Characteristics of Physical Activities in Daily Life in Chronic Obstructive Pulmonary Disease

Fabio Pitta, Thierry Troosters, Martijn A. Spruit, Vanessa S. Probst, Marc Decramer, and Rik Gosselink

Quantification of physical activities in daily life in patients with chronic obstructive pulmonary disease has increasing clinical interest. However, detailed comparison with healthy subjects is not available. Furthermore, it is unknown whether time spent actively during daily life is related to lung function, muscle force, or maximal and functional exercise capacity. We assessed physical activities and movement intensity with the DynaPort activity monitor in 50 patients (age 64 ± 7 years; FEV₁ 43 ± 18% predicted) and 25 healthy elderly individuals (age 66 ± 5 years). Patients showed lower walking time (44 ± 26 vs. 81 ± 26 minutes/day), standing time (191 ± 99 vs. 295 ± 109 minutes/day), and movement intensity during walking (1.8 ± 0.3 vs. 2.4 ± 0.5 m/second²; p < 0.0001 for all), as well as higher sitting time (374 ± 139 vs. 306 ± 108 minutes/day; p = 0.04) and lying time (87 ± 97 vs. 29 ± 33 minutes/day; p = 0.004). Walking time was highly correlated with the 6-minute walking test (r = 0.76, p < 0.0001) and more modestly to maximal exercise capacity, lung function, and muscle force (0.28 < r < 0.64, p < 0.05). Patients with chronic obstructive pulmonary disease are markedly inactive in daily life. Functional exercise capacity is the strongest correlate of physical activities in daily life.

Keywords: controlled study; chronic obstructive pulmonary disease; correlates; DynaPort; triaxial accelerometer

Guidelines recommend that, for people of all ages, a minimum of 30 minutes of daily physical activity of moderate intensity, such as walking, is necessary to maintain or develop fitness (1). Those not meeting this standard are considered insufficiently active. In addition, the level of disability and deconditioning is a strong predictor of mortality (2–4), and adherence to current physical activity guidelines is associated with significant reduction in risk of all-cause mortality (5). Therefore, quantifying physical activities in daily life is of great value, especially in sedentary populations, and the time spent actively during daily life, together with intensity and frequency, are key issues in the analysis of a population’s usual physical activity level (6).

Patients with chronic obstructive pulmonary disease (COPD) frequently report dyspnea related to everyday tasks (7, 8). Therefore, it has been suggested that patients with COPD may be in a downward spiral of symptom-induced inactivity (9), leading to deconditioning and muscle weakness. However, objective comparison between patients with COPD and age-matched healthy control subjects concerning time spent actively in daily life and intensity of movements is currently lacking. This comparison is crucial to judge the real impact of the disease on usual activities.

Recently, we validated a triaxial accelerometer in patients with COPD (DynaPort Activity Monitor; McRoberts BV, The Hague, Netherlands) (10), which is able to quantify precisely the time spent on different activities (walking, cycling) and body positions (standing, sitting, lying) in daily life, as well as movement intensity during walking. The use of this tool provides detailed and accurate comparison of physical activities in daily life between patients with COPD and healthy elderly control subjects.

Assessment of physical activities in daily life also enables one to investigate the relation between usual physical activity level and its potential physiologic surrogates. In patients with COPD, only modest relations have been found between laboratory-based exercise tests and lung function impairment (11). However, it is unclear to what extent objectively measured activities in real life are correlated with lung function, muscle force, or laboratory-based exercise tests.

Therefore, the present study was designed to investigate physical activities in daily life in patients with COPD compared with healthy age-matched individuals. In addition, we studied the relationship between physiologic variables and physical activities in daily life in patients with COPD. Preliminary results of this study have been previously reported in the form of abstracts (12, 13).

METHODS

Design

Physical activities in daily life, pulmonary function, respiratory and peripheral muscle force, maximal exercise capacity, and a 6-minute walking distance (6MWD) test were assessed in patients with COPD and healthy elderly subjects and cross-sectionally compared.

Subjects

Sixty-two patients (46 men) suffering from mild to very severe COPD (Global Initiative for Chronic Obstructive Lung Disease [GOLD] classes I–IV) (14) were initially included. They were all retired or on sick leave and no longer employed. Inclusion criteria were as follows: (1) stable condition at inclusion, with no infection or exacerbation for at least 3 months; (2) absence of severe and/or unstable cardiac disease as shown by electrocardiogram during rest and maximal exercise test; and (3) absence of other pathologic conditions that could impact physiologic activities in daily life (e.g., cerebrovascular diseases and rheumatism [see Presence of CoMorbidity in Methods]).

