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ANTHROPOMETRIC PROFILE AND SELF-REPORTED CLINICAL STATUS OF MASTER ATHLETES ACCORDING TO THREE LEVELS OF ENERGY EXPENDITURE

José Carlos Lopes Penha
Universidade Paulista – UNIP
Santos, São Paulo, Brasil
https://orcid.org/0000-0001-5631-0743

Wagner Correia Santos
Universidade Federal de São Paulo – UNIFESP
São Paulo, São Paulo, Brasil
https://orcid.org/0000-0003-4102-7376

Mariana Rodrigues Gazzotti
Universidade Federal de São Paulo – UNIFESP
São Paulo, São Paulo, Brasil
https://orcid.org/0000-0002-6061-785X

Oliver Augusto Nascimento
Universidade Federal de São Paulo – UNIFESP
São Paulo, São Paulo, Brasil
https://orcid.org/0000-0003-3138-2219

José Roberto Jardim
Universidade Federal de São Paulo – UNIFESP
São Paulo, São Paulo, Brasil
https://orcid.org/0000-0002-7178-8187

Abstract: Population aging associated with increased life expectancy, socioeconomic changes, advances in medicine, and sports practice. **Methods:** Were evaluated 91 elderly master athletes from the City of Santos (State of São Paulo, Brazil), of both sexes who practice higher intensity (HIE) (> 6.5 MET: swimming, adapted volleyball, track and tennis); moderate intensity (MIE) (4 to 6.5 METs: choreography, ballroom dancing and table tennis); and lower intensity exercises (LIE) (<4 METs: chess, mesh, bocce ball, dominoes, checkers and cards). **Results:** The mean age was 69.5 ± 6.8 years, BMI of 26.5 ± 4.0 kg/m², waist-hip ratio of 0.89 ± 0.14, systolic blood pressure of 132.9 ± 18.6mmHg and diastolic 79.4 ± 9.7mmHg; arterial hypertension was the most frequent comorbidity (30%). Out of the total number of athletes, 11 (12.1%) had normal fat mass and 6 (54.5%) were from the HIE group. Interestingly, 8 athletes (44.4%) from the HIE group were underweight and 13 (75%) had fat levels within the normal range, indicating that HIE could be a protective factor. **Conclusions:** HIE group have parameters associated with better health status than those in LIE. Physical activity maintenance throughout life should be encouraged, given its possible health and longevity benefits.
Keywords: Energy metabolism, elderly, athletes, health.

INTRODUCTION

Population aging is a worldwide occurrence since the 1980s (WHO, 1984; IBGE, 2019; Municipal Secretariat of Assistance and Social Development, 2006). This phenomenon is associated with increased life expectancy, a decline in mortality rate, socioeconomic changes, advances in medicine, better living conditions, and sports practice. Although regular physical activity determines evident benefits, 60 to 70% of the elderly individuals are sedentary, and less than 25% participate in any regular physical activity program or adequate exercise (Netto & Filho, 2006, p. 687-737).

Physical activity represents any body movement resulting from muscle contraction with energy expenditure significantly higher than resting. The lack of physical activity is associated with cognitive, cardiovascular, rheumatic, metabolic, and chronic-degenerative diseases (Amorim & Gomes, 2003). Epidemiological studies reported regular physical activity practice as a protective factor for diseases and risk factors (Blair et al., 1996, p. 205-210; Pate et al., 1995, p. 402-407; Sesso et al., 2000, p. 975-980). A planned, structured, and repetitive physical activity for conditioning of any part of the body is called exercise (Amorim & Gomes, 2003). Accordingly, increased physical activity levels seem may reduce morbidity and mortality in the general population, particularly the elderly population (Blair et al., 1996, p. 205-210; Mota et al., 2006, p. 219-225).

Regular physical activity performed two to three days per week may be enough for the elderly to maintain physical and functional fitness levels. However, five to seven days of training per week are necessary for master athletes (i.e., those who practice competitive modalities) to reach and maintain the physical fitness level and maximum performance conditions for competitive activities. The training volume satisfies reasonable conditioning goals (American College of Sports Medicine, 1995). Many studies, like the ones of Hawkins et. al. (2003, p. 1009-1011), have mentioned master athletes as the ideal aging model due to high-intensity exercises. A cross-sectional study by Kavanagh and Shephard (1990, p. 94-104) indicates that body fat percentage in master athletes aged between 35 and 70 years is around 28%, but it varies according to the sport performed. Athletes who participate in long-distance running present a lower body fat percentage (23.5%) than those who participate in short distance running (28.8%), racket sports (29.5%), or sports without load support, such as swimming (26.9%) (Kavanagh & Shephard, 1990, p. 94-104). Pollock et al. (1987, p. 725-731) observed that master athletes who continued training and competing presented a maximum heart rate decrease of 5 to 7 beats per minute over a ten-year follow-up period. Conversely, lean body mass changes little in master competitors. Kavanagh and Shephard (1990, p. 94-104) found mean values of 62.2 ± 8.2 kg and 45.2 ± 8.6 kg in male and female competitors aged 65 years, respectively, while Sipila et al. (1991, p. 399-403) observed a greater strength in athletes than sedentary individuals aged between 70 and 81 years. There are few reports in the literature regarding assessing physical activity levels in master athletes using the metabolic equivalent of task (METs). This knowledge could guide master athletes and the elderly to adjust the physical activity/exercise variables (e.g., intensity, frequency, and duration) to obtain maximum benefits and avoid exhaustion.

