Profile of the level of physical activity in the daily lives of patients with COPD in Brazil*

Perfil do nível de atividade física na vida diária de pacientes portadores de DPOC no Brasil

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Abstract

Objective: To evaluate characteristics of physical activities in daily life in COPD patients in Brazil, correlating those characteristics with physiological variables. **Methods:** Physical activities in daily life were evaluated in 40 COPD patients (18 males; 66 ± 8 years of age; FEV_1 = 46 ± 16 % of predicted; body mass index = 27 ± 6 kg/m^2) and 30 healthy age- and gender-matched subjects, using a multiaxial accelerometer-based sensor for 12 h/day on two consecutive days. We also assessed maximal and functional exercise capacity, using the incremental exercise test and the six-minute walk test (6MWT), respectively; MIP and MEP; peripheral muscle force, using the one-repetition maximum test and the handgrip test; quality of life, using the Saint George's Respiratory Questionnaire (SGRQ); functional status, using the London Chest Activity of Daily Living questionnaire; and dyspnea sensation, using the Medical Research Council (MRC) scale. **Results:** Mean walking time/day was shorter for COPD patients than for the controls (55 ± 33 *vs.* 80 ± 28 min/day; p = 0.001), as movement intensity was lower (1.9 ± 0.4 *vs.* 2.3 ± 0.6 m/s^2; p = 0.004). The COPD patients also tended to spend more time seated (294 ± 114 *vs.* 246 ± 122 min/day, p = 0.08). Walking time/day correlated with the 6MWT (r = 0.42; p = 0.007) and maximal workload (r = 0.41; p = 0.009), as well as with age, MRC scale score and SGRQ activity domain score (–0.31 ≤ r ≤ –0.43; p ≤ 0.05 for all). **Conclusions:** This sample of Brazilian patients with COPD, although more active than those evaluated in studies conducted in Europe, were less active than were the controls. Walking time/day correlated only moderately with maximal and functional exercise capacity.

Keywords: Pulmonary disease, chronic obstructive; Motor activity; Exercise tolerance.

Resumo

Objetivo: Avaliar as características de atividades físicas na vida diária de pacientes portadores de DPOC no Brasil e sua relação com diferentes variáveis fisiológicas. **Métodos:** Foram avaliados 40 pacientes portadores de DPOC (18 homens; 66 ± 8 anos; VEF_1 = 46 ± 16 % predito; índice de massa corpórea = 27 ± 6 kg/m^2) e 30 idosos saudáveis pareados por gênero e idade quanto às atividades físicas na vida diária, utilizando-se um acelerômetro multiaxial por 12 h/dia durante dois dias consecutivos. Foram ainda avaliados as capacidades máxima e funcional de exercício através do teste incremental máximo e do teste de caminhada de seis minutos (TC6), respectivamente; PImáx e PEmáx; força muscular periférica através dos testes de uma repetição máxima e de força de preensão manual; qualidade de vida através de *Saint George's Respiratory Questionnaire* (SGRQ); estado funcional através do questionário *London Chest Activity of Daily Living*; e sensação de dispneia através da escala do *Medical Research Council* (MRC). **Resultados:** Os pacientes portadores de DPOC apresentaram menor tempo de caminhada/dia quando comparados aos idosos saudáveis (55 ± 33 *vs.* 80 ± 28 min/dia; p = 0,001) e menor intensidade de movimento (1,9 ± 0,4 *vs.* 2,3 ± 0,6 m/s^2; p = 0,004). Os pacientes com DPOC também tenderam a passar mais tempo sentados (294 ± 114 *vs.* 246 ± 122 min/dia; p = 0,08). O tempo de caminhada/dia correlacionou-se com TC6 (r = 0,42; p = 0,007), carga máxima de trabalho (r = 0,41; p = 0,009), idade, escala MRC e domínio atividade do SGRQ (–0,31 ≤ r ≤ –0,43; p ≤ 0,05 para todos). **Conclusões:** Apesar de serem mais ativos do que pacientes europeus estudados previamente, pacientes portadores de DPOC no Brasil foram menos ativos em comparação a idosos saudáveis. O tempo de caminhada/dia desses pacientes correlacionou-se apenas moderadamente com a capacidade máxima e funcional de exercício.

