Original Article

Health-related physical condition variables in university students

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ABSTRACT

Alonso-Fernández D, Gutiérrez-Sánchez Á, Pino-Juste, M. Health-related physical condition variables in university students. *J. Hum. Sport Exerc.* Vol. 7, No. 1, pp. 331-340. The aim of this study was to assess the health of individuals over a sample of university students, by measuring variables related to fitness as a basis for reorienting physical activity programmes offered by the university sports services to optimise healthy physical condition of its users. We developed a descriptive study with a sample of 217 students of the University of Vigo applying battery tests AFISAL-INEFC variables measuring health-related physical condition variables: body composition, muscular strength, flexibility and maximal oxygen uptake. Since not all variables are normally distributed we used the nonparametric tests Mann-Whitney U and Chi-Square ($\chi 2$), using a significance level of $p < 0.05$. The results showed that in the hand-grip variables, peak oxygen consumption and lower body explosive power, women had a higher percentage of individuals with low fitness. The opposite situation occurred with the variable of trunk flexibility and hamstring muscles where men showed a lesser capacity. From a global view, the lower body explosive strength was the variable in which the university had a worse condition with 65.3% of subjects with low fitness. It would be positive to increase healthy physical activity programmes promote exercise in our target population (university students), particularly those affecting strength capacity and flexibility in both upper and lower body. **Key words**: HEALTH; PHYSICAL ACTIVITY; PHYSICAL EXERCISE; PHYSICAL FITNESS; UNIVERSITY STUDENTS.

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INTRODUCTION

Health as currently understood is a complex and holistic construct that is highly influenced by the actions or omissions of the individual. It is a more dynamic and responsible concept of health, in which our lifestyle plays a large role in its maintenance and preservation. In fact, the concept of lifestyle is intimately related to health, and is also a subjective term made up of different dimensions influenced by our habits and customs (Petlenko & Davidenko, 1998; Haskell et al., 2007; Welk, 2002). Currently there is much evidence that the regular practice of moderate physical and sport activities is one of the lifestyle habits that has the most direct impact on the improvement and maintenance of our health (Gledhill, 2001; Regidor et al., 2007; Rissanen & Fogelholm, 1999). The practice of regular physical exercise of light or moderate intensity causes a series of adaptations known as physical fitness, which produce benefits for individual health (Boraita, 2008; Kahn et al., 2002; Smith, 2004). Physical fitness is a different concept than physical activity since it addresses the capacity to exercise, understood as an integrating measure of all of the functions and structures that play a role in exercise (muscular, skeletal, cardiovascular, circulatory, psycho-neurological and endocrine-metabolic) (García-Atero et al., 2007). From this idea arises the union between physical fitness and health, healthy fitness, defined as the dynamic state of energy and vitality that allows people to complete habitual daily activities, enjoy active leisure time and face unforeseen emergencies without excessive fatigue, and at the same time allows hypokinetic diseases to be prevented, maximum intellectual capacity to be developed and the joy of living to be experienced (ACSM, 1995; Bouchard et al., 1994).

Despite the fact that the practice of physical exercise in free time and in the university context has increased in Spain, the prevalence of overweight and obese individuals has increased in recent decades (Aranceta et al., 2003; Gutiérrez-Fisac et al., 2006; Gutiérrez-Fiscac et al., 2005). The need to measure levels of healthy physical fitness in the adult population (Martínez-Ros et al., 2003; Sobejano et al., 2009) and to test the most suitable instruments to do so (Guirao-Goris et al., 2009; Martínez-Gomez et al., 2009) are derived from this fact.