Therefore, considering that the accurate determination of physical activity intensity is expressed as a function of energy expenditure and it has become indispensable in epidemiological studies (Poehlman et al., 2002, p. 1004-1009; Varo et al., 2003, p. 138-146; Rising et al., 1994, p. 800-804), this study aimed to analyze the health condition and body composition of master athletes who exercise with METs and verify its association with health risk.

MATERIAL AND METHODS

SAMPLE

The sample was recruited by convenience, according to the following inclusion criteria: master athletes aged over 60 years who signed the informed consent form, regular training in the City of Santos (Brazil), and no limitations hindering the assessments. Those who presented injury or severe illness or did not accept participating in the study were excluded. The sample was divided into three groups of sports according to energy expenditure in METs (Ainsworth et al., 2011, p. 1575-1581). Group A (< 4 METs) considered as light: chess, shuffleboard, bocce ball, dominoes, checkers, and gin rummy; Group B (4 to 6.5 METs) considered as moderate: choreography, ballroom dancing, and table tennis; and Group C (> 6.5 METs) considered as intense: swimming, adapted volleyball, track, and tennis.

METHODS

The study was approved by the research ethics committee of the São Paulo Hospital and Federal University of São Paulo on November 29, 2013 (number 473,532). The assessments were carried out in the morning at the Rebouças Sports and Recreation Center, located in the City of Santos (Brazil). All anthropometric measurements were assessed following the standardization suggested by França and Vívolo (1995, p. 19-31). The athletes answered a questionnaire that included questions about educational level, medications used, and weekly training frequency.

Weight – Body weight was measured using a digital scale (Toledo - model 2096PP/2-SP, Brazil) and recorded in kilograms. The athletes were barefoot and wore comfortable clothes. The scale was recalibrated after every ten athletes.

Height - Height was measured using a metallic tape measure (graduated in centimeters and decimeters) fixed to a wooden pillar and an anthropometric wooden cursor.

Body mass index (BMI) - BMI was calculated as the ratio between body weight (in kilograms) and height in meters squared (W/h^2).

Bioimpedance - Bioelectrical impedance analysis (BIA) was performed (Quantum BIA-101Q, MI., USA) to assess fat mass and fat-free mass (both in Kg and %). Values were obtained using the resistance and reactance parameters applied in an appropriate equation and measured with the patient in supine with electrodes positioned in the right hand and foot. Measurements were performed after fasting for at least four hours (Kyle et al., 2004a, p. 1226-1243; Brazilian Association of Nutrology and Brazilian Society of Parenteral and Enteral Nutrition, 2009).

Waist and hip circumference - Waist and hip circumferences were measured using a flexible tape measure, with an accuracy of one millimeter according to Heyward and Stolarczyk (1996, p. 76-85). Two measurements (in centimeters) were performed with the individuals standing, facing the examiner, and legs slightly apart. Waist circumference was measured at the midpoint between the inferior border of the lowest rib and the iliac crest, considering the recommendations of the World Health Organization (1995). The hip circumference was measured at the level of the largest lateral extension of the hips, with the participant in the right lateral position and using only the underwear. The waist-hip ratio (WHR) was calculated as the ratio between the waist and hip circumferences. According to the World Health Organization (1998), the cutoff value for the waist/hip ratio is < 0.85 for females and < 1.0 for males, and higher values are associated with health risk.

Spirometry – Spirometry was performed according to American Thoracic Society/European Respiratory Society recommendations (Miller et al., 2005, p. 319-338), with a portable spirometer (ndd, Switzerland). Forced expiratory volume in the first second (FEV1), forced vital capacity (FVC) and FEV1/FVC ratio were measured in absolute and predicted values.

STATISTICAL ANALYSIS

The sample was chosen by convenience, according to the master athletes' registration at the City Sports Department. Data are shown as mean and standard deviation. A questionnaire was used to describe the sample characteristics, the answers were grouped by similarity, and the percentage was calculated Groups were compared using the ordinary one-way ANOVA, and the Bonferroni post-hoc test was used to identify differences between groups. Inferential analyses were conducted using the Statistical Package for the Social Sciences (SPSS, IBM Corp., USA), version 10.0 for Windows, and the level of significance was set at $p < 0.05$ (two-tailed).

