Journal of Physical Education & Health, 2013, vol. 2 (4), 57-62

A HEALTH RELATED FITNESS ASSESSMENT AT THE UNIVERSITY OF BALEARIC ISLANDS

Josep Vidal-Conti

Exercise and Sport Science Research Group. University of Balearic Islands. Palma of Majorca. Spain.

Abstract

Physical fitness and health are two concepts that more and more evidence show their close relationship. The main aim of this paper is to provide an assessment protocol accessible, affordable and easy to apply, to assess fitness and health.

To test the protocol, a total amount of 115 participants (59 men and 56 women) aged 25.9 years were assessed.

The assessment protocol is designed and tested for application in a population over 18 years of age. It was used to assess the University of Balearic Islands community users. Based on evidence and validated tests (Alpha and Afisal test batteries, Stepping Queen College Test), the following measures for the design of the protocol for assessing the level of fitness and health were recorded: anthropometry (weight, BMI, body fat, waist circumference), fitness (lower extremity strength, upper body endurance, hand grip strength, maximum oxygen intake, flexibility), and blood pressure.

The assessment protocol include the previous action of the reception of the participant (explanation and administering of the International Physical Activity Questionnaire and the Physical Activity Readiness Questionnaire) and an ending action where a report of the results obtained and individual recommendations to improve the overall fitness and health level is provided to each participant.

Key words: *fitness, health, assessment.*

Introduction

Physical fitness constitutes an integrated measure of all the functions and structures involved in the performance of physical activity and/or exercise. These include musculoskeletal function, cardiorespiratory function, blood flow and circulatory function, endocrine and metabolic function and psychoneurological function. Recent studies have shown physical fitness to be an important predictor of morbidity and mortality in adults [6,14].

Hence, when physical fitness is tested, the functional status of all these systems is actually being checked. This is the reason why physical fitness is nowadays considered one of the most important health markers, as well as a predictor of morbidity and mortality for cardiovascular disease (CVD) and for all causes [11].

This seems to be valid in apparently healthy individuals, and also in people with diseases, such as diabetes mellitus, hypertension, metabolic syndrome and several types of cancer. This association is also independent of the adiposity [16]. Based on this evidence, the study of physical fitness level in young populations has been of increasing interest in the last years [10].

Among the health-related physical fitness components, cardiorespiratory fitness is the one that has been studied the most. Cardiorespiratory fitness reflects the overall capacity of the cardiovascular and respiratory systems and the ability to carry out prolonged exercise [18].

AIM

The main aim of this paper is to provide an assessment protocol accessible, affordable and easy to apply, to assess the fitness and health level of participants.

MATERIALS AND METHODS

Participants:

One hundred and fifteen members of the University of the Balearic Islands (students and employers) participate in the study (59 men and

56 women). Participants were 25.9 years old. The collection data was developed during March and April 2012.

Written permission of participants was required to participate in the study. All the participants were previously informed about the protocol and purposes of the study. The study protocol was approved by the local Ethical Committee of the University of Balearic Islands.

Instruments:

The assessment protocol is designed to inform and advise the participants of their of fitness and health levels. This study shows the results of applying the assessment protocol at the University of the Balearic Islands (Spain). The program was developed by the Physical Education Department.

The study outcomes were body measurements, physical fitness and blood pressure. Data on body measurements included: height, weight, BMI, body fat, waist circumference and triceps skinfold thickness. Anthropometry was assessed using an Omrom body composition monitor BF500 and a measuring tape for body circumferences.

Physical fitness was assessed by Alpha-Fit battery test for adults [17] and Queen College Step Test [7]. Data on physical fitness included: lower extremity strength, upper body endurance and hand grip strength, flexibility of the hamstrings, maximum oxygen intake (VO2max).

Blood pressure was measured with a blood pressure computer (Omron MIT Elite Plus).

In addition, to perform a custom report that is provided to the participant immediately after completing the assessment protocol was developed using the Microsoft Office Excel software.

