk factors for the development of cardiovascular diseases[5], increased risk of mortality from coronary diseases, increased abdominal fat, development of arterial hypertension and aortic stiffness[6-9].

On the other hand, the increase in cardiorespiratory fitness and energy expenditure with physical activities, especially if performed at moderate and / or vigorous intensity, reduces cardiovascular events and obesity, which contributes to lower morbidity, mortality, and prevention of functional deterioration at more advanced ages, as well as lower demand and expenditures with medical services[7,8,10,11].

However, Madureira et al.[12] found that approximately 68% of college students are considered inactive, and women presented a significantly higher prevalence of physical inactivity when compared to men. This behavior, added to the advent of technology, leads to an even greater level of sedentarism for this population 13. However, when it comes to

college students with health-related majors, it is expected that the knowledge acquired during college regarding risk factors related to low physical fitness positively influences a healthy lifestyle.

Therefore, the objective of the present study was to describe physical fitness status (anthropometric, hemodynamic and neuromuscular indicators) among college students with major in Physical Education.

Methods

The present study has a cross-sectional design[14], was approved by the Ethics Research Committee of the Faculty of Sciences of UNESP, Bauru Campus (Protocol No. 402/46/01/09), and all participants signed a consent form. The details of methods used are described below.

Participants

Twenty-five college students (49% female) (n = 110) and 51% male (n = 115) with major in Physical Education at the São Paulo State University (UNESP) were interviewed, with mean age of 20.6 ± 1.8 years (18 and 26, lower and upper limits, respectively). The inclusion criteria were: i. To be regularly enrolled in college with major in Physical Education at the São Paulo State University (UNESP), Bauru campus; ii. Age between 18-29 years old. As exclusion criteria we defined: i. Presence of any type of cardiovascular impairment; ii. Blood pressure values above 140x90 mmHg, according to the VI Brazilian Guidelines for Hypertension (2010)[15].

Measurements and procedures

Data collection of anthropometric, hemodynamic and neuromuscular indicators was performed in sessions at the Laboratory of Evaluation and Prescription of Exercise (LAPE), Department of Physical Education, São Paulo State University, Bauru campus.

For the anthropometric data, measurements of body weight and height were obtained using the Welmy® Scale and Stadiometer, and the nutritional status of the students was assessed with values of Body Mass Index (BMI).

Subcutaneous adiposity was measured by skinfold thickness, composed of triceps, thoracic and subscapular for men, and tricipital, supra-iliac and abdominal for women, using a Harpenden® type adipometer. The calculation of body fat percentage (BF) was obtained with the equation proposed by Jackson & Pollock[16], which allowed to classify the sample according to categories of adiposity proposed by Lohman[17] (> 25% for women and> 20% for men).

Aneroid sphygmomanometer with a cuff adequate to the circumference of the participant's arm was used to measure resting systolic blood pressure (SBP) and diastolic blood pressure (DBP), and the final value was the average of three measurements, following the guidelines of the VI Brazilian Guidelines for Hypertension[15]. Resting heart rate (RHR) values were obtained with a Polar® heart rate monitor.

Submaximal ergometric test (85% of estimated maximum heart rate [HR] for age) was performed on Imbramed ATL® treadmill, following Ellestad protocol[18]. HR values (pre-exertion, after each stage, post-test and during active and passive recovery) and values of maximum oxygen uptake (VO_2 max) were recorded.

The degree of flexibility was obtained with the sit and reach protocol, with two attempts, taking the highest as the final value. The strength of the participants was evaluated with the push-up test (modified for women) considering the maximum number of repetitions

performed. Muscle endurance (ME) was assessed by curl-up test according to the protocol described by Pollock[19].

Statistical analysis

Descriptive data were presented in percentiles, median and difference inter quartiles, since data did not present normal distribution. Mann-Whitney test was used to compare the anthropometric, hemodynamic and neuromuscular parameters between men and women, and the chi-square test (χ^2) analyzed the existence of associations between the variables according to sex. Statistical significance was set at $p < 0,05$ and BioEstat (version 5.2) was used to perform the analyzes.