RESULTS

The sample consisted of 91 master athletes aged between 60 and 89 years (69.5 ± 6.8 years), male 40.7 %, with a mean weight of 70.2 ± 14.5 kg, height of 161.2 ± 14.5 cm, systolic blood pressure of 132.9 ± 18.6mmHg, and diastolic blood pressure of 79.4 ± 9.7mmHg (prevalence of hypertension of 30%). Most of the spirometric values were normal, except for three athletes who presented obstructive ventilatory disorder (Table 1).

Table 1 shows that the majority of the participants had completed high school (37.4%), followed by primary education (25.3%). Most of the sample received less than five minimum wages per month (US$ 334 at the time of data collection), and 70% were retired.

The subjects trained the respective modalities five to seven times per week (60 minutes per session) and had a practice time of 1 to 3 years (2.08 ± 0.8 years). However, they reported practicing physical activity for 50.7 ± 6.9 years.

The self-reported health status (Table 2) shows a clear trend towards a high prevalence of chronic non-communicable diseases. In particular, 35 cases of hypertension (38.5%), 3 (3,3%) had chronic obstructive pulmonary disease (COPD), and 17% of total reported two or more diseases,

Anthropometric values (in absolute and predicted values) are shown in Table 3. Both groups presented similar age and BMI, normal lean mass index, and females presented a lower waist/hip ratio than males.

Table 4 shows all variables grouped by energy expenditure. Master athletes who performed the most vigorous activities (Group C: > 6.5 METs) presented a significantly higher lean mass percentage ($p < 0,05$) and lower body weight ($p < 0,05$), BMI ($p < 0,05$) body fat percentage ($p < 0,05$), and waist/hip ratio ($p < 0,05$) than master athletes that practiced light and moderate activities (Group A: < 4 METs and Group B: 4 to 6.5 METs, respectively). In addition, diastolic pressure was lower than the group who performed light physical activity (Group A: < 4 METs). Table 5 shows BMI classified according to the cutoff points proposed by the Pan American Health Organization (2001, p. 1-21). The frequency values of waist/hip ratio are shown in Table 6.

DISCUSSION

The present study analyzed the anthropometric profile, health conditions, risk factors, and energy expenditure in METs in three groups of master athletes of different sports from the City of Santos (Brazil). Master athletes who practice exercise with high energy expenditure presented a higher muscle mass and lower BMI, diastolic pressure, and waist/hip ratio than those with low- or moderate-energy expenditure.

The assessment of patients using METs allowed evaluating the real importance of physical activity intensity to some clinical parameters as blood pressure and the distribution of fat and muscle mass in master athletes. The distribution of athletes by physical activity intensity shows that most of the participants performed moderate- or low-intensity activities. Interestingly, despite no significant anthropometric characteristic differences were seen among groups, the mean age was higher in athletes who performed more vigorous intensity. However, the mean age of all groups was > 70 years, and no differences were observed regarding sex, and muscle mass.

Considering the BMI, the master athletes from the physical activity groups who performed < 6.5 METs (Groups A and B) presented a mean value above the normal value, considered as normal by WHO (1998) but within the normal range as considered by the Pan American Health Organization (2001) (cut off value 27 kg/m^2). The PAHO classification was designed for the elderly population of Latin America, which is the case of the study participants. As expected, lung function values were normal, except for three athletes who had chronic obstructive pulmonary disease. It has been observed, as in Hagberg et al. (1988, p. 101-105), that athletes aged > 60 years present higher lung volumes and capacities than those predicted for sedentary individuals. These findings may suggest that regular physical activity may delay the lung function decline observed with aging.

According to Fiatarone-Singh (1998, p. 243-288), body weight is expected to increase between 45 and 50 years and decline after 80 years. With aging, fat mass increases 2.0 to

7.5% of body weight per decade, independent of sex; however, this increase is observed, as in Tchernof and Després (2013, p. 359-404), in males and females aged up to 65 and 75 years, respectively, and decreases afterward. The weight decline is due to the reduced body water percentage and the marked muscle mass loss. A meta-analysis carried out by Fiatarone-Singh (1998, p. 243-288) demonstrated that increased body fat in females after the age of 45 was mainly due to peripheral fat redistribution to the central regions of the body and both visceral and intramuscular fat accumulation, which cannot be measured using skinfold calipers.

The increase in body fat accumulation with age has been carefully described by Spirduso et al. (1995). The android fat distribution (i.e., fat storage in the trunk, chest, back, and abdomen) is more prevalent in males, while females present a gynecoid pattern (fat accumulation in the hips and legs). The intra-abdominal adipose tissue has a considerable active metabolism, leading to increased metabolism of free fatty acids and LDL cholesterol levels. Moreover, the increased abdominal fat mass influences the production of tumor necrosis factor-alpha (TNF-αand interleukin-6 (IL-6), contributing to insulin resistance development, muscle catabolism, and dyslipidemia (Tchernof & Després, 2013, p. 359-404). According to a VIGITEL survey, conducted by the Brazilian Health Ministry, the country is experiencing an alarming situation: 52.5% of the adult population are overweight, and 17.9% of these are obese (Brazilian Health Ministry, 2015).

