International Journal of Gerontology 8 (2014) 193–196

Contents lists available at SciVerse ScienceDirect

International Journal of Gerontology

journal homepage: www.ijge-online.com

Original Article

Predictors of Physical Inactivity in Elderly Patients with Chronic Obstructive Pulmonary Disease☆

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ARTICLE INFO

Article history:
Received 8 February 2012
Received in revised form
5 December 2012
Accepted 9 January 2013
Available online 17 March 2013

Keywords:
chronic obstructive pulmonary disease,
elderly,
physical inactivity

SUMMARY

Background: Aging may contribute to decreased physical activity in chronic obstructive pulmonary disease (COPD). We explored the predictors of physical inactivity in older patients with COPD.
Methods: Thirty male patients with clinically stable COPD participated in the study (age 66.9 ± 4.3 years, forced expiratory volume in 1 second [FEV_1, % of predicted] 52.6 ± 24.6%). Patient characteristics were recorded. Pulmonary function testing was performed and disease stage was determined using the Global Initiative for Chronic Obstructive Pulmonary Disease (GOLD) classification system. Maximal inspiratory and expiratory muscle strength and quadriceps muscle strength were determined using a hand-held device. Dyspnea perception was assessed using the modified Medical Research Council (MMRC) scale. Functional capacity was evaluated using a 6-minute walk test (6MWT). Heart rate and oxygen saturation were recorded before and after 6MWT. Physical activity was assessed using the International Physical Activity Questionnaire (IPAQ).
Results: In elderly COPD patients, the IPAQ sitting score was significantly related to 6MWT distance ($r = -0.51$), GOLD stage ($r = 0.52$), paroxysmal nocturnal dyspnea ($r = -0.42$) and orthopnea ($r = -0.50$), MMRC score ($r = 0.40$), FEV_1 ($r = -0.48$), FEV_1/forced vital capacity (FVC) ($r = -0.47$), forced expiratory flow between 25% and 75% of FVC ($r = -0.43$), peak expiratory flow ($r = -0.43$), baseline heart rate ($r = 0.40$), change in heart rate ($r = -0.46$), and baseline oxygen saturation ($r = -0.43$, $p < 0.05$). GOLD stage, change in heart rate, and orthopnea independently predicted the IPAQ sitting score ($R = 0.732$, $R^2 = 0.536$, $F_{(1,24)} = 4.769$, $p = 0.039$).
Conclusion: Disease severity, heart rate response to exercise, and orthopnea are determinants of physical inactivity in elderly COPD.

1. Introduction

Chronic obstructive pulmonary disease (COPD) is characterized by progressive airflow limitation. It is a major cause of morbidity, prevalently affecting older people[1–4]. The severity of COPD increases with advancing age[1]. Comorbidities and hospitalization[5] are common in older patients with COPD[1]. Age-related changes in pulmonary function[6] and a compromised immune system[1] result in high mortality rates[2]. Improvements in COPD management can increase survival despite severe disability and respiratory impairment[7].

Declining mobility is common in elderly individuals and is associated with decreased pulmonary function and respiratory and peripheral muscle strength[6], and adverse health outcomes[8]. Functional exercise capacity is also reduced in elderly patients with COPD[7]. Physiological changes in COPD, including reduced body weight, lean body mass[2], pulmonary function[9], peripheral and respiratory muscle strength[6], and reduced respiratory muscle endurance[10], are factors responsible for progressive impairment of exercise tolerance[1].

In addition to lower physical exercise capacity, physical inactivity during everyday tasks is common in patients with COPD[11].

☆ All contributing authors declare no conflict of interest.

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1873-9598/$ – see front matter
http://dx.doi.org/10.1016/j.ijge.2013.01.015

The International Physical Activity Questionnaire (IPAQ) is now commonly used in assessment of physical activity since it has acceptable measurement properties[12]. To the best of our knowledge, there is a lack of studies investigating predictors of physical inactivity in elderly patients with COPD. Since spending a large part of the day in a sitting position is considered to be a characteristic of the elderly[13], we used the IPAQ sitting score to determine the level of physical inactivity in elderly patients with COPD. The purpose of this study was to investigate predictors of physical inactivity in COPD patients with advancing age.

2. Methods

2.1. Patients

Thirty elderly male patients with COPD (61–78 years) participated in this study. The diagnosis of COPD by a pulmonologist was based on medical history, current symptoms, and pulmonary function testing following Global Initiative for Chronic Obstructive Pulmonary Disease (GOLD) guidelines[14]. All subjects had stable COPD at the time of the study. Patient characteristics including age, height, weight, time from diagnosis, and smoking history were recorded. Body mass index was calculated as kg/m^2. Subjects who had significant musculoskeletal or cardiovascular conditions were excluded. All subjects provided written consent to participate in the study, which was approved by the Hacettepe University Ethics Committee.