Procedure:

The full assessment protocol consists of three stages (Figure 1). In the first stage, an explanation of the protocol is provided to the participant, and is administered the International Physical Activity Questionnaire – IPAQ short version [1] –, as well as a questionnaire for physical activity – PAR-Q (Ministry of Health British Columbia / Canadian Society for Exercise Physiology) –, with the objective of identifying individuals at high risk cardiac and also identifies musculoskeletal problems or medication.

In a second stage we proceed, in the following order, to the assessment of health parameters, body measurements and physical fitness.

In the third and final stage, the participant receives a report with the results of the different tests done and the normative values of each test. At the same time are provided healthy recommendations to improve those parameters that require it.

This study was a non-randomized controlled trial. The study used accidental sampling methods to draw a voluntary population.

Anthropometric assessment. Participants removed shoes, heavy clothing and pocket contents.

- Body weight (recorded in kilograms) and body fat (percentage) were measured with a composition monitor (Omrom BF500). Height was measured with a tape measure affixed to the wall. Subjects stand barefoot with heels together and back as straight as possible. The participants' height was judged to be the location at which the top of his or her head intersected the tape and was recorded in inches. Height and weight were used to calculate BMI.
- Waist circumference was assessed using anatomic marks on the participant's skin and recorded in centimeters using a tape measure. Result was the mean of the 3 measurements rounded off to the nearest 0.5cm. If these 3 measurements differed more than 1 cm from each other, 2 additional measurements were performed.
- Skinfold measurement of the nondominant arm triceps was taken with Holtain skinfold caliper (Holtain Ltd., Dyfed, UK). The triceps skinfold was taken on the back of the upper arm midway between the shoulder and elbow. Two measurements are performed not consecutively and the mean is used in the analyses.

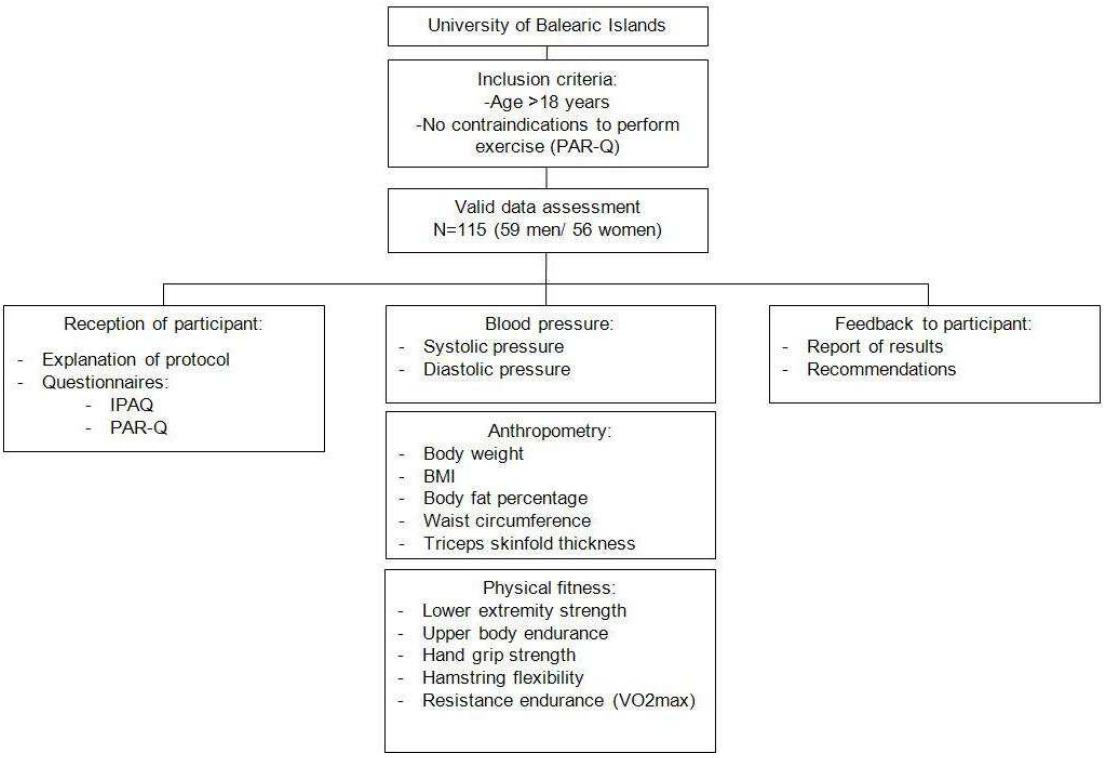

Figure 1. Study flow.