Soares et al. (2012, p. 1297-1304) suggest that obesity and low weight due to lean mass loss interfere with functional capacity. Therefore, there is an interrelation between physical activity levels and changes in fat, muscle, and bone mass during the aging process (Abbasi et al., 1998, p. 188-193; Hughes et al., 2002, p. 473-481). Nevertheless, active elderly individuals present lower fat mass and higher muscle mass values than those inactive (Kyle et al., 2004b, p. 255-260).

A normal waist/hip ratio was observed in approximately 60% of our master athletes. Hence, according to Heyward and Stolarczyk (1996, p. 76-85), about 40% of the participants presented a high risk of cardiovascular diseases. The World Health Organization (1998) considers the waist/hip ratio a criterion to characterize the metabolic syndrome, considering risk values of > 1.0 for males and > 0.85 for females. Associated with the BMI above normal values (in this case according to the WHO), these results indicate that the group with low and moderate energy expenditure tends to present higher body weight than expected for their height and increased visceral fat accumulation (Fiatarone-Singh, 1998, p. 243-288). Only 11 (12.1%) master athletes presented normal fat levels, and 6 (54.5%) of these were in the > 6.5 METs group. Interestingly, eight athletes (44.4%) in the > 6.5 METs group were underweight, and 13 (72%) presented fat levels within the normal range, indicating that exercise levels > 6.5 METs may be a protective factor. According to Clark et al. (1994, p. 895-896), individuals who have android fat deposition are more likely to present a higher risk of cardiovascular diseases than those with gynoid-type obesity. Therefore, body fat distribution assessed using the waist/hip ratio is an essential predictor of coronary heart disease risk.

The bioimpedance analysis showed a higher lean mass percentage in master athletes who performed activities > 6.5 METs. Lean tissue preservation appears to be dependent on the maintenance of vigorous-intensity training. Laukkanen et al. (1998, p. 141-156) observed that elderly individuals with high physical activity levels presented better health and functional capacity than sedentary elderly.

The maintenance of high-intensity physical activity might be interesting, even without losing weight. A recent analysis performed with 40 thousand people followed for several years showed that all-cause mortality was higher in highly sedentary individuals, and moderate to vigorous physical activity should be encouraged (Ekelund et al., 2020, p. 1499-1507).

Only 17.6% of the master athletes reported two or more diseases (cardiovascular diseases were the most mentioned), which is lower than the prevalence of chronic diseases in the Brazilian elderly population (70%). Diastolic blood pressure in elderly individuals who performed 4 to 6.5 METs and > 6.5 METs was significantly lower than those with energy expenditure < 4 METs. However, the absence of improvements in aortic stiffness suggests that elderly individuals who practice physical activity may be resistant to improvements in systolic blood pressure (Fletcher et al., 2001, p. 1694-1740). The > 6.5 METs group showed increased lean body mass, low body weight, BMI, and waist circumference. Together with low diastolic blood pressure, these findings suggest tan association between physical training and cardiovascular health in the elderly (Fletcher et al., 2001, p. 1694-1740). In general, most cardiac patients initiate the rehabilitation program based on exercises of up to 3 METs and often under medical supervision (Squires et al., 2018, p. 139-146). These patients should be advised to gradually increase the walking speed or intensity to 3.0 - 5.9 METs, as long as they remain asymptomatic (Riebe et al., 2015, p. 2473-2479). Therefore, a better survival is expected for master athletes than physically inactive elderly, mainly due to health, functional capacity, and physical activity levels.

LIMITATIONS

We must consider some study limitations. If nutritional variables were analyzed they would allow us to understand better the effects of physical activity on aging processes related to muscle mass, fat accumulation, and health conditions. Another limitation is related to the cross-sectional design of the study which hinders the establishment of cause-and-effect relationships and the energy expenditure monitoring over time. However, those were not the aim of this study, and the study design performed here is adequate for prevalence studies.

CONCLUSIONS

We conclude that master athletes with high energy expenditure present parameters associated with better health status (i.e., reduced BMI, diastolic pressure, hip-waist ratio, and increased muscle mass) than those with low energy expenditure. Physical activity maintenance throughout life should be encouraged, given its possible health and longevity benefits.