The control group included 26 healthy age- and sex-matched subjects (17 men), all of them retired. Twenty-four of them were relatives of employees or students of the hospital and two were healthy spouses of patients included in the COPD group. Inclusion criteria were the same as the COPD group, with the addition of normal spirometry results.

None of the individuals from both groups was engaged in any exer-
cise-training program before taking part in the study. All individuals gave informed consent, and all procedures were done according to the research ethics of the Declaration of Helsinki (15).

Exclusions
Twelve patients with COPD and one healthy elderly subject were excluded from the statistical analysis because they were not able to provide 2 valid days of assessment, which was considered the minimum number of necessary days to assess reliably physical activities in daily life (see Assessment of Physical Activity Level in Daily Life in Methods). A valid day of assessment was defined as 12 hours of measurement with the device correctly positioned and without any technical defect. All excluded subjects had a maximum of 1 assessment day considered valid. The reasons for invalid assessments were as follows: misplacement of the device (in seven patients with COPD) and technical problems (i.e., interruption of the measurement because of lack of battery power in five patients with COPD and one healthy subject). Therefore, statistical analysis was performed with 50 patients with COPD and 25 healthy elderly subjects (Table 1). The 12 excluded patients with COPD were not different from the remaining 50 in terms of lung function, muscle force, and exercise capacity. More detail on the exclusions is provided in the online supplement.

Presence of Comorbidities
A detailed overview of comorbidities in both groups is shown in Table 2. Both groups had similar prevalence of high blood pressure, back pain, arthritis, and obesity. The prevalence of osteoporosis, depression, and stable heart disease was higher in patients with COPD, as previously shown in the literature (16–18). In addition, matching for cardiac conditions could be checked based on the results of the maximal cycling exercise test. During this test, no electrocardiographic abnormalities or technical specifications of the severe cardiac disease that could impair the performance of usual physical activities were detected in any subject from both groups. Matching for smoking status was obviously not possible, because COPD is a disease linked to smoking, and the prevalence is lower in the general population.

Eighteen patients with COPD (36%) and only one healthy subject (4%) were using oral corticosteroids ($\chi^2 = 9.02, p = 0.003$). The mean dose was 8 ± 7 mg/day in these 18 patients with COPD. The healthy subject was using oral corticosteroids because of a scar inflammation after an abdominal plastic surgery which happened 3 months before inclusion in the study. The dose was 4 mg/day and the inflammatory treatment was in its last week, after complete remission of the postoperative complication.

Assessment of Physical Activity Level in Daily Life (Activity Monitoring)
Assessment was done with a triaxial accelerometer (DynaPort Activity Monitor; McRoberts BV). It consists of a small and lightweight box enclosed in a belt worn on the waist and a leg sensor (total weight 175 g). The DynaPort was recently validated in patients with COPD (10). It measures precisely the time spent in walking, cycling, standing, sitting, or lying, as well as movement intensity during walking, and is as accurate as video recordings. Technical specifications of the activity monitor can be found elsewhere (19).

Data from both groups were collected from March 2001 until December 2004, covering therefore all yearly seasons during almost 4 consecutive years. Assessments were done on consecutive weekdays, and each assessment day had 12 hours of duration, starting at the time that the patient woke up. Mean starting time was similar in patients with COPD and in healthy subjects (8:59 and 8:37 a.m., respectively). Evening hours (e.g., after 8:59 p.m. in patients with COPD and after 8:37 p.m. in healthy elderly subjects) were not included in the analysis because it is likely that elderly people in general have considerably fewer activities during this period when compared with the other periods of the day (see Assessment during Daytime in the online supplement).

All subjects were carefully instructed on how the device should be positioned, and they received a manual with clear instructions and figures. Patients also had to fill out a checklist to verify if their day was representative and to describe any possible hindrance of the activity monitor.

Complete “blinding” to the evaluation device was not possible because the subjects had to consent formally to take part in the study, and they had to be given some basic information about the measurements in the informed consent. However, both groups (patients and healthy individuals) had similar information. They were told only that it was a “device able to distinguish which movements were performed during the day.” Therefore, they were not aware that the aim of the research was to quantify time spent in each activity. In addition, subjects were told that a condition to take part on the study was that they should keep their daily activity completely unchanged while wearing the device.