Physical fitness assessment.

- Lower extremity strength (leg extensor power) was measured with the jump-and-reach test, which the aim is to jump as high as possible. The participant stands beside the jump-board facing forward. Dominant upper extremity is raised up straight against the jumping board, and mark with magnesium powdered middle finger. The vertical difference between the "standing height" and the "jumping height" was measured in centimeters with a tape measure.
- Upper body endurance was tested with modified push-ups to measure short-term endurance capacity of the upper extremity extensor muscles and the ability to stabilize trunk. The participant lie prone on the mat, and begin the push-up cycle by clapping hands behind the back once; this is followed by a normal straight-leg push-up with elbows completely straight in the up-position, so that the participant can touch his/her either hand with the other hand. The participant ends the cycle in prone position. The number of correctly performed push-ups completed in 40 seconds was counted.
- Hand grip strength was measured with a hand dynamometer (TKK-5001). The participant stands in an upright position with the dynamometer in the preferred hand. The arm is straight and slightly away from the body the scale facing the tester. The better result of two attempts was the score recorded in kilograms.
- Queen's College Step Test was conducted for indirectly estimating the maximum oxygen intake [7] (Vo2max). The participant steps up and down on a platform (16.25 inches) at a rate of 22 steps per minute for females and at 24 steps per minute for males. Participants are to step using a four-step cadence, "up-up-down-down" for 3 minutes. Heart beats are counted from 5-20 second of recovery.
- Flexibility of the hamstrings (knee flexors) and the trunk was assessed using sit-and-reach test, with a box (35 cm long, 45 cm wide and 32 cm high) with a mobile rule 1 m (within 0.5 cm) at the top. This test involves sitting on the floor with legs stretched out straight ahead. Shoes were removed. The soles of the feet were placed flat against the box. Both knees were locked and pressed flat to the floor. With

the palms facing downwards, and the hands on top of each other or side by side, the subject reached forward along the measuring line as far as possible. Position of the hands was controlled to be at the same level, not one reaching further forward than the other. The subject reaches out and holds that position for at one-two seconds while the distance is recorded [13].

Blood pressure assessment. Blood pressure was measured with a blood pressure computer (Omron MIT Elite Plus).

Statistical Analyses:

The analyses were performed with those participants that had complete data using PASW (Predictive Analytics SoftWare, formerly SPSS), version 21.0 SPSS Inc., Chicago, IL, USA. The level of significance was set at <0.05 for all the analyses. The t-test was used for comparison of variables for gender.

RESULTS

The total amount of participants was 115 (59 men and 56 women) aged 25.9 years.

Results shows that participants expend 4149 METs per week, but there are significant differences by gender (p=0.011). Men expend 4885 METs compared to women whose expend 3423 METs. According to the guidelines for data processing and analysis of the IPAQ, the 10.4% of participants are included in the category of low level of physical activity; 18.3% in the moderate level, and 70.4% in the high level.

Anthropometric parameters

The average of the anthropometric parameters of participants was 23.6 (SD=3.34) for BMI; 25.42 (SD=9.53) for body fat percentage; and 78.3cm (SD=9.83) for waist circumference. Significant differences were found by gender in body fat percentage (p=0.001) and waist circumference (p=0.001). No differences were found in BMI (p=0.244).

According to BMI categories, 3.5% of participants had underweight (<18.5); 71.3% normal weight (18.5-24.9); 23.5% overweight (25-29.9); 0.9% obesity class 1 (30-34.9%); 0% obesity class 2 (35-39.9); and 0.9% obesity class 3 (>40).