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REFERENCES

Abbasi, A. A., Mattson, D. E., Duthie Jr., E. H., Wilson, C., Sheldahl, L., Sasse, E., Rudman, I. W. (1998). Predictors of lean body mass and total adipose mass in community-dwelling elderly men and women. **The American Journal of the Medical Sciences,** 315(3), 188-193. http://doi.org/10.1097/00000441-199803000-00008

Ainsworth, B., Haskell, W. L., Herrmann, S. D., Meckes, N., Bassett, D. R. Jr., Tudor-Locke, C., Greer, J. L., Vezina, J., Whitt-Glover, M. C., Leon, A. S. (2011). 2011 compendium of physical activities: A second update of codes and MET values. **Medicine and Science in Sports and Exercise,** *43*(8), 1575-1581. http://doi.org/10.1249/MSS.0b013e31821ece12

American College of Sports Medicine. (1995). **Guidelines for exercise testing and exercise prescription.** 5th ed. Malvern and Williams & Wilkins.

Amorim, P. R. S. & Gomes T. N. P. (2003) **Energy expenditure in physical activity: assumptions, measurement techniques and applicability.** Shape.

Blair, S. N., Kampert, J. B., Kohl, H. W., Barlow, C. E., Macera, C. A., Paffenbarger Jr., R. S., Gibbons, L. W. (1996). Influences of cardiorespiratory fitness and other precursors on cardiovascular disease and all-cause mortality in men and women. **Jama,** 276(3), 205-210. http://doi.org/10.1001/jama.1996.03540030039029

Brazilian Association of Nutrology and Brazilian Society of Parenteral and Enteral Nutrition. (2009) Use of Bioimpedance to Assess Body Mass - **Project Guidelines** - Brazilian Medical Association and Federal Council of Medicine. http://www.projetodiretrizes.org.br/8_volume/39-Utilizacao.pdf

Brazilian Health Ministry. (2015). **Vigitel Brasil 2014**: surveillance of risk and protective factors for chronic diseases by telephone survey. Brazilian Health Ministry.

Clark, L. T., Karve, M. M., Rones, K. T., Chang-DeMoranville, B., Atluri, S., Feldman, J. G. (1994). Obesity, distribution of body fat and coronary artery disease in black women. **The American Journal of Cardiology***,* 73(12), 895-896. http://doi.org/10.1016/0002-9149(94)90818-4

Ekelund, U., Tarp, J., Fagerland, M. W., Johannessen, J. S., Hansen, B. H., Jefferis, B. J., Whincup, P. H., Diaz, K. M., Hooker, S., Howard, V. J., Chernofsky, A., Larson, M. G., Spartano, N., Vasan, R. S., Dohrn, I-M., Hagströmer, M., Edwardson, C., Yates, T., Shiroma, E. … Lee, I-M. (2020). Joint associations of accelerometer-measured physical activity and sedentary time with all-cause mortality: a harmonised meta-analysis in more than 44 000 middle-aged and older individuals. **Br J Sports Med.,** 54(24), 1499–1507. http://doi.org/10.1136/bjsports-2020-103270

Fiatarone-Singh, M. A. (1998). **Body composition and weight control in older adults**. Perspectives in exercise science and sports medicine: exercise, nutrition and weight control (Vol. 11). Cooper.

Fletcher, G. F., Balady, G. J., Amsterdam, E. A., Chaitman, B., Eckel, R., Fleg, J., Froelicher, V. F., Leon, A. S., Piña, I. L., Rodney, R., Simons-Morton, D. A., Williams, M. A., Bazzarre, T. (2001). Exercise standards for testing and training: a statement for healthcare professionals from the American Heart Association. **Circulation**, 104(14), 1694-1740. http://doi.org/10.1161/hc3901.095960

França, N. M. & Vívolo, M. A. (1995) Anthropometric measurements**.** In: Matsudo, V., editor. **Sports Science Tests**. 5th ed. CELAFISCS.

Hagberg, J. M., Yerg 2nd, J. E., Seals, D. R. (1988). Pulmonary function in young and older athletes and untrained men. **J Appl Physiol**., 65(1), 101-105. http://doi.org/10.1152/jappl.1988.65.1.101

Hawkins, S. A., Wiswell, R. A., Marcell, T. J. Exercise and the master athlete--a model of successful aging? **J Gerontol A Biol Sci Med Sci**., 58(11), 1009-1011. http://doi.org/10.1093/gerona/58.11.m1009

Heyward, V., Stolarczyk, L. M. (1996). **Anthropometric method**. Applied body composition assessment**.** Human Kinetics.

Hughes, V. A., Frontera, W. R., Roubenoff, R., Evans, W. J., Fiatarone-Singh, M. A. (2002). Longitudinal changes in body composition in older men and women: Role of body weight change and physical activity. **The American Journal of Clinical Nutrition***,* 76(2), 473-481. http://doi.org/10.1093/ajcn/76.2.473

IBGE – Brazilian Institute of Geography and Statistics (2019). http://www.ibge.gov.br.