Descritores: Doença pulmonar obstrutiva crônica; Atividade motora; Tolerância ao exercício.

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Introduction

In addition to obstruction of the airflow, COPD is characterized by physical deconditioning and inactivity.[1-3] Skeletal muscle dysfunction, one of the extrapulmonary characteristics of the disease, is related to the decrease of exercise capacity which, together with dyspnea, leads to physical inactivity. Physical inactivity in COPD has relevant repercussions, and is currently considered a factor directly related to the greater risk of acute exacerbations and early death.[4,5]

There is increasing interest in objectively evaluating the level of physical activity in daily life in different populations, among which are COPD patients.[3,6] In the recent literature, it is recommended, due to the relevant limitations in the use of questionnaires in this population, that the objective evaluation of the level of physical activity in daily life be carried out using movement sensors, which constitute portable equipment that quantifies the physical activity performed by an individual in a determined period of time.[7,8] This objective evaluation allows, for instance, to determine whether the patients reach the maximal level of daily physical activity recommended by the American College of Sports Medicine (ACSM) in order to consider an individual physically active (30 min of moderate physical activity, such as walking).[9]

Some previous studies evaluated in detail the characteristics of physical inactivity in COPD patients in European populations.[3,8,10-12] Recent data have shown that COPD patients in Brazil present a higher level of physical activity than does a population in Europe when the two were carefully paired.[13] However, a detailed evaluation of the characteristics of the level of physical activity in the daily life of COPD patients in Brazil is not yet available. For instance, a comparison of daily physical activity between COPD patients in Brazil and healthy elderly individuals has yet to be carried out. In addition, the proportion of COPD patients in Brazil that reach the minimal level of physical activity recommended by the ACSM is unknown.

The objective of this study was to characterize the level of physical activity in the daily life of a sample of COPD patients in Brazil. In addition, it was our objective to study the correlations between the physiological variables (such as pulmonary function and exercise capacity) and the level of physical activity in the daily life of this sample.

Methods

We studied 40 COPD patients in Brazil (Table 1). All patients were recruited during the initial evaluation for admission to the Regional University Hospital of Northern Paraná Pulmonary Rehabilitation Program. The diagnosis of COPD was established in accordance with the Global Initiative for Chronic Obstructive Lung Disease (GOLD) criteria.[2] In addition to the COPD diagnosis, the inclusion criteria were the following: clinical stability, without infections or exacerbations in the preceding 3 months; absence of severe or unstable heart disease; and absence of neuromusculoskeletal alterations which limited physical activities of daily living. Of the COPD patients, 17 (42%) used oral corticosteroid.

The control group comprised 30 healthy and sedentary individuals matched to the COPD patients regarding age, gender and anthropometric characteristics. The individuals in the control group were recruited from among relatives of students of the State University of Londrina and members of the local community. This group was evaluated according to the same inclusion criteria applied to the COPD group, although control group subjects were required to present normal spirometry results and to have had no regular physical activity in the preceding year.

All COPD patients were retired, and 13 (32.5%) of the 30 were informally employed. Informal work was defined as any occasional professional activity without employment (a few days a week or a few hours a day). In the control group, 27 individuals (90%) were retired and, of those, 10 were engaged in informal work.

The research project was approved by the State University of Londrina Research Ethics Committee (no. 061/06). All participants were informed on the procedures of the study and gave written informed consent.

The comorbidities among the studied patients are described in Table 2. The following were considered stable heart diseases: dilated cardiomyopathy without significant alteration of the heart function; history of ischemic cardiomyopathy; mitral valve disease; and chronic atrial fibrillation. The presence of systemic arterial hypertension was considered a comorbidity

Table 1 - Characteristics of individuals studied.

