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How many steps are enough to avoid severe physical inactivity in patients with chronic obstructive pulmonary disease?

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Abstract

While prognostically valuable, physical activity monitoring is not routinely performed for patients with COPD. We aimed to determine the number of daily steps associated with severe physical inactivity (physical activity level <1.40) in this population. We found that a daily step value <4,580 is associated with severe physical inactivity. Our results are of significant value for clinicians counseling patients with COPD to help avoid the morbidity of severe physical inactivity.

Keywords

chronic obstructive pulmonary disease; exercise; physical activity; pulmonary rehabilitation; pedometry

Regular physical activity has protective health benefits for patients with chronic obstructive pulmonary disease (COPD).¹ More importantly, severe physical inactivity defined as a physical activity level (PAL) <1.40 has been reported as the best individual predictor of all-cause 48-month mortality in this population.² The PAL is an index proposed by the World Health Organization as an objective measure of physical activity: PAL <1.40 = severely inactive, 1.40–1.69 = sedentary, and 1.70 = active. It is calculated by dividing total daily energy expenditure (kcal/day) by resting energy expenditure as measured by a multi-modality activity monitor.^{2–4} The PAL is rarely utilized in clinical practice due feasibility issues with multi-modality activity monitoring. Pedometers and low-cost activity monitors that measure steps (but not energy expenditure) are more feasible for clinical practice and may provide a reasonable surrogate for the PAL in the form of daily steps; however, the number of steps/day associated with severe physical inactivity in patients with COPD has not been reported.

We aimed to determine the relationship between steps/day and a PAL <1.40 by analyzing activity monitoring data from 165 patients with COPD. This study was approved by the Institutional Review Board at Mayo Clinic. After signing consent, each patient wore a validated monitor (SenseWear Pro ArmBand, BodyMedia Inc., Pittsburgh, PA) for 5 days which recorded daily energy expenditure and steps. PAL was calculated and analyzed as previously described.^{3,4}

Logistic regression modeling adjusting for gender, body mass index (BMI) and the age-dyspnea-obstruction (ADO) index was completed to define the value of steps/day for predicting a PAL <1.40 and showed a highly significant association with an area under the receiver operating characteristic curve (AUC) of 0.814 ($p < 0.0001$).⁵ Classification and

regression tree analysis revealed that <4,580 steps/day was the best cut-point for predicting a PAL <1.40. A Logistic regression model using this cut-point (adjusted for gender, BMI and ADO index) to predict a PAL <1.40 had an AUC of 0.818 ($p<0.001$). Patients with <4,580 steps/day were over 10 times more likely to have a PAL <1.40 (OR: 10.22 [95% CI: 3.95 - 26.46], $p<0.001$) than patients with >4,580 steps/day. A logistic model using steps/day alone had an AUC of 0.758 ($p<0.001$). The diagnostic performance of the 4,580 steps/day was respectable overall: sensitivity = 0.91, specificity = 0.57, positive predictive value = 0.75, negative predictive value = 0.81. Linear regression modeling showed that steps/day explained 35% of the variation in PAL (R-square: 0.35, $p<0.001$).

Our findings indicate that a defined number of daily steps, namely <4,580, is significantly and independently associated with severe physical inactivity (PAL <1.40) in patients with COPD. Our results also suggest that walking accounts for a significant portion of physical activity in patients with COPD making steps/day an effective marker of severe physical inactivity. While our results may benefit from replication using other methods (different monitors), the novelty of this report is the provision of a simple benchmark for use in daily practice that may help to identify severe physical inactivity (an established risk factor for adverse outcomes) in patients with COPD.

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Table 1

Characteristics of patients under study

Characteristic	n=165
Female	83 (50.3%)
Age (years)	70.4 ± 7.72
BMI (kg·m ⁻²)	29.1 ± 6.51
FEV ₁ (%pred)	42.8 ± 17.81
MMRC dyspnea grade (scale 0-4)	2.7 ± 1.1
ADO index	6.4 ± 1.79
Physical activity level (PAL)	1.39 ± 0.28
Patients with severe physical inactivity (PAL <1.40)	93 (59%)
Steps/day	3826.5 ± 3323.5

Data are presented as n (%) or mean ± SD. BMI: body mass index; FEV₁: forced expiratory volume in one second; %pred: % predicted; MMRC: modified Medical Research Council; ADO: age, dyspnea, and airflow obstruction