Kavanagh, T., Shephard, R. J. (1990). Can regular sports participation slow the aging process? Data on masters athletes. **The Physician and Sports Medicine,** 18(6), 94-104. http://doi.org/10.1080/00913847.1990.11710069

Kyle, U. G., Bosaeus, I., De Lorenzo, A. D., Deurenberg, P., Elia, M., Gómez, J. M., Heitmann, B. L., Kent-Smith, L., Melchior, J-C., Pirlich, M., Scharfetter, H., Schols, A. M. W. J., Pichard, C. (2004a). Bioelectrical impedance analysis-part I: Review of principles and methods. **Clinical nutrition,** 23(5), 1226-1243. http://doi.org/10.1016/j.clnu.2004.06.004

Kyle, U. G., Morabia, A., Schutz, Y., Pichard, C. (2004b). Sedentarism affects body fat mass index and fat-free mass index in adults aged 18 to 98 years. **Nutrition**, 20(3), 255-260. http://doi.org/10.1016/j.nut.2003.11.019

Laukkanen, P., Kauppinen, M., Heikkinen, E. (1998). Physical activity as a predictor of health and disability in 75-and 80-year-old men and women: A five-year longitudinal study. **Journal of Aging and Physical Activity**, 6(2), 141-156. https://doi.org/10.1123/japa.6.2.141

Miller, M. R., Hankinson, J., Brusasco, V., Burgos, F., Casaburi, R., Coates, A., Crapo, R., Enright, P., Van der Grinten, C. P. M., Gustafsson, P., Jensen, R., Johnson, D. C., MacIntyre, N., Navajas, D., Pedersen, O. F., Pellegrino, R., Viegi, G., Wanger, J. (2005). Standardisation of spirometry. **Eur Respir J**., 26(2), 319-338. http://doi.org/10.1183/09031936.05.00034805

Mota, J., Ribeiro, J. L., Carvalho, J., De Matos, M. G. (2006). Atividade física e qualidade de vida associada à saúde em idosos participantes e não participantes em programas regulares de atividade física. [Physical activity and health-related quality of life in elderly participants and non-participants in regular physical activity programs.] **Revista Brasileira de Educação Física e Esporte,** 20(3), 219-225. https://doi.org/10.1590/S1807-55092006000300007

Municipal Secretariat of Assistance and Social Development. (2006). **Elderly Guidance Booklet:** Myths and truths about old age - service guide. SMADS.

Netto, M. P. & Filho, E. T. C. (2006). **Geriatrics - Fundamentals, Clinic and Therapeutics** (2nd ed.). Atheneu.

PAHO. (2001). Well-being, Health and Aging in Latin America and the Caribbean - Preliminary Report. In Pan-American Health Organization. (2001). XXXVI Meeting of the Advisory Committee on Health Research - Multicentre Survey, Jul 9-11.

Pate, R. R., Pratt, M., Blair, S. N., Haskell, W. L., Macera, C. A., Bouchard, C., Buchner, D., Ettinger, W., Heath, G. W., King, A. (1995). Physical activity and public health: A recommendation from the centers for disease control and prevention and the American College of Sports Medicine. **Jama,** 273(5), 402-407. http://doi.org/10.1001/jama.273.5.402

Poehlman, E. T., Denino, W. F., Beckett, T., Kinaman, K. A., Dionne, I. J., Dvorak, R., Ades, P. A. (2002). Effects of endurance and resistance training on total daily energy expenditure in young women: a controlled randomized trial. **J Clin Endocrinol Metab**., 87(3), 1004-1009. http://doi.org/10.1210/jcem.87.3.8282

Pollock, M. L., Foster, C., Knapp, D., Rod, J. L., Schmidt, D. H. (1987). Effect of age and training on aerobic capacity and body composition of master athletes. **Journal of Applied Physiology**, 62(2), 725-731. http://doi.org/10.1152/jappl.1987.62.2.725

Riebe, D., Franklin, B. A., Thompson, P. D., Garber, C. E., Whitfield, G. P., Magal, M., Pescatello, L. S. (2015). Updating ACSM's recommendations for exercise preparticipation health screening [published correction appears in Med Sci Sports Exerc. (2016) 48(3), 579]. **Med Sci Sports Exerc**, 47(11), 2473–2479. http://doi.org/10.1249/MSS.0000000000000664

Rising, R., Harper, I. T., Fontvielle, A. M., Ferraro, R. T., Spraul, M., Ravussin, E. (1994) Determinants of total daily energy expenditure: variability in physical activity. **Am J Clin Nutr**., 59(4), 800-804. http://doi.org/10.1093/ajcn/59.4.800

Sesso, H. D., Paffenbarger, R. S., Lee, I-M. (2000). Physical activity and coronary heart disease in men the Harvard alumni health study. **Circulation,** 102(9), 975-980. http://doi.org/10.1161/01.cir.102.9.975