Characteristic	COPD	Healthy elderly individuals
	(n = 40)	(n = 30)
Age, years	66 ± 8	64 ± 7
Gender, M/F	18/22	14/16
BMI, kg/m^2	27 ± 6	28 ± 4
GOLD, II/III/IV	17/17/6	-
Pulmonary function		
FEV_1, % predicted	46 ± 16*	111 ± 20
FVC, % predicted	74 ± 22*	109 ± 20
FEV_1/ FVC	49 ± 16*	82 ± 5
MVV, % predicted	41 ± 19*	110 ± 27
Exercise capacity		
6MWT, % predicted	72 ± 18*	96 ± 9
6MWD, m	419 ± 111*	560 ± 75
W_{max}, watts	30 ± 22	-
VO_{2max}, mL.kg^{-1}.min^{-1}	17.9 ± 6.3	-

BMI: body mass index; GOLD: Global Initiative for Chronic Obstructive Lung Disease; MVV: maximal voluntary ventilation; 6MWT: six-minute walk test; 6MWD: six-minute walk distance; W_{max}: maximal workload; and VO_{2max}: maximal oxygen uptake. The values were described in mean ± SD, except for gender and GOLD class. The unpaired t-test was used to compare the groups. *p < 0.0001 *vs.* healthy elderly individuals.

due to the necessity of antihypertensive therapy. Obesity was defined as a body mass index (BMI) greater than 30 kg/m^2. Osteoarthrosis, osteoporosis, thyroid diseases and vascular disorder were reported by the patients themselves.

Physical activity in daily life was objectively evaluated by means of an activity monitor (Dynaport® Activity Monitor [DAM]; McRoberts BV, The Hague, Netherlands). The equipment comprises a small box positioned at the waist and a sensor of lower limb activity strapped to the body (total weight, 375 g). The equipment registers the time spent in different activities and body positions (walking, standing, sitting or lying), as well as the intensity of the movement during the time the individual is walking. The equipment was used for 12 h/day on two consecutive weekdays. The mean of the two days was used for the statistical analysis. The equipment has been validated for use in COPD patients,[14] and the minimal number of days needed in order to obtain a reliable evaluation was determined in a previous study.[3] After the use of the equipment, specific software (DynaScope; McRoberts BV) was used to conduct the reading and analysis of the data collected.

Pulmonary function testing was carried out using a Pony spirometer (Cosmed, Rome, Italy), in accordance with the Brazilian standards,[15] and the reference values established by Pereira et al. were used.[16]

Functional exercise capacity was evaluated with the six-minute walk test (6MWT), in accordance with the standards of the American Thoracic Society,[17] and the reference values were those described by Troosters et al.[18] For the evaluation of maximal exercise capacity, the cardiopulmonary exercise testing (maximal incremental) was performed in accordance with the standards of the American Thoracic Society/American College of Chest Physicians[19] and following a protocol previously described.[20] The test was conducted on a cycle ergometer for lower limbs (Monark, Varberg, Sweden) using a portable a blood gas analyzer (VO_{2000} Aeroport; Medical Graphics, St. Paul, MN, USA) and a digital electrocardiograph (Micromed, Brasília, Brazil).

Respiratory muscle strength was evaluated by measuring MIP and MEP according to the technique described by Black and Hyatt[21] and using the reference values described by Neder et al.[22] For the evaluation of the peripheral muscle strength, a maximal repetition test (MRT) was conducted using a multistation bodybuilding device (Righetto, Campinas, Brazil). The following muscle groups were evaluated: femoral quadriceps, biceps and brachial triceps. Grip strength was evaluated with an analogical dynamometer (Jamar; Preston, Jackson, MI, USA), and the reference values used were those proposed by Mathiowetz et al.[23]

The Saint George's Respiratory Questionnaire (SGRQ), a specific questionnaire for COPD patients and validated for use in Portuguese,[24] was applied in order to evaluate quality of life. The SGRQ is divided into three domains: symptoms, activity and psychosocial impact of the disease. The score is calculated for each domain, and a total score is the result of the addition of the three domains. The functional status was evaluated by means of the application of the London Chest Activity of Daily Living (LCADL) scale, validated for use in Portuguese.[25,26] The scale is divided into four domains: personal care, home care, physical activity and leisure. The score is calculated for each domain, and a total

score is the result of the addition of the four domains. The Medical Research Council (MRC) scale, also validated for use in Portuguese,[27] was used in order to evaluate the sensation of dyspnea during the daily life activities. The scale comprises only five items, and the patient chooses the item which corresponds to the limitation caused by dyspnea in his or her daily life.

