Influence of the level of physical activity over the cardiorespiratory capacity in older women*

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ABSTRACT

As age progresses, a decrease of daily activities and reduction of functionality where the cardiorespiratory capacity may be considered one of the most affected components, is faced. The aim of this study was to examine the association between level of physical activity and cardiorespiratory capacity in older women. Nine hundred and sixty women age above 60 years, non-institutionalized, divided in five age groups were evaluated: F1 (60-64 years; n = 286); F2 (65-69 years; n = 295); F3 (70-74 years; n = 207); F4 (75-79 years; n = 120) and F5 (> 80 years; n = 52). The level of physical activity was determined from the *Modified Baecke Questionnaire for Older Adults*, consisting of domestic, sports and recreational activities, in which the level of total physical activity was classified by the sum of these three components. The cardiorespiratory capacity was measured with the Six-Minute Gait Test. The cardiorespiratory capacity decreased an average of 24.5% and the level of physical activity 18.0% in this study. When examining the influences of the terciles of the level of physical activity concerning the cardiorespiratory capacity, the analysis of variance demonstrated that the superior tercile of the total physical activity level was the one which presented the lowest decrease in the cardiorespiratory capacity of 16.7%. However, the sports category of the physical activity level demonstrated differentiated values in the reduction of the cardiorespiratory capacity, where the non-practitioner of physical exercises sub-group presented the highest decrease of 18.6%, while the moderate practitioner sub-group decreased 16.3%, revealing hence the positive influence of moderate physical exercises practice over the cardiorespiratory capacity ($p < 0.05$). Higher physical activity, especially higher sports physical activity, may attenuate the decrease of cardiorespiratory capacity in older women, since women practitioners of moderate physical activities presented lower reduction of such capacity. Increase of physical activities is recommended, especially regular physical exercises, in order to attenuate the decrease of cardiorespiratory capacity, consequently aiding the maintenance of an independent life.

Keywords: Aging. Physical activity. Exercise.

INTRODUCTION

The cardiorespiratory system is considered one of the organic systems mostly affected by functional decline[1-3]. As age progresses, the ability to pick up and transport oxygen for the supply of the body metabolic demand during sustained physical activity becomes decreased[2,4-5], negatively influencing health as well as life quality of the elderly. Consequently, the maintenance of a suitable level of cardiorespiratory fitness (CRF) is essential for the independence, attenuation of fragility and prevention of dependence[6]. The CRF has been considered one of the main responsible factors for the loss of independence in the elderly[8]. Moreover, a satisfactory level of CRF presents a relevant impact on the decrease of risk for morbidity and/or mortality for all causes as well as for coronary diseases[9-11].

The decline verified in CRF is influenced by several factors, including the level of physical activity (LPA)[12]. A relative estimated decline rate in CRF of 10% per decade was verified both in individuals with low LPA as well as in individuals with high LPA[12-14]. More active individuals such as endurance master athletes, presented reductions in LPA of about 5% to 7% per decade, approximately the half of the rate observed in less active individuals[12,15-16]. Consequently, the amount of time spent in more vigorous physical activities decreases as age progresses and can be able to reduce mobility performance[17], as well as a transition to less intense activities seems to naturally occur, partially explaining the decline in CRF[4]. Therefore, the ability to maintain an increased level of LPA seems to be a critical fact in the maintenance of a suitable CRF in older subjects[12].

Studies involving the association between LPA and CRF in different age groups of the older population are found in the scientific literature[12-16,18]. Nonetheless, few studies have tried to investigate the association between LPA categories (domestic, recreational and sports) and CRF in this population[2]. Therefore, the aim of the present study was to investigate the extent of association between LPA and its categories with CRF, as well as to analyze the LPA influence and its categories over CRF of older women.

METHODS

Sample

The present study was conducted between March and September, 2005, in the city of Curitiba – Paraná state, being part of the Independent Project for the Third Age (Research Center in Exercise and Sport – Paraná Federal University). The study's subjects are older individuals who participate in community groups in the Curitiba city. The chosen groups were raffled among those which were constant in data provided by many institutions which promote several activities for the elderly in the city of Curitiba, Paraná.

The sample consisted of 960 women, age above 60 years, non-institutionalized (68.8 ± 5.9 years). In order to analyze the investigated variables, the sample was divided in five age groups: F1 (60-64 years; n = 286); F2 (65-69 years; n = 295); F3 (70-74 years; n = 207); F4 (75-79 years; n = 120) and F5 (> 80 years; n = 52).