### TABLE 1. BASELINE CHARACTERISTICS

<table>
<thead>
<tr>
<th>Patients with COPD (n = 50)</th>
<th>Healthy Elderly Subjects (n = 25)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Age, yr</td>
<td>64 ± 7</td>
</tr>
<tr>
<td>Sex, male/female</td>
<td>36/14</td>
</tr>
<tr>
<td>BMI, kg/m²</td>
<td>25 ± 6</td>
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<tr>
<td>Pulmonary function</td>
<td></td>
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<tr>
<td>FEV₁, %pred</td>
<td>43 ± 18</td>
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<tr>
<td>FVC, %pred</td>
<td>87 ± 22</td>
</tr>
<tr>
<td>FRC, %pred</td>
<td>155 ± 39</td>
</tr>
<tr>
<td>TLC, %pred</td>
<td>114 ± 20</td>
</tr>
<tr>
<td>T_{LCO}, %pred</td>
<td>49 ± 19</td>
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<tr>
<td>Muscle function</td>
<td></td>
</tr>
<tr>
<td>QF, %pred</td>
<td>56 ± 19</td>
</tr>
<tr>
<td>HF, %pred</td>
<td>92 ± 24</td>
</tr>
<tr>
<td>P_{max}, %pred</td>
<td>74 ± 24</td>
</tr>
<tr>
<td>P_{eff}, %pred</td>
<td>94 ± 29</td>
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<tr>
<td>Exercise capacity</td>
<td></td>
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<tr>
<td>6MWD, %pred</td>
<td>62 ± 22</td>
</tr>
<tr>
<td>W_{max}, %pred</td>
<td>49 ± 23</td>
</tr>
<tr>
<td>Peak VO₂, %pred</td>
<td>55 ± 25</td>
</tr>
</tbody>
</table>

Definition of abbreviations: BMI = body mass index; COPD = chronic obstructive pulmonary disease; FRC = functional residual capacity; HF = handgrip force; peak VO₂ = peak oxygen uptake; P_{max} = maximal inspiratory pressure; P_{eff} = maximal inspiratory pressure; QF = quadriceps force; TLC = total lung capacity; T_{LCO} = carbon monoxide diffusion capacity; 6MWD = 6-minute walking distance; W_{max} = maximal workload.

Values are expressed as mean ± SD.

* p < 0.0001.
† p < 0.005.
‡ p = 0.06.
§ p = 0.01.
¶ Ex-smokers or current smokers.
|| Clinically diagnosed depression.
‡‡ Under current antihypertensive treatment.
§§ Peripheral arterial insufficiency or venous thrombosis.
* Body mass index > 30 kg/m².
† In patients with COPD: mild atrial arrhythmia controlled with medication (n = 5), ischemic heart disease in the past (n = 5), or dilated cardiomyopathy (n = 5); in healthy elderly subjects: mild arrhythmia controlled with medication (n = 4).
— Continued
To determine the necessary number of assessment days, we studied the intraclass reliability coefficient in an initial sample of 33 individuals (18 patients with COPD and 15 age-matched healthy subjects), in which activity monitoring was performed during 5 consecutive days (Monday–Friday). This allowed us to determine the number of days necessary to achieve a between-day intraclass reliability coefficient of 0.70 or greater, which is considered as acceptable to assess reliably a variable in a group of individuals (20). The results of this analysis are described in detail in the online data supplement. Briefly, it was concluded that, to assess cross-sectionally walking time, standing time, sitting time, lying time, and movement intensity during walking time in daily life in that group of subjects, 2 days of assessment were necessary to achieve an acceptable intraclass reliability coefficient (0.70 < intraclass reliability coefficient < 0.88). Therefore, in patients assessed during 2 days, time spent in each activity and body position was averaged over 2 assessment days. In the subjects who performed 5 assessment days, the 2 days used in the analysis were randomly selected using a random number generator (21), and time spent in each activity and body position was also averaged over these 2 selected days.

Other Measurements
Pulmonary function (22), maximal inspiratory and expiratory pressures (23), quadriceps force (24), handgrip force (25), maximal exercise capacity (26), and 6MWD (27) were assessed. All methods and equipment are described in detail in the online supplement.

Sample Size and Power
A detailed description of the sample size calculation is provided in the online supplement. In brief, using a two-sided \( \alpha = 0.05 \), a \( \beta = 0.05 \) (or power of 95%), and a hypothetical drop-out rate of 25%, 15 patients in each group would be needed to show statistically significant differences in walking time between the two populations. We increased the sample to its current size (50 patients with COPD and 25 healthy subjects) for two reasons: (1) to cover the whole spectrum of COPD severity by having enough patients in all disease stages and (2) to take into account that the study involves correlations and multiple regression models.