Sipila, S., Viitasalo, J., Suominen, H. (1991). Muscle strength in male athletes aged 70-81 years and a population sample. **European Journal of Applied Physiology**, 63(5), 399-403. http://doi.org/10.1007/BF00364469

Soares, L. D. A., Campos, F. A. C. S., Araújo, M. G. R., Falcão, A. P. S. T., Lima, B. R. D. A., Siqueira, D. F., Fittipaldi, E. O. S., Arruda, S. G. B., Faro, Z. P. (2012). Análise do desempenho motor associado ao estado nutricional de idosos cadastrados no Programa Saúde da Família, no município de Vitória de Santo Antão-PE. [Analysis of motor performance associated with the nutritional status of elderly people registered in the Family Health Program in the city of Vitória de Santo Antão-PE.] **Collective Health and Science**, 17(5), 1297-1304. https://doi.org/10.1590/S1413-81232012000500023

Spirduso, W. W., Francis, K. L., Macrae, P. G. (1995). **Physical dimensions of aging.** Human Kinetics.

Squires, R. W., Kaminsky, L. A., Porcari, J. P., Ruff, J. E., Savage, P. D., Williams, M. A. (2018). Progression of exercise training in early outpatient cardiac rehabilitation: an official statement from the American Association of Cardiovascular and Pulmonary Rehabilitation. **J Cardiopulm Rehabil Prev**, 38(3), 139–146. http://doi.org/10.1097/hcr.0000000000000337

Tchernof, A. & Després, J-P. (2013). Pathophysiology of human visceral obesity: An update. **Physiological reviews**, 93(1), 359-404. http://doi.org/10.1152/physrev.00033.2011

Varo, J. J., Martínez-Gonzáles, M. A., Irala-Estévez, J., Kearney, J., Gibney, M., Martínez, J. A. (2003). Distribution and determinants of sedentary lifestyles in the European Union. **Int J Epidemiol**, 32(1), 138-146. http://doi.org/10.1093/ije/dyg116

WHO. (1984). **The uses of epidemiology in the study of the elderly**: report of a WHO scientific group on the epidemiology of aging. World Health Organization.

WHO. (1995). **Physical status**: The use of and interpretation of anthropometry, report of a WHO expert committee. World Health Organization.

WHO. (1998). **Obesity**: preventing and managing the global epidemic. Report of a WHO consultation on obesity. World Health Organization.

Male Female	37 (40.7%) 54 (59.3%)
	X (DP)
Age years)	69.5 6.8)
Weight (kg)	70.2 (14.5)
Height (cm)	161.2 (14.5)
BMI (kg/m^2)	26.5 (4.0)
Waist circumference (cm)	90.1 (14.8)
Hip circumference (cm)	100.2 (8.9)
Waist/hip ratio (cm)	0.89 (0.14)
Systolic BP (mmHg)	132.9 (18.6)
Diastolic BP (mmHg)	79.4 (9.7)
SpO2 (rest) (%)	95.6 (14.5)
Heart rate (rest) (bpm)	79.5 (20.1)
FVC pre-BD (% predicted)	100.8 (17.1)
FEV1 pre-BD (% predicted)	98.1 (18.6)
FEV1/FVC pre-BD (% predicted)	98.2 (11.8)
FVC post-BD (% predicted)	103.6 (16.9)
FEV1 post-BD (% predicted)	101.4 (18.6)
FEV1/FVC post-BD (% predicted)	97.4 (10.3)
EDUCATIION	**f %**
Elementary School	23 25.3
Junior High School	13 14.3
Senior High School	34 37.4
College and University	21 23.1
ECONOMIC STATUS	
Retired	64 70.3
Income 1-3 minimum monthly wages	7 4.4
Income 3-5 minimum monthly wages	4 8.3
Income > 5 minimum monthly wages	8 8.8

Mean (standard deviation); BMI:body mass index; SpO2: arterial pulse oxygen saturation; FVC: forced vital capacity; FEV1: forced expiratory volume in the first second; BD: bronchodilator. Minimum monthly wage: income related to the minimum salary a worker should receive in Brazil; BP: blood pressure

Table 1 Demographic characteristics of master athletes of the City of Santos, Brazil (N = 91).

ASSOCIATED DISEASES	f	%
Arterial hypertension	35	38.5
Hypercholesterolemia	28	30.8
Leg varices	24	26.4
Osteoporosis	12	13.2
Arthritis	12	13.2
Obesidty	10	11.0
Diabetes	9	9.9
Cardiovascular disease	5	5.5
COPD	3	3.3
Two or more diseases	16	17.6

*COPD: Chronic obstructive pulmonary disease".

Table 2. Frequency of self-reported diseases by master athletes of the City of Santos, Brazil (N = 91).