The index known as Body mass index, airway Obstruction, Dyspnea, and Exercise capacity (BODE) index was calculated based on the BMI, FEV_1, sensation of dyspnea using the MRC scale and the six-minute walk distance (6MWD). The score attributed to each item varied from zero to three for FEV_1, 6MWT and the MRC scale, whereas zero or one were attributed to BMI. The total score of the BODE index varies from zero to ten points, and higher values indicate higher risk of mortality.

For the statistical analysis, we used the software GraphPad Prism 3 (GraphPad Software, San Diego, CA, USA). For the evaluation of the distribution of the normality of data, we used the Kolmogorov-Smirnov test. Data were described as mean ± SD. The unpaired t-test was used to compare the group of COPD patients and the control group. Pearson's coefficient was used for the study of the correlations, except for those involving the BODE index and SGRQ scores, as well as the LCADL and MRC scale scores, all of which were evaluated using Spearman's coefficient. The statistical significance was set at $p < 0.05$ for all analyses.

Results

The groups were paired as for the distribution of gender and presented no statistical differences as for age and BMI. In addition to the obstruction of the airflow and the decrease of the exercise capacity shown in Table 1, the COPD patients presented a MRC scale score of 3 ± 1 points, BODE index of 4 ± 2 and smoking history of 38 ± 35 pack-years. Table 1 also shows that the healthy elderly individuals presented normal values for pulmonary function and exercise capacity.

Figure 1 shows the time spent per day in different activities or body positions in both groups. Patients with COPD presented a shorter walking time per day than did the healthy elderly individuals (55 ± 33 *vs.* 80 ± 28 min/day; p = 0.001), and a lower intensity of walking movement (1.9 ± 0.4 *vs.* 2.3 ± 0.6 m/s^2; p = 0.004). The COPD group patients also tended to spend more time seated per day than did the healthy elderly individuals (294 ± 114 *vs.* 246 ± 122 min/day; p = 0.08). Patients with COPD spent most of the day seated or lying down (41% and 15% of the time, respectively), whereas the rest of the time was spent moving (7%), standing (36%) or in undefined activity/position (1%). The healthy elderly individuals spend approximately half of the day moving and standing (10% and 39% of the time, respectively), whereas the rest of the time was spent seated (34%), lying (15%) or in undefined activity/position (2%).

Table 2 - Presence of comorbidities in COPD patients and in healthy elderly individuals.

Comorbidity	COPD, n (%)	Healthy elderly individuals, n (%)
	(n = 36)	(n = 30)
Obesity[a]	11 (31)	11 (37)
Stable heart disease	12 (33)	10 (33)
Systemic arterial hypertension[b]	18 (50)	17 (57)
Diabetes	13 (36)	5 (17)
Osteoarthrosis	11 (31)	10 (33)
Osteoporosis	5 (14)	4 (13)
Thyroid disease	7 (19)	3 (10)
Vascular disease[c]	10 (28)	11 (37)
Smoking[d]	33 (92)	9 (30)

It was not possible to conduct the survey of the comorbidities in 4 COPD patients. [a]Body mass index > 30 kg/m^2. [b]Necessity of antihypertensive therapy. [c]Peripheral arterial insufficiency or venous thrombosis. [d]Former smokers and smokers.

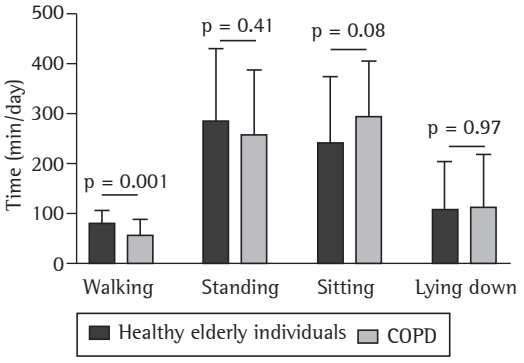

Figure 1 - Time spent per day in different activities and body positions in COPD patients and healthy elderly individuals. The unpaired t-test was used to compare the groups.