With the present sample size and using an \( \alpha = 0.05 \), the study had more than 80% power to detect significant differences in each of the main variables studied (time spent walking, standing, sitting, and lying in daily life, and movement intensity during walking). Details on the power and sample size analysis are provided in the online supplement.

Statistical Analysis
Statistical analysis was performed using the SAS version 8 statistical package (SAS Institute, Cary, NC) and the GraphPad Prism 3 (GraphPad Software, San Diego, CA). Normal distribution was checked with the Kolmogorov-Smirnov test. The only variable that showed a nonnormal distribution was cycling time, both in patients with COPD and healthy elderly subjects.

A comparison of time spent in different activities between patients with COPD and healthy control subjects was done with an unpaired \( t \) test, except for cycling time, in which the equivalent nonparametric test (Mann-Whitney) was used. A stepwise multiple regression analysis was performed to assess independent contributors to the variance in walking time in daily life in patients with COPD. Pearson’s coefficient was used for the single correlation between the DynaPort outcomes with physiologic variables. The level of significance was set at \( p \leq 0.05 \).

In addition, day-to-day variability in physical activities in daily life was studied with the coefficient of variation, and these results were included in the online supplement.

RESULTS
As expected, patients with COPD were characterized by airflow obstruction, hyperinflation, and reduced diffusion capacity. In addition, severely reduced peripheral and respiratory muscle force and pronounced reduction in functional and maximal exercise capacity were also observed. Healthy control subjects were characterized by normal values in all these outcomes. Baseline characteristics from both groups are described in Table 1.

Characteristics of Physical Activities in Daily Life
An overview of results concerning physical activities in daily life is presented in Table 3. Compared with healthy control subjects, patients with COPD had reduced walking time, standing time, and movement intensity during walking in daily life (all \( p < 0.0001 \)). In addition, patients with COPD had higher sitting time (\( p = 0.04 \)) and lying time (\( p = 0.004 \)). The proportion of time spent in each of the activities and body positions during the day is shown in Figure 1. Patients with COPD spent most of the day (64 ± 15%) in the sitting or lying position and only 6 ± 4% in walking, whereas in healthy elderly subjects, these proportions were 46 ± 16% and 11 ± 4%, respectively.

Correlates of Physical Activities in Daily Life
Table 4 offers a detailed overview on the single correlations observed in patients with COPD. Walking time in daily life was positively correlated with 6MWD (Figure 2), maximal workload, peak oxygen consumption, quadriceps force, handgrip force, maximal inspiratory and expiratory pressures, FVC, FEV, and diffusion capacity (0.28 < \( r < 0.76 \), all \( p < 0.05 \)). Standing time in daily life was positively correlated with 6MWD, maximal workload, peak oxygen consumption, FVC, total lung capacity, diffusion capacity, handgrip force, and maximal inspiratory and expiratory pressures (0.28 < \( r < 0.62 \), all \( p < 0.05 \)). Movement intensity during walking in daily life was correlated with 6MWD (\( r = 0.38, p = 0.006 \)), handgrip force and quadriceps force (\( r = 0.33 \) for both, \( p = 0.02 \)), and maximal workload (\( r = 0.31, p = 0.03 \)).

Further analysis of our data showed that, in patients with COPD, 6MWD accounted by itself for most of the variability in the stepwise multiple regression models of walking time (partial \( R^2 = 0.56, p < 0.0001 \)), standing time (partial \( R^2 = 0.35, p < 0.0001 \)), and movement intensity (partial \( R^2 = 0.23, p = 0.0007 \)). No other variable (including the use of oral corticosteroids, current smoking status, and other comorbidities) contributed significantly to the explanation of walking time, standing time, and movement intensity in walking in daily life.