After detailed clarification about the aims of this investigation, used procedures, benefits and possible risks, the subjects signed a consent form conditioning their participation as volunteers. The research protocol was approved by the Ethics Committee of the Biological Sciences Sector of the Paraná Federal University, ac-

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Received in 11/1/06. Approved in 4/10/06.

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cording to the norms established in the 196/96 Resolution form the Health National Council about research in humans.

The exclusion criteria were: the individuals who were not able to complete the 6-minute walk test (n = 11); women with disturbs of any nature which hamper them from performing the suitable fulfillment of the proposed tasks, or did not participate in the evaluations developed by the Independent Project for the Third Age.

Procedures

All evaluations were performed in a same period of the day (between 08:00 and 10:00 o'clock) in order to avoid the influence of circadian variations. The participants were instructed not to perform vigorous physical activity the previous day, as well as not to ingest food for a period of two hours prior to its beginning. All evaluations were performed in the Department of Physical Education of the Paraná Federal University. Anthropometric variables were collected; the six-minute walk test was applied as well as a questionnaire in an interview format was administered.

Anthropometric variables

The anthropometric variables were obtained according to procedures proposed by Lohman *et al.*[19]. In order to have height determined (in cm), the evaluated individual remained in orthostatic position, barefeet, with feet united, wearing the least clothes as possible. Besides that, she should be in inspiratory apnea and with head oriented at 90º according to Frankfurt plan, with heel, pelvic waist, scapular waist and occipital region surfaces in contact with the measurement instrument (SANNY stadiometers, STANDARD model, 0.1 centimeter precision), which was connected to the wall. Body mass (BM, in kilograms) was measured with the evaluated individual remaining in orthostatic position, barefeet, and wearing the least clothes as possible. The body mass should be distributed between the lower limbs during the time spent on the platform of the measurement instrument (TOLEDO digital scale, model 2096 PP; 0.1 kilograms precision). The body mass index (BMI) was obtained with the use of the body mass/height^2 quotient, where the body mass value is expressed in kilograms and the height in meters.

Cardiorespiratory fitness

The six-minute walk test (WT6) was conducted according to standardization proposed by Rikli and Jones[20], being conducted on a rectangular area of 54.4 meters (18.0 m long x 9.2 m wide). After brief instruction on the test's procedures, the individual would stand behind a line which signaled the starting point. When the main evaluator gave the starting signal, the subject should walk the longest distance as possible within the six minutes. These minutes were timed by a second evaluator (TIMEX timer, model 85103). The subjects could reduce velocity or even end the test performance if any of the following symptoms were felt: dyspnea; dizziness and chest, head or legs pain. The test result was obtained in meters completed in the six minutes time. According to Rikli and Jones[6], the WT6 presents a considerable correlation with the submaximal test on treadmill ($0.71 < r < 0.82$), test-retest reproducibility ($0.88 < r < 0.94$) and validity, being able to be considered a reliable indicator of cardiorespiratory fitness in older subjects.

Physical activity level

Data were obtained after administration of the *Modified Baecke Questionnaire for Older Adults*, according to standardization by Voorrips *et al.*[21] and adapted for older subjects. This research instrument consists of 12 items, involving routine domestic (D_LPA), recreational (R_LPA) and sports physical activities (S_LPA). All evaluators were previously trained with the purpose to decrease the inter-evaluator variability. Despite the evident limitations due to the subjectivity applied in the questionnaire's answers, even though this research instrument has presented correlation with other quantification methods of physical activity[17], such as the 24-hour record of activities (r = 0.78) and pedometer (r = 0.72). Moreover, the *Modified Baecke Questionnaire for Older Adults* presents considerable reproducibility (r = 0.89) in older subjects[22].

Three groups (low, moderate and high LPA) were made through a percentil division with the aim to investigate the association between different LPAs and CRF In addition to that, of the LPAs categories, the S_LPA was subdivided in three categories according to score obtained in the *Modified Baecke Questionnaire for Older Adults* (activity x duration x frequency): points = 0.0 (non-participant in sports activities), points from 0.0 to ≤ 5.0 (low intensity of S_LPA) and points > 5.0 (moderate intensity of S_LPA). Individuals with high S_LPA were not found.