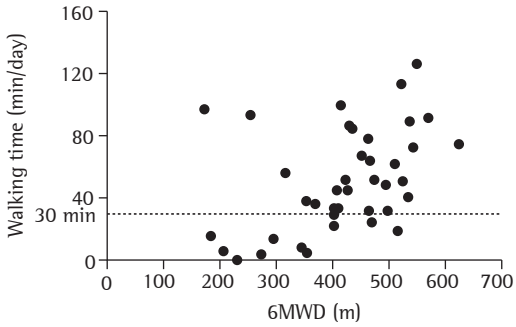

Figure 2 - Correlation between walking time per day and the six-minute walk distance (6MWD) in COPD patients (r = 0.42; p = 0.007). The dotted line positioned at 30 min corresponds to the minimal level of daily physical activity recommended by the American College of Sports Medicine.

Of the group of COPD patients, 29 (72%) spent, on average, more than 30 min/day walking (Figure 2), compared with 93% of the healthy elderly individuals.

Table 3 shows that, in COPD patients, the walking time per day correlated positively with the 6MWD (r = 0.42; p = 0.007; Figure 2), with the maximal workload in the cardiopulmonary exercise testing (r = 0.41; p = 0.009) and with maximal oxygen uptake (VO_{2max}; r = 0.36; p = 0.02). In addition, walking time correlated negatively with age, MRC scale and the activity domain of the SGRQ ($-0.31 \leq r \leq -0.43$; $p < 0.05$ for all). The time spent standing per day correlated positively with FEV_1, FEV_1/FVC and maximal voluntary ventilation, in % of the predicted values ($0.41 \leq r \leq 0.43$; $p < 0.05$ for all) and negatively with age, quantity of pack-years, BODE index, SGRQ activity domain and SGRQ total score ($-0.33 \leq r \leq -0.41$; $p < 0.05$ for all). The intensity of the movement in daily life correlated positively with the 6MWT (r = 0.64; p = 0.0001), SGRQ symptom domain (r = 0.37; p = 0.02), maximal workload in the cardiopulmonary exercise testing (r = 0.62; p < 0.0001) and VO_{2max} (r = 0.48; p = 0.002), and correlated negatively with the personal care domain and LCADL total score, MRC scale, BODE index and age ($-0.32 \leq r \leq -0.58$; $p < 0.05$ for all). In the group of healthy elderly individuals, only intensity of movement correlated with the 6MWD (r = 0.49; p = 0.005) and age (r = –0.39; p = 0.003).

Table 3 - Correlations between walking time and standing time per day during different physical activities in the daily life of COPD patients in Brazil.

Characteristic	Walking time/day	Standing time/day
Age	–0.43**	–0.33*
Pack-years	–0.10	–0.34*
MRC	–0.31*	–0.25
BODE	–0.30	–0.34*
SGRQ activity	–0.33*	–0.41*
SGRQ total	–0.27	–0.41**
Pulmonary function		
FEV_1, %predito	0.17	0.41**
FEV_1/FVC	0.02	0.41**
MVV, % of predicted	–0.02	0.43**
Exercise capacity		
6MWT	0.42**	0.12
W_{max}	0.50**	0.19
VO_{2max}	0.36*	0.15

MRC: Medical Research Council scale; BODE: Body mass index, airway Obstruction, Dyspnea, and Exercise capacity; SGRQ: Saint George's Respiratory Questionnaire; MVV: maximal voluntary ventilation; 6MWT: six-minute walk test; W_{max}: maximal workload; and VO_{2max}: maximal oxygen uptake. Pearson's correlation coefficient was used, except for the variables BODE index, MRC, SGRQ and VO_{2max} %predicted, for which Spearman's correlation coefficient was used. *$p \leq 0.05$. **$p < 0.01$.

Discussion

The present study showed that COPD patients in Brazil are less active in physical activities of daily living when compared with healthy elderly individuals. They spent most of their time lying down or seated, in addition to walking with lower movement intensity. These results can be attributed to the sedentary lifestyle adopted by COPD patients as a consequence of the systemic alterations of the disease, although the opposite hypothesis has also been raised, that is, the inactivity can be precursor of the systemic alterations and not its consequence.[28]

Although COPD patients were physically inactive in relation to the healthy elderly individuals, they were more active than were the patients in Europe paired in other studies.[3,13] This probably reflects the fact that, in COPD patients, lower socioeconomic status and greater ethnic miscegenation seem to be related to a greater level of physical activity in daily life, as previously described.[13,29] However, this difference was not observed when the results of the healthy elderly individuals in Brazil were compared with the group of healthy elderly individuals in Belgium

in another study.[3] Healthy elderly individuals in Brazil and in Belgium were found to spend most of their time walking or standing, and the mean walking time per day was comparable between the two groups (80 ± 28 *vs.* 81 ± 26 min/day, respectively). This suggests that the determining factors of the level of physical activity in healthy elderly individuals are not the same in COPD patients. Future studies on the matter are necessary.

