Cardiorespiratory fitness and body fat distribution in women with 50 years or more

CAPACIDADE CARDIORRESPIRATÓRIA E DISTRIBUIÇÃO DE GORDURA CORPORAL DE MULHERES COM 50 ANOS OU MAIS

CAPACIDAD CARDIORRESPIRATORIA Y DISTRIBUCIÓN DE LA GRASA CORPORAL EN MUJERES CON 50 AÑOS O MÁS

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ABSTRACT

To verify the relationship between cardiorespiratory fitness and body fat in women. Evaluations were performed on 229 women with ages ranging between 50 and 84 years. Anthropometric assessment was performed and waist/hip ratio and conicity index values were obtained. The cardiorespiratory fitness was evaluated by the six minutes walk test and one pedometer was used to evaluate the speed, length, and total number of steps. The results were distributed in quartile, and interquartil comparison was performed by means of analysis of variance with post-hoc test. The relationship between the six minutes walk test and anthropometrics was identified using the Pearson's correlation coefficient. Results showed that women with cardiorespiratory fitness in the quartile4 were younger than those in quartile1 ($p \leq 0.05$). The anthropometric variables values were lower ($p \leq 0.05$) for results in the quartiles3 and 4 compared to those in quartiles1 and 2. In conclusion, women with higher adipose tissue and central fat accumulation presented lower cardiorespiratory fitness.

KEY WORDS

Women.
Physical fitness.
Body composition.
Risk.

RESUMO

Verificar a relação entre capacidade cardiorrespiratória e gordura corporal em mulheres. Foram analisadas 229 mulheres com idade entre 50 e 84 anos. Foi realizada avaliação antropométrica e calculada a razão cintura/quadril, bem como o índice de conicidade. A capacidade cardiorrespiratória foi avaliada pelo teste de caminhada de seis minutos. Com o pedômetro foi possível avaliar: velocidade, comprimento da passada e total de passos. Os resultados foram distribuídos em quartil, e a comparação feita pela análise de variância com post-hoc. A relação entre teste de caminhada de seis minutos e a antropometria foi feita pela correlação de Pearson. Os resultados revelaram que mulheres com capacidade cardiorrespiratória no quartil4 apresentaram idade estatisticamente menor ($p \leq 0,05$) que as do quartil1. As medidas antropométricas apresentaram valores menores ($p \leq 0,05$), quando comparados os resultados dos quartis3 e 4 com os quartis1 e 2. Conclui-se que mulheres com maior tecido adiposo e acúmulo de gordura central apresentam menor capacidade cardiorrespiratória.

DESCRITORES

Mulheres.
Aptidão física.
Composição corporal.
Risco.

RESUMEN

Verificar la relación entre capacidad cardiorrespiratoria y grasa corporal en mujeres. Fueron estudiadas 229 mujeres con edades entre 50 y 89 años. Fue realizada una evaluación antropométrica, comprobada la razón cintura/caderas y calculado el índice de conicidad. La capacidad cardiorrespiratoria fue ponderada por test de caminata de seis minutos. Con el podómetro fue posible evaluar: velocidad, distancia y cantidad total de pasos. Los resultados fueron agrupados por cuartiles, y la comparación se realizó por Análisis de Varianza con post-hoc. La relación entre el test de caminata de seis minutos y la antropometría fue normalizada por la Correlación de Pearson. Los resultados demostraron que las mujeres con capacidad respiratoria en el cuartil 4 tenían estadísticamente una edad inferior ($p \leq 0.05$) que aquellas del cuartil 1. Las medidas antropométricas presentaron valores menores ($p \leq 0.05$) al compararse los resultados de los cuartiles 3 y 4 con los correspondientes a los cuartiles 1 y 2. Se concluye que las mujeres con mayor cantidad de tejido adiposo y acumulación de grasa en zona central presentan inferior capacidad cardiorrespiratoria.

DESCRIPTORES

Mujeres.
Acondicionamiento físico.
Composición corporal.
Riesgo.

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INTRODUCTION

Some characteristics that follow the aging process are progressive reductions in the cardiorespiratory fitness, mobility, muscle endurance and strength, which compromise the performance of tasks in the daily life routine[1]. These reductions are associated to the reduction of the muscle mass/strength, known as sarcopenia[2]. Among older people, sarcopenia is strongly associated to lesser autonomy, since it significantly compromises the free movement of this part of the population.