Statistical analysis

All analyses were conducted with the use of the *Statistical Package for the Social Sciences* (SPSS, 13.0) *for Windows*. Firstly, the *Kolmogorov Smirnov*.normality test was applied followed by the mean value and standard deviation for the determination of the descriptive values. In order to obtain a suitable data analysis, the age variable was categorized in five groups. According to Reijneveld[23], the use of half-decade age groups seems to be ideal in epidemiological studies, since it avoids the possibility of age influence over the investigated variables within the same age group. One-way ANOVA was used with the purpose to verify whether there were significant differences between the investigated groups. Later, to detect the site of these differences, the *post hoc* Tukey analysis was applied. The *Pearson* correlation coefficient was used in order to determine the degree of association among the variables. The significance level adopted was of 0.05.

RESULTS

The anthropometric characteristics of the studied population are presented in table 1. A decrease in the mean values of body mass and height, and consequently the body mass index (BMI) also declined with age progression; however, this value was not significant. Body mass significantly decreased between the 60-64 (70.2 ± 13.1) and 65-69 groups (69.1 ± 12.3) for the latter (62.2 ± 11.1 kg). Height decreased between younger women (155.9 ± 6.2) when compared with older ones, from 75 years (153.9 ± 5.3 and 152.4 ± 5.7 cm).

TABLE 1
Anthropometric characteristics, divided by age groups

Age group	60-64 (n = 286)	65-69 (n = 294)	70-74 (n = 206)	75-79 (n = 117)	> 80 (n = 46)
Body mass (kg)	70.2 ± 13.1	69.1 ± 12.3	67.4 ± 11.3	66.6 ± 11.2	62.2 ± 11.1*†
Height (cm)	155.9 ± 6.2	154.9 ± 6.7	154.7 ± 5.5	153.9 ± 5.3*	152.4 ± 5.7*
BMI (kg/m^2)	28.8 ± 4.9	28.7 ± 4.8	28.1 ± 4.5	28.1 ± 4.6	26.7 ± 4.1*

* – different from the 60-64 age group, $p < 0.05$;
† – different from the 65-69 age group, $p < 0.05$.

Table 2 describes CRF behavior, measured through the six-minute walk test. As age progresses, this variable declined 18.6% of F1 (523.0 ± 67.1) for F5 (426.1 ± 73.20 m).

Table 3 presents the descriptive values – mean value and standard deviation; the Level of Physical Activity; which was called Total Level of Physical Activity (T_LPA), for being the value of the sum of three categories – Domestic Level of Physical Activity (D_LPA); Sports Level of Physical Activity (S_LPA) and Recreational Level of Physical Activity (R_LPA). The mean values demonstrate a decline from the first to the last age group in all categories, with the ex-

ception of the R_LPA; such increase was not significant, though. The decline of the S_LPA presented similarities to the T_LPA, while the D_LPA demonstrated greater decreases among the age groups.

TABLE 2
Six-Minute Walk Test (WT6), divided by age group

Age group	60-64 (n = 286)	65-69 (n = 294)	70-74 (n = 206)	75-79 (n = 117)	> 80 (n = 46)
WT6 (meters)	523.0 ± 67.1	499.0 ± 72.7*	483.2 ± 71.1*	461.2 ± 70.8*†	426.1 ± 73.2*†‡§

* – different from the 60-64 age group, p < 0.05;
† – different from the 65-69 age group, p < 0.05;
‡ – different from the 70-74 age group, p < 0.05;
§ – different from the 75-79 age group, p < 0.05.

TABLE 3
Characteristics of the Participants in the Total Level of Physical Activity (T_LPA, points), subdivided in Domestic (D_LPA), Sports (S_LPA) and Recreational Activities (R_LPA), divided by age groups

Age group	60-64 (n = 286)	65-69 (n = 294)	70-74 (n = 206)	75-79 (n = 117)	> 80 (n = 46)
T_LPA	6.02 ± 2.80	5.83 ± 2.67	5.45 ± 2.81	4.92 ± 2.47*†	4.94 ± 2.45
D_LPA	2.5 ± 0.6	2.3 ± 0.5*	2.1 ± 0.6*†	2.0 ± 0.7*†	1.9 ± 0.5*†‡
S_LPA	2.77 ± 2.16	2.77 ± 2.27	2.40 ± 2.34	1.78 ± 1.92*†	1.91 ± 1.84
R_LPA	0.87 ± 1.54	0.86 ± 1.46	0.96 ± 1.44	1.16 ± 1.62	1.06 ± 1.39

* – different from the 60-64 age group, p < 0.05;
† – different from the 65-69 age group, p < 0.05;
‡ – different from the 70-74 age group, p < 0.05.