Various works have addressed the study of variables related to healthy physical fitness in young populations (Aranceta et al., 2003; Gutiérrez-Fisac et al., 2006; Gutiérrez-Fiscac et al., 2005). Likewise, there are tools described in the literature that measure physical fitness, among which are the Eurofit Battery for Adults (Oja & Tuxworth, 1998), the Canadian Physical Activity Fitness and Lifestyle Appraisal (Gledhill, 2002) or the Health-Related Fitness Test Battery for Adults (Suni et al., 1996). A battery of physical tests has also been designed and validated in Spain, the aim of which is to assess the healthy physical fitness of the adult population: the AFISAL-INEFC battery (Rodríguez et al., 1998a; Rodríguez et al., 1998b). The use of this battery will allow us to test the physical fitness parameters of individuals closely linked to individual health: body composition, muscular strength, muscular endurance, flexibility and cardiovascular endurance (Rodríguez et al., 1998a; Rodríguez et al., 1998b).

Based on these, this investigation intends to study healthy physical fitness variables (body composition, muscular strength, flexibility and cardiovascular endurance) in a sample of university students in order to reorient physical activity and sport programmes developed by university sport services and enable health-promoting actions through the practice of physical exercise in the university community.

MATERIAL AND METHODS

Participants

The current exploratory descriptive transversal study was carried out during the 2009-2010 academic year with students enrolled in the University of Vigo. In selecting the sample, the number of centres, degrees and students was taken into account, with a cluster sampling for centres and a random sampling for students in order to achieve the best possible representation. The sample was made up of 217 students, 110 women and 107 men, and the average age was X =22.05±1.9.

Instrument

The tests described in the protocol of the AFISAL-INEFC battery for measurement of healthy physical fitness were used (Rodríguez et al., 1998a) with validity and reproducibility demonstrated in the Spanish population establishing normative values by age and sex (Rodríguez et al., 1998b). In particular, the tests administered were those related to assessing body composition (waist size and weight, to calculate body mass index, BMI) (Keys & Brozek, 1953), maximum hand grip strength with both hands (hand grip) (Oja & Tuxworth, 1998), explosive lower body strength (vertical jump) (Rodríguez et al., 1998a) flexibility of trunk extensor muscles and hamstrings (modified sit-and-reach) (Hoeger & Hopkins, 1992) and cardiovascular endurance through indirect measurement of maximum oxygen consumption (2 Km UKK-test) (Oja et al., 1991) (Annex 1). For identifying individuals with possible risk factors, the Physical Activity Readiness Questionnaire (C-AAF PAR-Q, validated Spanish version) was administered as a prerequisite for the physical tests (Rodríguez, 1996).

Procedure

The researchers involved in the study were trained beforehand to guarantee the uniformity of criteria and measurement protocols.

Before completing the tests, the participant signed an "informed consent document". All subjects participated voluntarily and given the type of study and the techniques used, this study respected all ethical procedures for the collection of data and Organic Law 15/1999 regarding the protection of personal data. The study complied with the precepts of the Declaration of Helsinki.

As an obligatory initial condition, the subject had to complete the Physical Activity Readiness Questionnaire (C-AAF, PAR-Q) (Rodríguez, 1996) to assess the suitability of the individual for carrying out the physical tests of the battery. Once passed this requirement, the subject took each of the tests after the researcher explained the protocol to be followed, and data were collected. Finally, a personal report was delivered to each participant with the results obtained and individual recommendations for physical activity or sport programmes to improve or maintain his or her healthy physical fitness. The entire procedure described took about 50 minutes for each participant.

Statistical analysis

A univariate analysis was carried out to describe each variable corresponding to the tests of the AFISAL-INEFC, calculating the basic values (average and standard deviation) A bivariate analysis was also carried out, and given that not all of the variables complied with the normality calculated with the Kolmogorov-Smirnov test, an analysis of a non-parametric test was used. For comparing between continuous values of each component of healthy physical fitness, the Mann-Whitney U test was used and the Chi-squared test ($\chi 2$) was used for comparing categorised data. The significance level used in all statistical procedures was $p<0.05$. The data analysis was carried out with the statistical packet SPSS 17.0.

RESULTS

Table 1 presents descriptive data for both genders for each component of the healthy physical fitness test collected through the tests of the AFISAL-INEFC battery. The values obtained are related with the reference values described as "recommended" by the protocol of the AFISAL-INEFC battery for the age and gender of the sample studied (Table 1).