Results

Table 1 shows the characteristics of the sample according to sex, and we found that men presented higher anthropometric indicators (weight, height, BMI) than women, as well as higher values in VO_2 max, strength, and muscle endurance. Regarding the hemodynamic profile, it was verified that women had significantly lower SBP and DBP values than men, but, for RHR, women presented significantly higher values than men (p-value = 0.001).

Table 1. Characteristcs of the sample according to sex (Bauru/SP, n= 225)

	Female (n= 110)		Male (n= 115)		p-value
Variables	M_e (IR)	Min / Max	M_e (IR)	Min / Max	
Age (years)	20 (8)	18 / 26	21 (14)	18 / 32	**0.004**
Weight (Kg)	57.5 (35.1)	47.2 / 82.3	74 (46.8)	55.2 / 102	**0.001**
Height (cm)	163 (34)	148 / 182	178 (29)	163 / 192	**0.001**
BMI (Kg/m^2)	21.5 (12.5)	17.5 / 30	23.6 (11.7)	18.2 / 30	**0.001**
Body fat (%)	23.8 (26.9)	10.1 / 37	10.5 (28.7)	3.4 / 32	**0.001**
Flexibility (cm)	32 (47)	6 / 53	31.5 (41)	9 / 50	0.125
Strength (rep)	21 (46)	2 / 48	25 (46)	9 / 55	**0.001**
Muscle endurance (rep)	32.5 (44)	11 / 55	45 (45)	23 / 68	**0.001**
RHR (bpm)	80 (65)	54 / 119	70 (61)	46 / 107	**0.001**
SBP (mmHg)	110 (50)	90 / 140	118 (50)	96 / 146	**0.001**
DBP (mmHg)	72 (32)	58 / 90	78 (36)	54 / 90	**0.001**
VO_2 max (mL/kg/min)	43.8 (23.6)	32.6 / 56.2	49.6 (41.1)	34.8 / 75.8	**0.001**

Notes: Min = minimum; Max= maximum; M_e= median; IR= interquartile range; BMI= Body Mass Index; ME= Muscle Endurance; HRH= Resting heart rate; SBP= Systolic Blood Pressure; mmHg= milimiters of mercury; DBP= Diastolic Blood Pressure; VO_2 max= maximum oxygen uptake; rep= repetitions
Source: The authors

Table 2 presents reference values in percentiles for males and females of the same age group. Analyzing the hemodynamic indicators, it was possible to verify that 22% and 13% of the males presented levels of concern (below p25) for SBP and DBP, respectively. For VO_2 max, it was found that 10% of women were below p10 (very bad) and 7% of males were between p5 and p10. For neuromuscular variables, 20% of females were below p25 for strength, identified as poor. Regarding flexibility, 41% of the women and 46% of the men registered below-expected performance. For muscle endurance, 32% of women and 16% of men were at poor performance.

For body composition, males presented the percentage of body fat around 15%, while for women, 17%. It is worth mentioning that 37% of women and 4% of men presented relative values of body fat classified as obesity.

Table 2. Classification of variables in percentile according to sex (Bauru/SP, n= 225)