For different professionals from the health area, one of the most used methods to evaluate the effects of sarcopenia over the cardiorespiratory fitness and the motor performance is the six-minute walking test (6MWT)[3], which presents good correlation to the maximum consumption of oxygen[4]. It is simple, safe, low cost and easy to apply[3] and may be executed both by healthy people[5] and patients with heart diseases[6] or chronic obstructive pulmonary disease (COPD)[7].

Similarly to sarcopenia, another characteristic that follows the aging process is the increase of body fat, especially that located in the central region of the body[8], which is more associated to the occurrence of heart diseases than to the total body fat itself[9].

Even though the influence of the accumulation of body fat in the abdominal region over the prevalence of chronic diseases is well established in the specialized scientific literature and the consequences of sarcopenia over the cardiorespiratory fitness are already known, there is still no clear standpoint on the interaction between the distribution of fat, predominantly central, and the cardiorespiratory fitness among older people.

Amongst older populations, this information may indicate the potential of the 6MWT as an indicator of cardiovascular risk, since if there is really a relation between a better performance at the 6MWT and lesser accumulation of fat in the trunk region; low scores at the 6MWT could be used by health professionals as a simple tool for diagnosing populations in higher level of health risk.

OBJECTIVES

Therefore, the purpose of this study was to verify if different results in the walking test reflect differences in indicators of cardiovascular risk, as well as to verify if there is a relation between the cardiorespiratory fitness, evaluated through the 6MWT, and the distribution of body fat in women with 50 years of age or more.

METHOD

Sample

The sample of the present study comprised 229 women who were at least 50 years old (analyzed sample: 50 to 84 years old), participated in the project Open University Program for Senior Citizens (Universidade Aberta à Terceira Idade - UNATI), developed at UNESP (Universidade Estadual Paulista), and in programs of preventive medicine in two private health insurance plans of the city Presidente Prudente-SP.

The subjects were invited to participate in the present study and the necessary clarification was provided regarding the purposes and methodology employed for data collection. Only those who signed the *Term of Free and Clarified Consent* were part of this sample. The study project was approved by the Committee of Ethics in Research of the FCT/UNESP, according to the process no. 188/2007. The study excluded subjects who presented clinical problems that did not allow them to make any physical effort or orthopedic problems that compromised the execution of the walking test.

Similarly to sarcopenia, another characteristic that follows the aging process is the increase of body fat...

Indicators of body composition

The weight was obtained through the use of a Filizola® pendulum scale, with the accuracy of 0.1kg. The height was measured through a stadiometer, with the accuracy of 0.1cm. In both cases the subjects stood up, with their weight distributed equally on both feet, in orthostatic position, heels in contact with each other, arms relaxed and next to the trunk, head position in relation to the Frankfurt plane and breathing normally.

In order to have the circumferences of their waist and hips measured, the subjects would stand up, breathing normally and with their arms relaxed next to the trunk. All records were made at the end of a regular exhalation and expressed in centimeters. Both measures of circumferences were taken with a Sanny® metallic measuring stick, which was 2m long and had the accuracy of 0.1cm.

The measure of the waist circumference (WC) was taken with the measuring stick placed in the shorter circumference, between the iliac crest and the last rib. The hip circumference (HC) was measured with the metallic measuring stick placed in the longer circumference, at the height of the gluteus maximus.

The triceps skinfold (TSF) was measured in the right half-body, adopting the median value. Finally, a Lange® adipometer (*Cambridge Scientific Industries*), with accuracy in millimeters (mm) was also used. All methodological procedures regarding

the collection of the anthropometric variables were performed as described in the literature[10]. The body mass index was calculated by dividing the body weight, in kilograms, by the height, in meters, raised to the power of 2 ($IMC=P/A^2$).

The distribution of the body fat was calculated through the Waist/Hip Ratio (WHR), dividing the measure of the WC by the HC and by the conicity index (CONI), obtained through the formula: $CONI = CC/\{0.109[v(Weight/Height)]\}$.

Indicators of physical fitness

The 6MWT was performed on a flat track of 150 meters, which was marked every 5 meters. The subjects were instructed to walk as fast as they could, during six minutes. During the test, an instructor monitored the subject and encouraged him verbally.

The quantity of steps during the test was registered through a pedometer (Model NL-2000, New Lifestyles Inc, MO). The device was placed on the subject's waist and started at the beginning of the test, the value corresponding to the number of steps was then checked right after the test finished. These records allowed to measure the number of steps, the walking speed (meters/second) and the length of the steps (meters). All anthropometric measures and the 6MWT were executed by previously trained examiners.