From the absolute mean values presented in table 3, the relative mean decline of the T_LPA was calculated, showing a decline of 18.0% of F1 (6.02 ± 2.80) for F5 (4.94 ± 2.45).

Figure 1 presents the behavior of the three categories of the T_LPA (Domestic, Sports and Recreational) with age advance. The relative decline from F1 to F4 of the D_LPA (2.5 ± 0.6 for 1.9 ± 0.5) and S_LPA (2.77 ± 2.16 for 1.91 ± 1.84) was of 24.0% and 31.1% respectively, demonstrating a remarkable decrease in the level of sports activities of this population. Possibly, the S_LPA has a greater impact over the CRF due to its more remarkable percentage reduction.

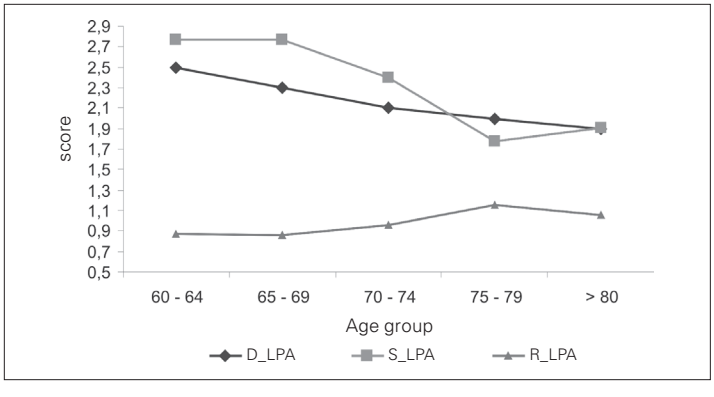

Figure 1 *– Alteration of the Domestic LPA (LPA_D), Sports_LPA (LPA_S) and Recreational LPA (LPA_R), with age progression*

A percentile division was performed in order to analyze in detail the influence of T_LPA over the CRF, forming this way three classes of LPA: low; moderate and high (table 4).

Figure 2 presents the relation between the T_LPA and CRF. A decrease was observed with age advance in the three levels of T_LPA. The younger women demonstrated similarities in the CRF in the two higher levels. The most remarkable reduction occurred in the moderate T_LPA class (19.9%). There was a slight increase

TABLE 4
Mean values and Standard deviation of the classes of the Total Level of Physical Activity (LPA_T), divided by age group

Age group	Low LPA_T	Moderate LPA_T	High LPA_T
60-64	506.9 ± 69.3	525.9 ± 63.7	530.3 ± 68.1
65-69	480.8 ± 69.7	487.5 ± 78.2	523.4 ± 62.6*†
70-74	460.3 ± 78.2	484.9 ± 63.2	504.9 ± 63.8*
75-79	461.8 ± 71.8	448.6 ± 72.0	475.3 ± 67.0
> 80	419.3 ± 53.3	421.7 ± 80.7	442.1 ± 73.2

* – different from the Low LPA_T class, p < 0.05;
† – different from the Moderate LPA_T class, p < 0.05.

between the third and fourth class of the Low T_LPA, and an apparent stabilization between the second and third class of the Moderate T_LPA. The lowest values of the CRF were found in the low T_LPA class, with a single exception in F4 in the Moderate T_LPA class. On the other hand, the highest values of CRF were observed in the high level of T_LPA.

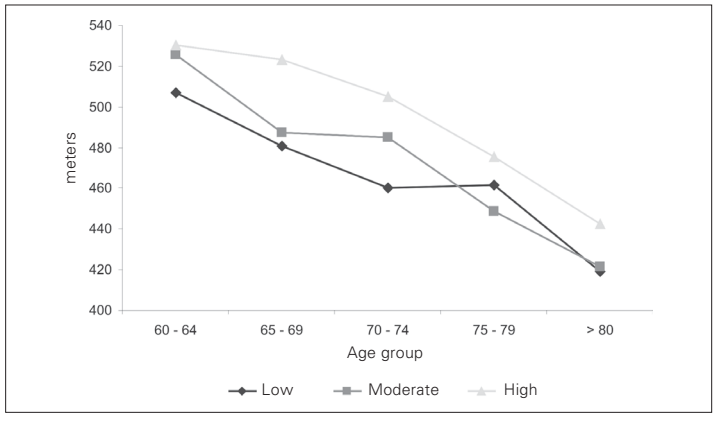

Figure 2 *– Relationship between the Total Level of Physical Activity and the Cardiorespiratory Fitness*

A subdivision of S_LPA in non-participants of sports activities, practitioners of physical exercises of low intensity and of moderate intensity was determined in order to verify the degree of influence of physical exercises practice obtained through the S_LPA and the alterations in CRF. In this study, participants of high intensity physical exercises were not found.