Physical fitness parameters

The average of the fitness parameters of participants was 31.18 cm (SD=8.88) of flexibility; 14.99 push-ups (SD=5.40) of upper body endurance; 36.14 cm (SD=12.36) of lower extremity strength (vertical jump); 36.38 L/min of VO2 max (SD=10.89); and 36.38 of hand grip strength (SD=11.74).

Blood pressure parameters

In reference to blood pressure, means were 123 mmHg for systolic and 76 for diastolic pressure. Significant differences appear in systolic pressure by gender (p=0.012), where women obtain lower scores. No differences were found in diastolic blood pressure. According to the Hypertension Spanish Association [15] ranges, 40.9% of participants have optimal blood pressure; 19.1% normal; 16.5% normal-high; 20.9% hypertension grade 1; and 2.6% hypertension grade 2.

Table 1. Characteristics of sample and comparisons between gender.

	Men		Women		*p*=
	Mean	(SD)	Mean	SD	
METs / week	4885.96	(417.08)	3423.51	(432.69)	0.011
Age	24.32	(0.89)	26.75	(1.36)	0.027
Systolic blood pressure	126.7	(1.59)	118.9	(2.39)	0.012
Diastolic blood pressure	75.58	(1.45)	75.93	(1.70)	0.991
Body mass index (kg/m2)	23.96	(0.29)	22.29	(0.40)	0.244
Waist circumference	82.54	(0.82)	72.12	(1.33)	0.001
Body fat (%)	19.05	(0.74)	31.01	(1.04)	0.001
Hand grip strength	43.66	(1.37)	28.55	(1.10)	0.001
VO2 max	53.60	(1.30)	37.74	(0.58)	0.001
Flexibility	30.35	(1.23)	33.09	(1.28)	0.175
Modified push-ups	17.63	(0.70)	11.61	(0.53)	0.001
Vertical jump	45.81	(1.14)	27.16	(0.96)	0.001

DISCUSSION

The results show that participants have an average BMI of 23.6 (normal weight range 18.5-24.9). However, it is noteworthy that 25.3% is in ranges of overweight and / or obesity. Overweight and obesity are linked to increased risk of morbidity from hypertension, dyslipidaemia, type 2 diabetes, coronary heart disease, stroke, gallbladder disease, osteoarthritis, sleep apnoea and respiratory problems, and endometrial, postmenopausal breast, prostate, and other cancer [3, 12]. In addition, obesity is associated with increased overall mortality [4].

Body fat percentages by gender were 18.9% in men and 32.3% women. Both values are placed at the upper limit of healthy (in man 8-20% and women 21-33%) [5].

Although the blood pressure values may look good, according to the Spanish Hypertension Society [15], with 40.9% of optimal values and 19.1% of normal values. It's necessary to highlight the high values obtained (23.5% with hypertension) considering that the average age of the participants was 25.9 years.

In physical fitness testing results show that men are, in all tests, above the 50th percentile, unlike women who are slightly less in flexibility test and lower extremity strength (vertical jump). It's important to highlight the inclusion of the handgrip test, which is one of the most used tests for assessing muscular fitness in epidemiological studies. In adults, handgrip strength has been reported to be a strong predictor of morbidity and life expectancy [8].

CONCLUSION

The assessment protocol of fitness and health corresponds with the main objective stated to be an accessible, affordable and easy to apply to assess the physical fitness and health level of the participants, and also to inform and advise them about their health and raise awareness of the importance of adopting healthy lifestyles.