Statistical analysis

The mean and the measures of dispersion, standard deviation and confidence interval of 95% were calculated for all motor and anthropometric variables. All variables related to the 6MWT were distributed in quartiles (Q), according to their respective percentilar value (P), as it follows: Q_1 (P_0-$P_{24,9}$), Q_2 (P_{25}-$P_{49,9}$), Q_3 (P_{50}-$P_{74,9}$), Q_4 (P_{75}-P_{99}).

For the purpose of the statistical analysis, the variables regarding the 6MWT (cardiorespiratory fitness) were considered dependent: walked distance (m), number of steps, step length (cm) and walking speed (meters/second). This procedure was adopted according to the hypothesis that its results would be influenced by the indicative measures of body fat distribution (waist circumference, waist/hip ratio and conicity index), considered independent variables. The variance analysis (One-Way ANOVA) was used to compare the means according to the interquartil values ($Q_1xQ_2xQ_3xQ_4$) of the dependent variables, complemented with a LSD (least significant difference) post-hoc test. Pearson's correlation coefficient was applied in order to verify the correlation among the variables - age, anthropometrics and the variables regarding the 6MWT. The software Statistical Package for Social Science (SPSS®: version 10.0) was used for the calculations. The significance level of 5% was adopted for all statistical analysis.

RESULTS

Table 1 presents the descriptive results regarding the studied variables, with their respective values for means, standard deviation, minimum, maximum and confidence interval of 95%.

Table 1 - Descriptive statistics of the studied variables - Presidente Prudente, SP - 2007

	Mean ± SD	Minimum	Maximum	CI 95%
Age (years)	63.57 ± 7.36	50	84	62.61 - 64.53
Weight (kg)	67.12 ± 11.91	39.4	105.7	65.57 - 66.67
Height (cm)	156.34 ± 6.20	140.9	173.0	155.54 - 157.15
BMI (kg/m^2)	27.41 ± 4.34	17.26	40.27	26.84 - 27.97
TSF (mm)	26.52 ± 5.95	12	44	25.74 - 27.29
WC (cm)	87.53 ± 10.96	55	124	86.11 - 88.96
WHR	0.86 ± 0.07	0.677	1.145	0.85 - 0.87
Conicity	1.23 ± 0.09	0.90	1.48	1.22 - 1.24
6MWT (meters)	531.67 ± 80.2	300	720	521.23 - 542.12
Total steps	772.85 ± 66.6	469	970	764.18 - 781.52
Speed (m/s)	1.48 ± 0.22	0.83	2.00	1.45 - 1.51
Step length (cm)	69 ± 0.08	41	93	68 - 70

SD=Standard Deviation; CI=Confidence Interval; BMI=Body Mass Index; TSF=Triceps Skinfold; WC=Waist Circumference; WHR=Waist Hip Ratio; Conicity=Conicity Index; 6MWT=Six-Minute Walking Test.

Table 2 presents the results from the comparison of the variables indicating body fat according to the age group.

It is possible to observe that only the comparison of the WHR between women from 60-69 years old and those aged =70 years old and the comparison of the conicity index between women aged ≥ 70 years old and those in the other age groups presented statistical differences.

This fact indicates that, in a general way, the total body fat did not increase in the older groups and, therefore, it was decided to use the whole group, regardless the age, for comparing the results according to the interquartil values.

Table 2 - Mean values and standard deviation for the studied variables of women with at least 50 years of age - Presidente Prudente - 2007

	Group I (n= 83) 50-59 years Mean (SD)	Group II (n= 92) 60-69 years Mean (SD)	Group III (n= 54) ≥ 70 years Mean (SD)
BMI (kg/m²)	27.4 (4.1)	27. (4.3)	27.9 (4.7)
TSF (mm)	27.2 (6.1)	25.8 (5.4)	26.7 (6.6)
WC (cm)	87.1 (11.1)	86.4 (10.4)	90.1 (11.4)
WHR	0.85 (0.08)	0.85 (0.07)	0.88 (0.07)[b]
Conicity	1.22 (0.09)	1.22 (0.08)	1.26 (0.10)[ab]

BMI=Body Mass Index; TSF=Triceps Skinfold; WC=Waist Circumference; HC=Hip Circumference; WHR=Waist Hip Ratio; Conicity=Conicity Index; a= different from Group I and b= different from Group II

The variables related to the 6MWT were distributed in quartiles and the comparisons are presented in Table 3. According to the comparisons made, the first observation to be mentioned refers to the average age, which was statistically lower ($p \leq 0.05$) than those that presented results of cardiorespiratory fitness located in the quartile 4, in relation to those in the quartile 1. The average age of those who presented the total number of steps and number of steps by second according to the quartile 3 was also statistically lower ($p \leq 0.05$) than that in the quartile 1.