	Female **X (SD)**	**Male** **X (SD)**
Age (years)	69.1 (7.1)	70.0 (6.5)
Weight (kg)	65.3 (10.9)	77.4 (16.1)
BMI (kg/m^2)	26.6 (3.9)	26.3 (4.2)
Waist circumference (cm)	86.4 (11.5)	95.4 (17.5)
Hip circumference (cm)	100 (8.5)	99.9 (9.6)
Waist/hip ratio (cm)	0.86 (0.09)	0.96 (0.19)
Fat-free mass (kg)	37.8 (4.0)	50.1 (8.0)
Fat-free mass (%)	58.6 (4.6)	65.9 (9.8)
Fat-free mass index (kg/m^2)	15.4 (1.2)	17.1 (2.1)
Fat mass (kg)	27.4 (7.4)	27.3 (11.4)
Fat mass (%)	41.4 (4.6)	34.1 (9.8)
Fat mass index (kg/m2)	11.2 (2.8)	9.2 (3.6)

Mean and standard deviation; BMI: body mass index

Table 3 Anthropometric characteristics of master athletes of the City of Santos, Brazil, according to sex (N = 91).

Variables	< 4 METs (n:15)	4 a 6.5 METs (n:58)	> 6.5 METs (n:18)	P
Male (n %)	8 (53.3%)	20 (34.5%)	9 (50%)	
Female (n %)	7 (46.7%)	38 (65.5%)	9 (50%)	0.273
Age (years)	69.7 (7.2)	68.7 (6.0)	71.7 (8.6)	0.744
Sistólic pressure (mmHg)	135.4 (19.6)	131.7 (16.1)	134.3 (24.9)	0.038
Diastolic pressure (mmHg)	84.9 (11.0)	79.8 (12.1) ‡	79.9 (12.1) ‡	0.02
Weight (kg)	74.4 (11.1)	72.4 (15.1)	59.6 (9.2) *	0.359
Heigth (cm)	165.0 (8.9)	157.7 (7.4)	161.2 (16.9)	0.007
BMI (kg/m²)	27.3 (3.3)	27.1 (4.1)	23.9 (2.9) *	0.419
Waist circumference (cm)	94.3 (10.5)	89.7 (12.8)	87.7 (22.1)	<0.001
Hip circumference (cm)	101.3 (7.8)	102.2 (8.7)	92.8 (6.5) *	0.11
Waist/hip ratio (cm)	0.93 (0.09)	0.88 (0.09)	0.95 (0.27)	0.109
Fat-free mass kg)	46.0 (7.4)	42.9 (9.1)	39.7 (6.0)	0.001
Fat-free mass (%)	62.0 (7.1)	59.7 (7.0)	67.2 (9.2) *	0.302
Fat-free mass index (kg/m²)	16.7 (1.4)	16.0 (2.0)	15.9 (1.3)	<0.001
Fat mass (kg)	28.5 (7.6)	29.5 (9.0)	19.9 (7.4)	0.001
Fat mass (%)	38.0 (7.0)	40.3 (7.0)	32.8 (9.3)	0.002
Fat mass index (kg/m2)	10.5 (3.0)	11.1 (3.2)	8.0 (3.0)	

‡ p < 0,05 vs groups < 4 METs; * p < 0,05 vs groups < 4 METs and 4 to 6 METs; mean and standard deviation; BMI: body mass index

Table 4. Variables according to METs *(metabolic equivalent task)* for physical activity by master athletes of the City of Santos, Brazil (N = 91).

	Female (n=54)		**Male** (n=37)	**p**
Underweight	9 (16.7)		8 (21.6)	
Normal weight	27 (50.0)		19 (51.4)	0,748
Overweight and obese	18 (33.3)		10 (27)	
	< 4 METS (n:15)	**4 to 6 METS** (n: 58)	**> 6,5 METS** (n: 18)	p
Underweight	1 6.7%	8 13.8%	8 44.4%	
Normal weight	7 46.7%	31 53.4%	8 44.4%	0.016
Overweight and obese	7 46.7%	19 32.7%	2 11.2%	

OPAS - body mass index (underweight: < 23 kg/m², normal weight: 23 – 27,9 kg/m², overweight: 28 – 29.9 kg/m², obese: > 30 kg/m²).

Table 5. BMI classified according to the cutoff points proposed by the Pan American Health Organization (OPAS, 2002) [23].

Waist/hip ratio	**Female**	**Male**	**p**
Normal	24 (44.4)	32 (86.5)	< 0.001
High	30 (55.6)	5 (13.5)	

Waist/hip ratio	**METS**			**p**
	< 4 METS	**4 to 6 METS**	**> 6,5 METS**	
Normal	9 60.0%	37 63.8%	10 55.6%	0.814
High	6 40.0%	21 36.2%	8 44.4%	

WHO cut off points: male (favorable: < 1,0 and unfavorable: > 1.10) – female (favorable: < 0.85 and unfavorable: > 0.85)

Table 6. Waist/hip ratio according to the cut off points by the World Health Organization (1998).