BIBLIOGRAPHY

1. Booth, M.L. (2000). Assessment of Physical Activity: An International Perspective. Research Quarterly for Exercise and Sport, 71 (2), s114-120.
2. British Columbia Ministry of Health/Canadian Society for Exercise Physiology, 202-185 Somerset St.West Ottawa, ON K2P 012 http://www.csep.ca
3. Clinical guidelines on the identification, evaluation, and treatment of overweight and obesity in adults: executive summary. Expert Panel on the Identification, Evaluation, and Treatment of Overweight in Adults. The American journal of clinical nutrition 68: 899-917, 1998.
4. Flegal, KM, Graubard, BI, Williamson, DF, and Gail, MH. Cause-specific excess deaths associated with underweight, overweight, and obesity. JAMA : the journal of the American Medical Association 298: 2028-2037, 2007.
5. Gallagher, D., Heymsfiel, S.B., Heo, M., Jebb, S.A., Murgatroyd, P.R. & Sakamoto, Y. (2000). Healthy percentage body fat ranges: an approach for developing guidelines based on body mass index. Am J Clin Nutr ,72, 694-701.
6. Kodama S, Saito K, Tanaka S, Maki M, Yachi Y, Asumi M, et al. Cardiorespiratory fitness as a quantitative predictor of all-cause mortality and cardiovascular events in healthy men and women: a meta-analysis. JAMA. 2009;301:2024–35.
7. McArdle, W.D., Katch, F.I., Pechar, G.S., Jacobson, L. & Ruck, S. (1972). Reliability and interrelationships between maximal oxygen uptake, physical work capacity and step test scores in college women. Med Sci Sport 4(4), 182-186.
8. Metter EJ, Talbot LA, Schrager M, Conwit R. Skeletal muscle strength as a predictor of all-cause mortality in healthy men. J Gerontol A Biol Sci Med Sci 2002; 57: B359–B365.
9. National Institutes of Health and National Heart, Lung, and Blood Institute. (1998). Clinical guidelines on the identification, evaluation, and treatment of overweight and obesity in adults. Evidence Report. Obes Res, 6 (suppl. 2), 51S-209S.
10. Ortega, F.B., Ruiz, J.R., Castillo, M.J., Moreno, L.A., González-Gross, M., Warnberg, J. & Gutiérrez, A. (2005). Low level of physical fitness in Spanish adolescents. Relevance for future cardiovascular health (AVENA study). Rev Esp Cardiol, 58 (8), 898-909.

11. Ortega, F.B., Ruiz, J.R., Castillo, M.J. & Sjostrom, M. (2008). Physical fitness in childhood and adolescence: a powerful marker of Health. International Journal of Obesity, 32, 1–11.
12. Renehan, AG, Tyson, M, Egger, M, Heller, RF, and Zwahlen, M. Body-mass index and incidence of cancer: a systematic review and meta-analysis of prospective observational studies. Lancet 371: 569-578, 2008.
13. Rodríguez, F.A., Valenzuela, A, Gusi, N., Nácher, S. & Gallardo, I. (1998). Valoración de la condicion física saludable en adultos (y 11): fiabilidad, aplicabilidad y valores normativos de la batería Afisal-Inefc. Educación fisica y deportes 54, 54-65.
14. Ruiz JR, Sui X, Lobelo F, Morrow Jr JR, Jackson AW, Sjostrom M, et al. Association between muscular strength and mortality in men: prospective cohort study. BMJ. 2008;337:a439.
15. Sociedad Española de Hipertensión. (2003). 1ª Guía Europea de manejo de la Hipertensión Arterial. Journal of Hypertension 21, 1011-1053.
16. Sui, X., LaMonte, M.J., Laditka, J.N., Hardin, J.W., Chase, N., Hooker, S.P. & Blair, S.N. (2007). Cardiorespiratory fitness and adiposity as mortality predictors in older adults. JAMA, 298 (21), 2507-2516.
17. Suni, J.H., Oja, P., Miilunpalo, S.I., Pasanen, M.E., Vuori, I.M. & Bos, K. (1999). Health-related fitness test battery for middle-aged adults: associations with physical activity patterns. Int J Sports Med, 20(3), 183-191.
18. Taylor HL, Buskirk E, Henschel A. Maximal oxygen intake as an objective measure of cardio-respiratory performance. J Appl Physiol. 1955;8(1):73-80.
19. World Health Organization. (2000). Obesity. Preventing and managing the global epidemic. Technical Report Series No. 894. Geneva: World Health Organization.

Received: October 2012
Accepted: April 2013
Published: November 2013

Correspondence

Josep Vidal-Conti
Exercise and Sport Science Research Group. University of Balearic Islands.
Cra. Valldemossa km.7’5. Edifici Guillem Cifre.
07122. Palma of Majorca. Spain.
Tel. +34 971172095
josep.vidal@uib.es