The results of the present study also reveal a positive correlation between the walking time per day, the 6MWD and the maximal workload in the cardiopulmonary exercise testing in COPD patients. A correlation between the level of physical activity in daily life and functional exercise capacity has been previously shown, ranging between 0.46 and 0.74 in different studies.[3,6,30] In the present study, the correlation between physical activity in daily life and the 6MWT in patients (r = 0.42), as well as the correlation between physical activity in daily life and maximal exercise capacity (r = 0.41), was lower than that observed (r = 0.64) in the study involving patients in Belgium.[3] Previous results also showed that, in European patients, the 6MWD was the principal determining factor of walking time per day in the daily life of the COPD patients ($r^2 = 0.56$; $p < 0.0001$), and the patients who walked less than 400 m on the 6MWT were those considered extremely inactive in their daily lives.[3] This was not observed for the patients in Brazil, since we did not identify a value in the 6MWT that could determine which individuals were inactive. Taken together, these results indicate a less direct relationship between physical activity in daily life and exercise capacity in patients in Brazil when compared with patients previously studied in other countries. This can be explained, at least in part, by the higher level of physical activity in the patients in Brazil in relation to patients in those other countries.

Based on the recommendations of the ACSM,[9] most COPD patients and healthy elderly individuals in Brazil (72.5% and 93%, respectively) can be considered physically active for reaching a minimal level of walking recommended per day. This is a positive finding, since some authors[4] showed that individuals with COPD who performed some level of regular physical activity presented lower mortality levels and lower risk of hospitalization due to the disease. However, in view of the fact that COPD patients in Brazil were less active in their daily lives when compared with patients in European populations previously studied, it is questionable whether the daily minimum of 30 min of walking suggested by the ACSM is a applicable value to qualify individuals in Brazil as active or not. In addition, although most COPD patients in Brazil are considered active, they walked at an intensity 17% lower than that observed for the healthy elderly individuals (2.0 ± 0.4 *vs.* 2.3 ± 0.6 m/s^2; p = 0.03), which might indicate that the biological benefit obtained from walking is not ideal.

The limitations of the present study include the fact that the sample was recruited at a single location in Brazil (southern region) and included individuals of a relatively homogeneous social class, that is, individuals treated via the Unified Health Care System. However, those factors might not have influenced the results significantly, since the weather in the region of Londrina, Brazil, reflects well the weather of the most part of the country (mean annual temperature of 20°C, relative humidity of 78% and mean rainfall of 1,400 mm/year).[13] In addition, the mean monthly income of the individuals in the present study, in Brazilian reals (R$), was R$919.00, which is typical of the income of most Brazilians. The absence of patients with mild COPD (GOLD I) in the present sample can also be considered a limitation, since it was impossible to evaluate how this part of the population behaves in relation to the healthy elderly individuals. Another limitation was the small number of days of monitoring of the physical activity in daily life (two consecutive weekdays). A previous study showed that this number of days is sufficient to obtain a valid estimate in COPD patients using the DynaPort activity monitor.[3] However, there are no previous studies indicating the necessary number of days to evaluate healthy elderly individuals with this equipment. In addition, the weekend was not included in the period of monitoring, which contributes to the decrease of day-to-day variability and for a realistic estimate of the habitual level of physical activity in this population. Nevertheless, we believe that, since the individuals were sedentary and retired, there would not be a great variability in the level of physical activities among the days of the week.

In summary, COPD patients in Brazil were less active in physical activities of daily living when compared with healthy elderly individuals, in addition to walking with lesser intensity of movement. The time of daily walking correlated only moderately with the functional capacity and the maximal capacity of exercise.

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