Regarding the step length, there was no interquartil statistical difference observed according to the age, not even when considering the anthropometrical measures of the quartiles 2 and 4, in relation to the quartile 1, except for the Triceps Skinfold (TSF), which was statistically lower ($p \leq 0.05$).

Table 3 - Mean and standard deviation of the variables: age and anthropometrics according to the cardiorespiratory fitness, divided by quartile and number of subjects per quartile - Presidente Prudente, SP - 2007

	Age	BMI	TSF	WC	WHR	CONI
Distance (m)						
Q_1	65.9±7.5	28.6±4.4	28.6±6.5	90.2±9.7	0.86±0.06	1.24±0.07
Q_2	64.1±7.8	27.6±5.1	26.6±6.1	88.1±11.2	0.85±0.06	1.24±0.09
Q_3	63.5±7.7	27.2±4.4	25.3±5.6[1.2]	87.7±12.1	0.87±0.09	1.23±0.11
Q_4	60.8±5.5[1.2.3]	26.2± 3.2[1]	25.6±5.1[1]	84.2±10.0[1]	0.84±0.07	1.20±0.09
Total Number of Steps						
Q_1	66.4±7.9	27.9±4.6	27.4±5.8	90.6±10.7	0.88±0.06	1.26±0.08
Q_2	64.3±7.3	28.5±4.6	27.2±6.2	90.3±11.3	0.85±0.07	1.24±0.09
Q_3	62.3±7.2[1]	27.0±4.0	26.3±5.9	85.8±9.8[1.2]	0.85±0.08	1.22±0.09[1]
Q_4	61.5±6.0[1.2]	26.3±4.0[2]	25.3±6.0	83.7±10.8[1.2]	0.85±0.08	1.20±0.09[1]
Speed (m/s)						
Q_1	66.0±7.6	28.8±4.3	28.9±6.0	90.5±9.9	0.86±0.06	1.24±0.07
Q_2	64.3±7.9	27.8±5.1	26.8±6.5	88.7±10.9	0.86±0.07	1.24± 0.08
Q_3	63.3±7.3	26.9±4.1[1]	25.1±5.4[1]	87.0±12.0	0.86±0.08	1.23± 0.11
Q_4	60.8±5.6[1.2]	26.2±3.2[1.2]	25.6±5.1[1]	84.1±10.1[1.2]	0.84±0.07	1.20±0.09[1.2]
Step Length (cm)						
Q_1	65.4±7.4	28.4±4.6	28.3±6.7	88.6±10.3	0.85±0.06	1.23±0.07
Q_2	63.5±7.5	27.6±4.8	26.1±6.4[1]	88.0±11.5	0.86±0.08	1.24±0.09
Q_3	63.2±8.0	27.1±4.3	26.3±5.3	88.2±11.1	0.87±0.08	1.25±0.10
Q_4	62.0±6.2	26.3±3.2	25.2±4.8[1]	85.2±10.9	0.85±0.07	1.21±0.09

Superscript numbers ([1, 2, 3] and [4]) represent, respectively, statistically significant differences of the respective variables regarding the other quartiles (Q_1, Q_2, Q_3 and Q_4).

As for the other anthropometrical measures, no statistically significant differences were found between the subjects who presented results classified at the quartiles 1 and 2. Almost all anthropometrical measures presented statistically lower values ($p \leq 0.05$) when compared to the results of the quartiles 3 and 4 of the variables of motor performance to the results of the quartiles 1 and 2 with exception for the Waist Hip Ratio. The Conicity Index (CONI) did not present any interquartil significant difference in the comparisons of the results for walked meters as well.

Table 4 presents the coefficients of correlation among the results of the variables regarding the cardiorespiratory fitness to the age and the indicators of adiposity and cardiovascular risk. The age and indicative measures of body fat and cardiovascular risk presented negative and signifi-

cant correlation ($p \leq 0.05$) with almost all parameters of the cardiorespiratory fitness.