Table 1. *Results of the AFISAL-INEFC battery applied to university students.*

	Female *Age 21.8±2.2 n=110*		**Male** *Age 22.3±1.6 n=107*	
	Mean±SD	*AFISAL	Mean±SD	*AFISAL
BMI (kg/m^2)	23.52±4.72	18.5-24.99	22.11±5.41	18.5-24.99
Maximum hand grip strength (kg)	47.61±8.72	50-60	83.27±15.43	85-97
Sit and reach flexibility test (cm)	30.61±4.27	31-37	22.31±9.15	23-31
Explosive lower body strength, vertical jump (cm)	24.23±9.11	30-35	44.26±14.71	46-52
VO_{2max} assessment, 2-km test (ml·kg^{-1}·min^{-1})	36.49±12.87	30-39	47.33±16.04	40-49

Note. SD= standard deviation; BMI=Body mass index; VO_{2max}= Maximum oxygen consumption. reference value.*

Establishing a comparison between the results obtained for men and women, using the Mann-Whitney U test, it was observed that there were significant differences between the genders for all healthy fitness variables studied. Men had statistically higher values for the variables: hand grip strength ($p<0.001$), explosive lower body strength ($p<0.001$) and maximum oxygen consumption ($p<0.016$). Women had higher values for BMI ($p<0.022$) and flexibility of trunk extensor muscles and hamstrings ($p<0.001$).

When comparing the average values obtained with the reference values provided by the AFISAL-INEFC battery, it was observed that for both genders the average was within the "recommended" values for BMI and maximum oxygen consumption tests. Also, for both genders the average values obtained were not within the recommended range for the tests of maximum hand grip strength, flexibility and explosive lower body strength.

It is also noted that women had, according to the BMI classification (Keys & Brozek, 1953), a larger proportion of excessive weight than men (19% and 11.2%, respectively), a statistically significant difference ($p=0.028$) (Table 2).

Table 2. *Proportion of university students with BMI values within the recommended range and percentage overweight (BMI>24.99) for both genders.*

	Male		**Female**		***Total***			
BMI Classification	n	%	n	%	*n*	%	**χ2**	**p**
Overweight	12	11.2	21	19	33	15.2	506	0.028
Recommended range	95	88.8	89	81	184	84.8		

For the maximum hand grip strength and maximum oxygen consumption variables (Table 3), there was a larger percentage of women subjects with low physical fitness as compared to men. Something similar occurred with the explosive lower body strength, which also resulted in a statistically significant difference between the two genders (p=0.048). The opposite situation was found for the trunk and hamstring flexibly variable for which there was a larger percentage of male subjects with lower physical fitness than women.

Table 3. *Proportion of university students with values within the recommended range and with low fitness for variables of healthy fitness in both genders.*

	Male		**Female**		***Total***		**P**
Maximum hand grip strength	**n**	**%**	**n**	**%**	***n***	**%**	
Low ability	63	58.9	68	61.8	131	60.4	0.082
Recommended Range[1]	44	41.1	42	38.2	86	39.6	
Flexibility of trunk and hamstrings	**n**	**%**	**n**	**%**	***n***	**%**	
Low ability	61	57.0	60	54.5	120	55.3	0.079
Recommended Range[2]	46	42.0	50	45.5	97	44.7	
Explosive lower body strength	**n**	**%**	**n**	**%**	***n***	**%**	
Low ability	65	61.7	76	69.1	142	65.5	0.048
Recommended Range[3]	42	38.3	34	30.9	75	34.6	
Maximum oxygen consumption	**n**	**%**	**n**	**%**	***n***	**%**	
Low ability	39	36.4	44	40.0	83	38.2	0.067
Recommended Range[4]	68	63.6	66	60.0	134	62.8	

Minimum values for the recommended range:
[1] Male: 85 kg
Female: 50 kg
[2] Male: 23 cm
Female: 31 cm
[3] Male: 46 cm
Female: 30 cm
[4] Male: 40 ml · kg^{-1}· min^{-1}
Female: 30 ml · kg^{-1}· min^{-1}

Overall, explosive lower body strength was the variable for which the university students showed the worst condition for both genders, with 65.5% of subjects with low fitness, followed by the hand grip strength variable with 60.4% and the trunk and hamstring flexibility variable with 55.3%.