Table 5 presents the results of the Tc6 stratified by the S_LPA. The women included in the group non-participant of sports activities presented the lowest values in the WT6. Inversely, the highest values were found in the moderate S_LPA category. The majority of the sample concentrated in the low S_LPA group, being equal to over 65% of the women. A percentage reduction of women involved in the moderate S_LPA category was verified with age advance.

TABLE 5
Mean values and Standard deviation of the Six-Minute Walk Test (WT6) and categories of the Sports Level of Physical Activity, divided by age group

Age group	Non-participants	Low LPA_Esp	Moderate LPA_Esp
60-64	511.6 ± 50.8	522.3 ± 69.9	536.4 ± 59.4
65-69	467.4 ± 72.4	498.0 ± 72.4*	526.9 ± 65.0*†
70-74	434.6 ± 64.1	493.2 ± 68.6*	507.0 ± 61.6*
75-79	458.4 ± 64.6	455.3 ± 72.5*	521.6 ± 51.3*
> 80	416.9 ± 58.8	425.7 ± 69.4	449.3 ± 125.7

* – different from the non-practitioner category, p < 0.05;
† – different from the low LPA_S category, p < 0.05.

The best performance levels of CRF were found in younger women, as shown in figure 3. There was a straight relationship of

performance in the WT6 with the increase of intensity of the S_LPA, regardless the age, except for F4 in the low S_LPA group. The percentage decreases of the CRF in the categories non-participant in sports activities, low and moderate S_LPA were of: 18.6; 18.5 and 16.3%, respectively. The variance analysis demonstrated that there were no differences in the groups of S_LPA of women from F1 and F5 ($p < 0.05$). Nevertheless, these differences were verified in all groups of F2, as well as in the groups non-participant of sports activities with the low S_LPA group and moderate S_LPA of F3; and of the groups non-participant in sport activities and low S_LPA for moderate S_LPA in F4 ($p < 0.05$).

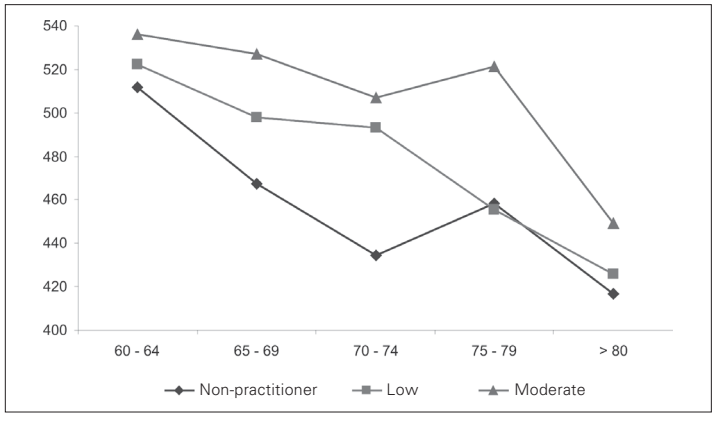

Figure 3 *– Relationship between Cardiorespiratory Fitness and Sports Level of Physical Activity*

The results of the correlation analysis between CRF and T_LPA and its categories are presented in table 6, divided by the age groups. The degree of association is significant between T_LPA, S_LPA, D_LPA and CRF, except for F4 in these categories and of F1 in the D_LPA category. The R_LPA presented an inverse relationship in the two last groups, not significant, though.

TABLE 6
***Pearson* correlation values between Level of Physical Activity (LPA) and its categories and the Six-Minute Walk Test (WT6), divided by age groups**

Age group	60-64 (n = 286)	65-69 (n = 295)	70-74 (n = 207)	75-79 (n = 120)	> 80 (n = 52)
LPA_T x WT6	0.131*	0.257†	0.308†	0.010	0.285*
LPA_D x WT6	0.108	0.193†	0.218†	0.137	0.467†
LPA_S x WT6	0.156†	0.227†	0.296†	0.154	0.305*
LPA_R x WT6	0.024	0.091	0.048	–0.176	–0.109

* $p < 0.05$; † $p < 0.01$.
LPA_T – total level of physical activity;
LPA_D – domestic level of physical activity;
LPA_S – sports level of physical activity;
LPA_R – recreational level of physical activity.