	Male (n= 115)						
Variables	p5	p10	p25	p50	p75	p90	p95
RHR (bpm)	90	87	76	70	64	59	57
SBP rest (mmHg)	140	138	128	118	110	104	100
DBP rest (mmHg)	90	87	80	78	70	64	60
VO_2 max (mL/kg/min)	42	44	45	50	54	60	65
Body fat (%)	20	18	13	10	9	7	5
Flexibility (cm)	17	19	26	31	36	42	44
Strength (rep)	10	16	20	25	33	45	50
Muscle endurance (rep)	30	33	39	45	51	56	59
	Female (n= 110)						
Variables	p5	p10	p25	p50	p75	p90	p95
RHR (bpm)	98	96	87	80	74	65	62
SBP rest (mmHg)	130	126	120	110	102	98	93
DBP rest (mmHg)	90	86	79	72	69	60	60
VO_2 max (mL/kg/min)	34	35	40	44	45	49	52
Body fat (%)	34	32	28	24	21	18	17
Flexibility (cm)	17	21	26	32	39	45	47
Strength (rep)	6	10	15	17	29	36	44
Muscle endurance (rep)	22	24	28	33	39	46	52

Notes: IBMI= Body Mass Index; ME= Muscle Endurance; RHR= Resting heart rate; bpm= beats per minute; SBP= Systolic Blood Pressure; mmHg= milimiters of mercury; DBP= Diastolic Blood Pressure; VO_2 max= Maximum oxygen uptake; cm= centimiters
Source: The authors

When comparing the distribution of women and men who presented values different from those recommended for anthropometric, neuromuscular and hemodynamic variables (Table 3), we found a higher percentage of women with altered values of body fat (37% versus 4%; p-value = 0.001), RHR (60% versus 19%, p-value = 0.001) and muscle endurance (32% versus 13%, p-value = 0.001). On the other hand, a higher percentage of males presented SBP above the reference values (6% versus 22%, p-value = 0.001). No significant differences were found between sexes regarding flexibility, strength, DBP and VO_2 max.

Table 3. Distribution of participants presenting values different than the recommended in anthropometric, neuromuscular and hemodynamic variables according to sex (Bauru/SP, n= 225)

		Female	Male	
Variables		(n= 110)	(n= 115)	p-value
Anthropometric				
Body fat	Higher	41 (37%)	5 (4%)	**0.001**
Neuromuscular				
Flexibility	Lower	37 (41%)	40 (46%)	0.590
Strength	Lower	22 (20%)	35 (30%)	0.091
Muscle Endurance	Lower	36 (32%)	16 (13%)	**0.001**
Hemodynamic				
RHR	Higher	66 (60%)	22 (19%)	**0.001**
SBP rest	Higher	7 (6%)	26 (22%)	**0.001**
DBP rest	Higher	11 (10%)	15 (13%)	0.535
VO_2 max	Higher	11 (10%)	9 (7%)	0.643

Notes: RHR= Rest heart rate; SBP= Systolic Blood Pressure; DBP= Diastolic Blood Pressure; VO_2 max= Maximum oxygen uptake. Reference values for body fat = <20% for men and <25% for women; flexibility= > 31; strength: >15 for women and >22 for men; Muscle endurance= >30 for women and >35 for men; RHR= <78; SBP rest= <130 mmHg; DBP rest= < 80mmHg; VO_2 max= >35 mL/kg/min for women and >43 mL/kg/min for men
Source: The authors

Discussion

The present study sought to describe health-related physical fitness of college students with major in Physical Education and verified that a higher percentage of women presented results different than the ideal for body fat, RHR, and muscle endurance, while a higher percentage of men had SBP above the recommended level. Regarding cardiorespiratory fitness, 93% of men and 74% of women had levels above the recommended.

Specifically on the percentage of body fat, women presented median values of 23.8% and men 10.5%. The results of this research are similar to those found among college students in the south of the country, with values of 23.9% and 13.8% for women and men, respectively[20]. The difference in fat percentage between sexes can be explained by hormonal responses since estrogen is responsible for the accumulation and regulation of adipose tissue[21], as well as exogenous factors and practice of physical activities[22]. Regarding this subject, the results indicated that 37% of the women and 4% of the men presented values of body fat higher than the recommended, even though we are talking about a professional category in whose physical health is intrinsically associated to the nature of the job.