The WHR was the variable that indicated less significant correlations to the cardiorespiratory fitness, presenting statistical correlation only to the number of steps and the steps per second. The CONI did not present statistical correlation only to the step length.

Table 4 - Correlation among the cardiorespiratory fitness, age and anthropometrical variables - Presidente Prudente, SP - 2007

	Age	BMI	TSF	WC	WHR	CONI
Distance (m)	-0.24*	-0.24*	-0.25*	-0.22*	-0.09	0.18*
Number of Steps	-0.22*	-0.13*	-0.15*	-0.21*	-0.14*	-0.20*
Speed (m/s)	-0.24*	-0.24*	-0.25*	-0.22*	-0.09	-0.18*
Step Length	-0.16*	-0.22*	-0.21*	-0.14*	-0.02	-0.08

BMI=Body Mass Index; TSF=Triceps Skinfold; WC=Waist Circumference; WHR=Waist Hip Ratio; Conicity=Conicity Index; *$p \leq 0.05$.

DISCUSSION

Cross-sectional study involving 229 women with at least 50 years of age indicating significant influence of the body composition to the cardiorespiratory fitness.

It was possible to observe that the age may have negative influence over the cardiorespiratory fitness. Similar results were also observed in another recent study[11], with subjects from 18 to 80 years old, both male and female. One of the possible explanations refers to the progressive reduction of lean muscle mass as age advances (sarcopenia), which has already been described in the literature[12-13]. These evidences are clearer for older groups, since women who presented the best results of cardiorespiratory fitness also presented lower average age.

In the present study, besides the shorter walked distance, older women also presented a lower number of steps, as well as lower speed. Such data may be additional indicators of the negative role of aging over the reduced muscular strength, pulmonary function and cardiac fitness[7]; physical characteristics that negatively compromise the autonomy of these people. In this context, it is possible to observe that, among women, age was a variable of significant impact over the physical health indicators and, therefore, it needs to be further studied in the Brazilian population.

Regarding the indicators of total adiposity (TSF and BMI) and cardiac risk (WC, WHR and CONI), women who presented the lowest values in these indicators also presented the highest values of cardiorespiratory fitness, indicating that people with high values of total and central body fat present poorer cardiorespiratory fitness. The correlation analysis reinforces these findings, since it indicates that age and indicators of total and central adiposity are correlated, in a negative and significant way, to almost all indicators of cardiorespiratory fitness. Furthermore, these evidences are similar to previous findings observed among North American adolescents[8] and Brazilian adults[14-15], indicating that this inverse relation already exists among younger populations and seems to exist regardless the age.

In addition, these evidences allow to infer that women who present the worst results in the 6MWT are the same who present a greater probability of suffering a cardiac event, not only because of the poorer cardiorespiratory fitness, but also because of their higher total and central fat values. Similar results were reported by a previous study[15], in which poorer performance at the 6MWT was observed among subjects with overweight and obesity.

Besides its relation to health, these findings have relevance due to the fact that the poorer performance affects also the autonomy of movements, which will consequently affect the life quality of these subjects. These data agree to the already existing data, indicating that older subjects must be stimulated in different aspects, both in the physical, as showed by this study, and in the cognitive, as observed by other researchers[16].

Some limitations must be presented so that future studies may advance based on the findings here exposed. The first limitation refers to the lack of information regarding the national literature, which caused the execution of comparisons to be made with different age groups, as well as with both genders. In addition, the fact that the cross-sectional model was used limits the establishment of cause and effect relations between cardiorespiratory fitness and body fat, and therefore conclusions can only be made by the existence of a relation between the variables. Therefore, the development of new studies is suggested in order to analyze, in a longitudinal way, the effects of aging over the different indicators of cardiovascular risk and physical fitness related to health (cardiorespiratory fitness, muscle strength, body composition and flexibility) in samples of subjects with similar age to the ones studied here.

CONCLUSION

The presented results allow the conclusion that, in the analyzed women, the cardiorespiratory fitness presented a positive correlation to the total body fat (represented by the body mass index and the triceps skinfold) and central body fat (represented by the waist circumference, the waist/

hip ratio and the conicity index); and those who presented the worst performance at the cardiorespiratory fitness test also presented greater cardiovascular risk. These results suggest that the association between poor cardiorespiratory fitness and the excess of body fat may increase the risk of developing several chronic diseases in women. Nevertheless, according to the presented limitations, the development of studies of this nature is recommended, with a longitudinal design, using more accurate measures of cardiorespiratory fitness and body composition.

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