<table>
<thead>
<tr>
<th>TABLE 3. CHARACTERISTICS OF PHYSICAL ACTIVITIES IN DAILY LIFE IN PATIENTS WITH CHRONIC OBSTRUCTIVE PULMONARY DISEASE AND HEALTHY ELDERLY SUBJECTS</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Patients with COPD (n = 50)</strong></td>
</tr>
<tr>
<td>Walking time, min</td>
</tr>
<tr>
<td>Cycling time, min</td>
</tr>
<tr>
<td>Standing time, min</td>
</tr>
<tr>
<td>Sitting time, min</td>
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<tr>
<td>Lying time, min</td>
</tr>
<tr>
<td>Movement intensity during walking, m/s²</td>
</tr>
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</table>

For definition of abbreviation see Table 2.
In healthy elderly subjects, walking time in daily life was positively correlated with peak oxygen consumption ($r = 0.47$, $p = 0.02$) and maximal workload ($r = 0.45$, $p = 0.02$), and negatively correlated with body mass index ($r = -0.47$, $p = 0.02$). Standing time was correlated with FVC ($r = 0.47$, $p = 0.02$) and total lung capacity ($r = 0.42$, $p = 0.04$). Stepwise multiple regression showed that peak oxygen consumption was the only variable to contribute significantly to the model of walking time in healthy elderly subjects ($R^2 = 0.35$, $p = 0.003$). Age and sex were not significantly related to any outcome of the activity monitor in both populations.

**DISCUSSION**

The present study clearly showed that most patients with COPD spend significantly less time walking and standing and more time sitting and lying in daily life when compared with sedentary healthy elderly subjects. In addition, when patients with COPD do walk, they walk significantly slower than healthy subjects. Finally, the present study showed that a reduced 6MWD is the best surrogate marker of inactivity during daily life in patients with COPD.

Inactivity in COPD is not a surprising finding on itself. Others have used different tools to suggest that patients with COPD are less active compared with a control group. By using “activity counts” as outcome, Schonhofer and coworkers (9) and Singh and Morgan (28) described that patients with COPD had levels of daily movement counts that were lower than the average level recorded in age- and sex-matched healthy subjects. However, the devices used in these studies are unable to provide detailed information on time spent in different activities in real life and are likely less sensitive than triaxial accelerometers (29). Therefore, this is the first study to show detailed differences between patients with COPD and healthy control subjects in terms of time spent in different activities and positions, as well as in intensity of activities such as walking. Our results showed that patients with COPD not only walk less time per day when compared with age-matched healthy subjects, but also walk 25% slower (i.e., at a lower movement intensity). The degree of sedentary behavior in patients with COPD is further illustrated by the fact that they spent 12% of the time during the day (or twice the walking time) in the lying position, as compared with 4% in healthy elderly subjects. It is also important to note that individuals from both groups spent a large part of the day in the sitting position, which seems to be a characteristic of the elderly, whether or not they have a disease (30).

The American College of Sports Medicine states that individuals of all ages should maintain a minimum of 30 minutes of moderate exercise (e.g., walking) per day to maintain or develop fitness (1). Our study shows objective data on physical activity in daily life, providing an accurate insight on this important issue. In the present study, none of the 25 subjects included in the healthy group showed less than 30 minutes of walking time per day in both assessment days. In contrast, 15 of the 50 patients with COPD (30%) did not reach 30 minutes of walking time per day in both assessment days. In addition, even in those patients with walking time exceeding 30 minutes per day, the movement intensity was 17% lower than the movement intensity observed in healthy elderly subjects (2.0 $\pm$ 0.3 vs. 2.4 $\pm$ 0.5 m/second²; $p = 0.008$). This finding shows that even the most active patients...
with COPD probably walk at an intensity insufficient to bring benefits in terms of fitness maintenance. Furthermore, Garcia-Aymerich and colleagues (31) suggested that inactivity is a risk factor for hospital readmission in COPD. According to the threshold in their study (walking at least 60 minutes/day every day), 74% of the patients included in the present study can be considered “at risk.” These results raise concerns about the sedentary lifestyle in patients with COPD. Referral for pulmonary rehabilitation programs and encouragement to be more active in daily life should be an important part of the management of patients with COPD because inactivity may influence their clinical evolution.