DISCUSSION

This study analysed physical fitness variables related to health in a university population as a starting point for reorienting physical activity and sport programmes run by university sport services. Considering the average values obtained for BMI, university students of both genders are within recommended values for their age, a finding that coincides with other international studies of a similar population (Konrad, 2000; Tremblay & Chiasson, 2002; Loch et al., 2006). However, 15.2% of university students are overweight, for which a shift toward physical activity and healthy eating habits would be recommended.

The high percentage of BMI found for women as compared to men coincides with the results of other studies that analyse physical activity levels (Martínez-Ros et al., 2003; Gómez et al., 2005), in which men are always more physically active than women.

The only variable for which the proportion of university students within the recommended range exceeded the proportion of their peers with low fitness was maximum oxygen consumption, a finding that does not coincide with the study of Loch et al. (2006), in which the sample of students had deficient values for that variable.

For the rest of the variables studied, the proportion of subjects with low physical fitness exceeded subjects with recommended values for both genders. This situation was more accentuated in the maximum hand grip strength variable and most of all in the explosive lower body strength variable where 13 of every 20 university students showed deficient values. For this particular test, the results could be due to the fact that the action they are based on (vertical jump) has a component of technical execution that could somewhat reduce the potential of the subject in measurement. However, in the study undertaken in Brazil by Konrad (2000), the jump test in non-university student youths returned normal values, while the tests that gave deficient results in this study were flexibility of the trunk extensor muscles and maximum oxygen consumption.

CONCLUSIONS

The results obtained allow us to affirm that a large percentage of the youth evaluated showed deficient values in the following variables of healthy physical fitness: hand grip strength, flexibility of trunk extensor muscles and hamstrings and explosive lower body strength.

This scenario warns us of the necessity to implement physical exercise programmes in university sport services to facilitate the regular practice of physical and sport activities, and thereby increase healthy physical fitness levels among students. This action would be a great step for preventing illnesses associated with inactivity in the university community and to counteract the abandonment of regular physical activity or sport that occurs in this period of life (Carlin et al., 2009).

One of the highest priority objectives is to achieve a correct awareness and attitude change in youth that allows them to develop healthy habits regarding nutrition and the practice of sport (Rodríguez et al., 1999).

To this end, the university and its sport services should become aware of the physical and sport habits of its students and thereby create appropriate promotion policies that optimise the limited available resources. The instruments and protocols used in this work can be used to achieve that awareness.

However, it is necessary to consider some limitations to this study. On one hand, it would be necessary to obtain a larger sample that guarantees a better representation of the population of Galician university students, and on the other hand, the additional application of a questionnaire of physical activity habits that would grant a more segmented vision of university students and their levels of inactivity. Due to the small number of this type of studies in our country, undertaking further studies is very important in our opinion, with larger sample and in other institutions in order to contrast the results of this study and attempt to better measure and understand the factors associated with the healthy physical fitness of university students.

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ANNEX 1

Test	Material
1. Body Composition Assessment waist (cm) and weight (kg)	-Holtain Stadiometer (precision ± 1 cm) and SECA scales (± 1 g).
2. Maximum hand grip strength (kg)	-Takei-5001 adaptable hand-grip dynamometer (precision ± 0.2 kg)
3. Back flexibility, modified sit and reach test (cm)	-Approved Psymtec-LA0125 (35 x 45 x 32 cm) with a 1 cm moveable ruler.
4. Explosive lower body strength, vertical jump (cm)	-Indistortable Holtain measuring tape (precision ± 1 mm)
5. VO_{2max} assessment, UKK-test 2km ($ml \cdot kg^{-1} \cdot min^{-1}$)	-Approved Namaste 898 stopwatch.