DISCUSSION

The functional decrease occurred in the cardiorespiratory variable in this population confirms other studies[1-2,4-5,7,12,14]. This alteration is clinically relevant once it is a strong and independent predictor of mortality risk for all diseases causes as well as coronary diseases[9-10].

The CRF demonstrated a reduction with age progression, presenting an association with the decline of T_LPA. However, the categories of T_LPA revealed different impacts over the CRF. The women who obtained higher values of T_LPA attenuated the CRF decline; therefore, the body has higher probabilities to adapt to these alterations. Conversely, in the women who obtained moderate or low T_LPA, the decline in the CRF was severe, in this case, the body may not be able to adapt to the new condition and provoke morbidity. Therefore, it is important to maintain a high T_LPA, regardless of age, for the maintenance of an independent life.

The results concerning the decrease of T_LPA and consequently of CRF are similar to the ones in the study by Talbot *et al.*[4], who demonstrated that the high intensity activities are the ones which suffer the most with age advance. This transition process of the activities which demand a higher energetic cost for less vigorous activities may explain the decrease verified in CRF, since the maintenance of high levels of LPA may be considered as a critical factor in the maintenance of the CRF of elders[12,17]. Moreover, the decrease of the CRF in the high T_LPA category may be considered relevant, since the body's adaptation may be facilitated due to the attenuation of this decline.

When analyzing the influence of the categories in the T_LPA over the CRF, the most remarkable reduction was obtained in the S_LPA of 31.1%, demonstrating that the different S_LPA may result in differentiated performances in the WT6. A subdivision of the S_LPA was performed in order to examine such influence. This subdivision was according to the intensity, being divided in women non-participant of physical exercises, low intensity practitioners and moderate intensity practitioners. The physical exercises practiced in this sample were: gymnastics, walking, stretching, senior or circular dancing, water gymnastics, swimming, body building, physical therapy exercises and yoga.

Table 5 presented a change in behavior with age advance concerning physical exercises habits. There was a gradual increase of the women who did not practice physical exercises. The average percentage of participation in physical exercises of moderate intensity was around 12.0%. The majority of the women was in the low intensity – more than 65% in all age groups.

This behavioral alteration can be better understood when verifying table 6. There was a positive association between the S_LPA and the CRF, except for F4. However, in this age group and in the following one a negative association between the R_LPA and the CRF occurred. These results reinforce the concept that women tend to decrease the activities which demand greater energetic cost – exhausting activities, for recreational activities which are characterized as low intensity. The recreational activities described as habitual were: crochet, knitting, embroidering, sewing, ball room dancing, handcrafts, bingo and word puzzles.

This transition process to less vigorous activities and the decrease of the physical exercises intensity may be understood as an important public health problem, since the maintenance of satisfactory levels of CRF would not be happening.

The cardiorespiratory system may adapt to training stimuli regardless of age[18], as it is suggested in figure 5, where different levels of CRF for different intensities of S_LPA were presented. The women with the best CRF were the ones who belonged to the higher intensity group, showing hence that the adherence to physical exercise programs oriented to older women possibly will aid in the maintenance of the CRF and consequently to an expectation of a longer independent life[3].

The practice of more vigorous physical exercises may provide the CRF maintenance, as well as keep functionality[24]. Nevertheless, low intensity activities, in their majority, do not reach a minimum threshold necessary for the occurrence of relevant cardiorespiratory adaptations, contributing for the increase of morbidity and/or mortality risk for all causes and for coronary diseases[9-11]. A greater number of investigations concerning the relationship between the amount of exertion usually performed through sports, recreational and domestic activities over the CRF should be presented, due to their antagonist influences.

CONCLUSION

The CRF has shown to decline with age increase; however, the S_LPA presented a straight relationship with the WT6 performance,

once it reflects different responses in the CRF of this sample. The S_LPA revealed to predict around 1% of the alterations of the WT6, regardless of age. Despite the inevitable decline of the CRF with age advance, the maintenance of high levels of T_LPA may attenuate this process, since the women who were in the moderate category of S_LPA demonstrated the lowest CRF reductions. The category which did not practice physical exercises contradictorily presented the highest percentage reduction. Therefore, the maintenance of high LPA is recommended, especially regular practice of physical exercises (S_LPA) with the purpose to aid the maintenance and attenuation of the CRF and consequently extend the expectation of an independent life.

All the authors declared there is not any potential conflict of interests regarding this article.

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