2.2. Measurements

2.2.1. Pulmonary function

Pulmonary function was tested using a spirometer (Spirolab; Medical International Research, Rome, Italy). The highest value from at least three technically acceptable maneuvers was expressed as a percentage of the predicted values for forced vital capacity (FVC), forced expiratory volume in 1 second (FEV_1), peak expiratory flow rate (PEF), and forced expiratory flow between 25% and 75% of FVC ($FEF_{25-75\%}$)[15].

2.2.2. Breathlessness

Functional dyspnea was measured using the modified Medical Research Council (MMRC) dyspnea scale[16]. The scale consists of five statements describing respiratory disability from none (score 0) to almost complete incapacity (score 4). The score is the number that best fits the patient's level of activity.

2.2.3. Respiratory muscle strength

Inspiratory (MIP) and expiratory muscle strength (MEP) was measured using a hand-held mouth pressure device (Micro RMP; Micro Medical, Rochester, UK). MIP was measured at residual lung volume, whereas MEP was measured at total lung capacity[10,17].

2.2.4. Peripheral muscle strength

Isometric quadriceps strength was determined using a hand-held dynamometer (PowerTrack Commander II; JTECH Medical, Salt Lake City, UT, USA) from both sides and the mean value was recorded[18].

2.2.5. Exercise capacity

Functional exercise capacity was assessed using a 6-minute walk test (6MWT) (ATS 2002). Heart rate (PF3000 heart rate monitor; Polar Electro, Kempele, Finland), oxygen saturation (KTPS-01 pulse oximeter; KTMed, Seoul, Korea), dyspnea, and fatigue on a 10-point modified Borg scale were recorded before and after the test. Two 6MWT tests at least 30 minutes apart were performed to eliminate any potential learning effect. The test producing the greater distance was used for analysis. The 6MWT results are expressed in meters and percentage of the predicted values[19]. The predicted maximum heart rate was calculated as 220 minus the patient's age to determine the percentage maximum heart rate reached at the end of the 6MWT[20].

2.2.6. Physical activity

The level of physical activity was determined using the Turkish version of the IPAQ. This is a seven-item questionnaire consisting of list of activities, and requests estimates of the duration and frequency for each activity engaged in over the previous 7 days[12]. Scores for moderate and vigorous activities and walking were calculated as the sum of the corresponding item scores in terms of duration multiplied by known metabolic equivalents (METS) per activity. The sitting question is a separate score and is not included in the physical activity score. It represents the level of physical inactivity.

2.2.7. Multidimensional disease severity

Multidimensional disease severity was measured using the BODE index, consisting of airflow obstruction (FEV_1), functional dyspnea (MMRC dyspnea scale), exercise capacity (6MWT), and body mass index[21]. For FEV_1, 6MWT, and MMRC, a score of 1–3 points was recorded; for body mass index, the score was 0 or 1 point. The points for each variable were added to obtain a score ranging from 0 to 10. The BODE index has four severity stages: Stage I (score 0–2), Stage II (score 3–4), Stage III (score 5–7), and Stage IV (score 8–10).

2.3. Statistical analysis

Statistical analysis was performed using Statistical Package for Social Sciences (SPSS) version 15.0 (SPSS Inc., Chicago, IL, USA)[22]. For descriptive analyses, data are presented as mean ± SD unless otherwise specified. Correlations were assessed using Pearson correlation coefficient analysis. Multiple linear regression was performed using the IPAQ sitting score as the dependent variable and variables significantly related according to the correlation analysis ($p \leq 0.015$) as the independent variables. Probability values of $p < 0.05$ were considered to be statistically significant.

3. Results

The characteristics for the 30 study participants are presented in Table 1. Their mean age was 66.87 ± 4.31 years and the mean FEV_1

Table 1
Anthropometric and functional characteristics for COPD patients.

	Mean ± SD	Range
Age (y)	66.87 ± 4.31	61–78
Body mass index (kg/m^2)	25.53 ± 3.72	17.36–33.98
Time from diagnosis (y)	8.42 ± 6.47	1–30
MMRC	1.73 ± 0.91	0–3
FEV_1 (%)	52.62 ± 24.59	16–104
FVC (%)	68.79 ± 21.74	38–113
FEV_1/FVC	60.74 ± 13.56	33.50–78.60
PEF (%)	57.28 ± 27.28	20–128
$FEF_{25-75\%}$ (%)	30.07 ± 19.99	9–82
Smoking (pack-y)	47.76 ± 27.10	1–110
6MWT distance (m)	497.72 ± 118.28	171–655.6
HR_{max} (%)	72.58 ± 10.78	51.61–99.33
BORG-dyspnea (0–10)	2.23 ± 2.45	0–9
BORG-fatigue (0–10)	2.32 ± 2.37	0–10
MIP (cmH_2O)	86.66 ± 28.23	22–153
MEP (cmH_2O)	132.93 ± 36.98	72–244
SpO_2 (%)	94.37 ± 2.44	89–99
Quadriceps muscle strength (N)	288.48 ± 76.66	107.60–427.50
IPAQ total	1662.16 ± 2370.99	149–12159
IPAQ sitting	583.45 ± 205.29	180–960
BODE index (0–10)	2.59 ± 2.10	0–8