Previous studies have shown significant correlation between motion counts (reported as “vector magnitude units”) and 6MWD (32, 33). Nevertheless, correlation of 6MWD with more accurate measures of physical activity level, such as walking time, standing time, and movement intensity during walking in real life, had never been previously described. In addition, the 6MWD was the only variable to enter the multiple regression model for these variables. These findings further validate the 6MWD, a simple test and easy to incorporate in the clinical routine (34, 35), as a test to reflect the functional exercise level for daily physical activities (36). In contrast to the 6MWD, outcomes such as peripheral muscle force and maximal exercise capacity showed more modest correlations with walking and standing time in real life. In addition, our results also showed that impairment in terms of airflow obstruction was weakly associated with lower activity level in daily life (see also online supplement). These results indicate that, in patients with COPD, physical activities in daily life are better predicted by a “global” or “integrative” test (e.g., 6MWD) rather than by tests focused on single components of physical functioning, such as lung function and muscle force. In fact, our study showed that 6MWD was capable of identifying patients with COPD who had low walking time during daily life. As shown in Figure 2, 16 of 20 patients with a 6MWD of less than 400 m (or ~60%predicted) had an average walking time of less than 30 minutes/day. Therefore, these patients surely cannot meet the minimum value recommended by the American College of Sports Medicine guidelines (1). In addition, three of the remaining four patients with a 6MWD of less than 400 m also had also low walking time in daily life (33–39 minutes/day, at intensities 21% lower than the average found in healthy elderly subjects). In contrast, in patients with a 6MWD higher than 400 m or 60%predicted, neither 6MWD nor any other variable in this study was able to predict accurately walking time in daily life. In other words, if the 6MWD is severely reduced, patients are markedly inactive in daily life. However, in patients with COPD with a higher 6MWD, physical activities in daily life are highly variable, hardly predictable, and require objective measurement. An important issue that remains to be elucidated is whether changes in 6MWD are related to changes in walking time in real life after interventions such as pulmonary rehabilitation programs. Concerning healthy elderly subjects, the 6MWD did not correlate to walking time in daily life ($r = -0.02, p = 0.9$).

Both groups had similar a prevalence of some comorbidities that one can argue as possible limiting factors to the performance of physical activities in daily life (high blood pressure, back pain, arthritis, obesity). In addition, none of the patients in both groups reported to feel impaired in daily life by these factors. Furthermore, no electrocardiographic abnormalities or clinical signs suggestive of severe cardiac disease that could impair the performance of usual physical activities were detected during the maximal cycling test in any subject from both groups. Therefore, patients were matched for comorbidities as far as this is possible when comparing these two populations. However, because patients with COPD tend to have higher prevalence of some comorbidities than the general elderly population (e.g., depression [17], osteoporosis [16], heart disease [18]), matching the populations for these comorbidities could arguably result in selection bias. In addition, as expected because of the disease itself, the use of oral corticosteroids had higher prevalence in the COPD group. However, use of oral corticosteroids, current smoking status, and other comorbidities did not account significantly for variation in the multiple regression models of walking time, standing time, and movement intensity in daily life. Therefore, physical activities in daily life were reduced in patients with COPD independently of these factors.

Limitations of the present study include the fact that the technique used for activity monitoring, although very precise if properly applied, is susceptible to misplacement of the device by the subjects and technical problems, which were the two reasons to consider an assessment day as invalid. Concerning misplacement of the device, although subjects were carefully instructed on how the activity monitor should be positioned and received a manual with clear instructions and figures, misplacement occurred in seven subjects, all of them patients with COPD. This is an interesting finding, especially for those who plan to perform research with activity monitoring in patients with COPD in the future. Concerning technical problems with the device, the proportion of subjects excluded for this reason among the subjects assessed for 2 days was similar in both groups (5 of 44 patients with COPD [11%] vs. 1 of 11 healthy elderly subjects [9%]). Another limiting factor of the technique is the cost of the device, which is higher when compared with other motion sensors available on the market. In addition, there is a need for technical expertise to use the software. These issues limit the use of this tool for general clinical purposes. Furthermore, the DynaPort does not measure activities of the upper extremity. This could lead to underestimation of overall energy expenditure in case the outcomes of the device are translated to kilocalories or metabolic equivalents, for example. It is also important to note that other factors not investigated deeply in the present study, such as oxygen desaturation (37) and depression (38), could also be correlated to daily activity.

In conclusion, patients with COPD are markedly inactive when compared with healthy elderly subjects in daily life. The 6MWD is the strongest correlate of walking and standing time during daily life in patients with COPD. Patients with a severely impaired 6MWD are likely to have very low physical activity level in daily life.

Conflict of Interest Statement: F.P. does not have a financial relationship with a commercial entity that has an interest in the subject of this manuscript; T.T. does not have a financial relationship with a commercial entity that has an interest in the subject of this manuscript; M.A.S. does not have a financial relationship with a commercial entity that has an interest in the subject of this manuscript; V.S.P. does not have a financial relationship with a commercial entity that has an interest in the subject of this manuscript; M.D. does not have a financial relationship with a commercial entity that has an interest in the subject of this manuscript; R.G. does not have a financial relationship with a commercial entity that has an interest in the subject of this manuscript.

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