Regarding cardiorespiratory fitness, 10% of the women and 7% of the men presented values of VO_2 below the recommended levels for age, similar to other studies[23,24]. In addition, men had higher values of cardiorespiratory fitness than women. Women are expected to have lower cardiorespiratory fitness due to lower cardiac output and oxygen transport capacity. Another factor that contributes to increasing VO_2 max is the practice of physical activities, especially aerobic type and at high intensity[25]. Scientific evidence indicates that men are physically more active than women[26-28], which could partially explain the findings obtained in the present study.

For muscle strength, 30% of men and 20% of women did not achieve the expected performance for age. For muscle endurance, there was a significant difference between sexes,

and 32% of women and 13% of men did not reach normal values for the age group. In agreement with our findings, a study with adolescents in the southern region of the country found that males obtained significantly higher values of strength and muscle endurance than females and, according to the researchers, it can be explained by the higher amount of mass muscle activity in men[24,29]. It should be taken into account that non-ideal values of neuromuscular variables, in general, are risk factors for chronic-degenerative dysfunctions associated with the motor system, as well as can result in an increased risk of falls among the elderly[30].

It was found that 41% of women and 46% of men presented low levels of flexibility. Even with no statistical differences between sexes, this finding shows a high percentage of participants with reduced flexibility if we consider that the population in question is composed of college students with major in Physical Education. A similar situation was observed in another study, with nursing students who also presented a poor performance in this component of physical fitness[31]. Additionally, a study analyzing the quality of life of workers in health-related areas found that 80% of men and 76% of women had poor flexibility[32]. In other words, it seems that, with a few exceptions, college students with major in Physical Education perform a lower amount of flexibility exercises than the recommended.

In general, Tthe median values, although not significant, were higher for women, corroborating with data from the Brazilian population. In agreement with these results, another study carried out with students of Physical Education found higher values for women, whereas the men presented greater muscle strength[33]. Because it is a physical quality whose determination is multifactorial, it can be influenced, among other factors, also by the level of physical activity and its reduction would be associated with the process of arterial stiffening and, therefore, the increased risk of developing arterial hypertension[34].

Regarding RHR, it was found that women had higher median values when compared to men, as observed in the study performed by Aeschbacher et al.[35]. About 60% of women had RHR higher than the reference values for age. In the literature, RHR is considered an independent risk factor for cardiovascular events, and high values may increase the chance of aggravations, such as ischemic myocardial disease, impaired endothelial function, and it can also contribute to accelerating atherosclerosis[36]. Regarding this subject, we consider important to maintain levels of RHR close to normal. It is a consensus in the literature that regular practice of physical activities, particularly aerobic exercises, is an efficient way to reduce RHR[37]. For BP, it was observed that males presented a greater number of individuals with high BP when compared to women. Our findings are in agreement with other studies that observed higher BP in men than in women[38]. In this case, considering that approximately one-third of the population in underdeveloped countries are affected by arterial hypertension[39] and that the prevalence is higher among men, this indicator deserves special attention because more than 20% of our sample was at risk of developing the disease.

Based on the data presented, it can be stated that men presented significantly higher physical fitness when compared to women, corroborating with the results of another study carried out in the south of the country[40].

The present study pointed out that the participants presented alterations in all variables analyzed, showing that even among college students with a major in Physical Education there is a tendency to a sedentary lifestyle and high risk of chronic non-communicable diseases.

With this background, we suggest actions promoting the practice of physical activities, a higher amount of places to perform physical activities, programs and courses focused on the importance of physical fitness and health of professionals should also be taken into account during college time. As limitations, we point out to the cross-sectional design of the study,

which does not allow the establishment of cause-effect relationships, as well as the lack of knowledge about the habitual physical activity level of the sample.

Conclusion

The results of the study revealed that male college students presented higher levels of physical fitness compared to women, and a significant number of college students with major in Physical Education presented low levels of anthropometric, hemodynamic and physical fitness variables, which makes them at high risk of developing numerous chronic noncommunicable diseases.

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