Published in final edited form as:
J Cardiopulm Rehabil Prev. 2011 ; 31(3): 193–197. doi:10.1097/HCR.0b013e3181fc09b7.

The role of physical inactivity in increasing disability among older adults with obstructive airway disease

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Abstract

PURPOSE—The independent contribution of physical inactivity to disability in obstructive lung disease (OLD) is difficult to study, partly because inactivity may reflect disease severity. We examined the relationship of physical inactivity to disability progression over a 1-year period among a group of older adults with OLD.

METHODS—A population-based cohort with self-reported physician-diagnosed emphysema, chronic obstructive pulmonary disease, or chronic bronchitis (n=206) completed baseline interviews and in-person spirometry, with 1-year followup interviews. The Community Health Activities Model Program for Seniors (CHAMPS) Physical Activity Questionnaire provided estimates of energy expenditure; we defined inactivity as no expenditure in moderate or vigorous intensity activities. Disability was measured with the Valued Life Activity (VLA) disability scale; increased disability was defined as a ≥10% increase in VLA disability score over 1-year followup. Logistic regression tested the relationship between baseline inactivity and disability increase, controlling for age, sex, baseline VLA disability, comorbidities, smoking, and pulmonary function (forced expiratory volume in 1 second, % of predicted).

RESULTS—Of 206 subjects, 48 (27%) were physically inactive at baseline; 42.9% of individuals whose disability increased were inactive at baseline compared to 23.4% of those who did not experience a disability increase. With adjustment for covariates, increased disability after 1 year was significantly (*P*=.04) more likely among individuals who were inactive at baseline (OR=2.4 [1.02, 5.9]).

CONCLUSION—Physically inactive individuals with OLD had more than double the odds of an increase in disability, even after controlling for baseline disability, lung function, and other covariates. These results provide strong support for the importance of maintaining physical activity among individuals with OLD.

Key words or phrases

Obstructive lung disease; physical activity; physical inactivity; disability

In the general population, low levels of physical activity are associated with greater disability and health care utilization, as well as an increased risk of mortality. Similar associations have been noted among older adults with obstructive lung disease (OLD), particularly chronic obstructive pulmonary disease (COPD).[1,2] Adults with COPD tend to be less active than age-matched peers without COPD,[3] but the contribution of physical inactivity to disability in COPD is difficult to study, in part because physical inactivity may

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simply reflect disease severity. Delineating the role of physical inactivity in the progression of disability among adults with OLD, taking into account lung function as a measure of severity, could inform rehabilitation strategies. The objective of this study was to examine the longitudinal relationship between physical inactivity and progression of disability in a group of older adults with self-reported physician diagnose of COPD, chronic bronchitis, or asthma.

METHODS

We used data from an ongoing population-based, longitudinal cohort study of U.S. adults with various airways diseases followed by telephone interview. During the initial recruitment in 2001, subjects aged 55–75 years were asked if they had ever been diagnosed by a physician with chronic bronchitis, emphysema, chronic obstructive pulmonary disease (COPD) or asthma; if so, they were included in the OLD cohort (n=517 at baseline). The initial recruitment also included individuals with allergic rhinitis or sleep apnea, who are not included in this analysis. Annual retention among the original sample averaged approximately 80% over 5 annual followup telephone interviews through 2006. In 2006, another 375 individuals were added from northern California using the same recruitment protocol, for a total sample size of 675 at that point. Of this total, 243 reported either COPD or emphysema, 209 reported chronic bronchitis without concomitant COPD or emphysema, and 139 reported asthma only. In 2007, 86% (583 individuals) were reinterviewed. The analyses reported here are limited to individuals who reported COPD, emphysema, chronic bronchitis, or asthma; completed a home visit with a corresponding telephone interview in either 2006 or 2007, as described below (n=206); and completed at least 1 followup telephone interview in the year after the home visit (n=176). The study was approved by the University Committee on Human Research.

Home visit

At the end of both the 2006 and 2007 telephone interviews, participants who lived in Northern California were asked to participate in a home visit. Among the assessments made during the home visit were spirometry and a physical activity questionnaire. Home visits were conducted an average of 45 days following the telephone interview. Home visit personnel received extensive training in all procedures and were required to demonstrate correct performance of all procedures, including spirometry, prior to going out into the field. Of 327 individuals who were geographically eligible, 251 (77%) received a home visit; 240 of these had self-reported physician diagnose of COPD, emphysema, chronic bronchitis, or asthma. Of the 240, 34 individuals did not complete spirometry and/or the physical activity measure, leaving 206 with complete data from the home visit.

Physical activity

Physical activity was measured with the Community Healthy Activities Model Program for Seniors (CHAMPS) Physical Activity Questionnaire for Older Adults.[4] The CHAMPS is a self-report questionnaire designed specifically for use with older populations, and has been found to be valid, reliable, and sensitive to change.[4,5] Respondents report the total time spent in activities for a typical week. Each activity is linked to a metabolic equivalent (MET) value. Two measures of estimated caloric expenditure per week can be derived from questionnaire responses: expenditure in all activities including light intensity activities, and expenditure only in activities of moderate or vigorous intensity (MET value ≥3.0). We defined physical inactivity as no expenditure reported in moderate or vigorous intensity activities.

Disability

Disability was measured using the Valued Life Activities (VLA) scale, which assesses difficulty in functioning in 28 activity domains, ranging from self-care to household chores to social and recreational activities.[6,7] Respondents rate difficulty caused by their condition in each life activity (0=no difficulty, 1=a little difficulty, 2=a lot of difficulty, and 3=unable to perform). Activities that respondents do not perform for reasons unrelated to their respiratory condition or that are not applicable to them are not rated or included in scoring. The summary score used for this study was the proportion of activities affected (unable to perform or able to perform but with some level of difficulty; % affected). An increase in disability was defined as an increase ≥10% in the proportion of VLAs affected between the baseline and 1-year follow-up telephone interviews, a cut-point that we have used in previous analysis.[8]

Other variables

Age, sex, race, education, and smoking history were collected in the telephone interview. Smoking history was classified as current, former, or never. Participants were asked whether a physician had diagnosed any of the following comorbid conditions: high blood pressure, heart disease, diabetes, arthritis, cancer, stroke, or kidney disease. For analysis, individuals were categorized as having 0, 1, or ≥2 of these comorbid conditions.

Pulmonary function testing was conducted using the EasyOne™ Frontline spirometer (NDD Medical Technologies, Chelmsford, MA), which meets American Thoracic Society (ATS) criteria. Spirometry was performed according to ATS guidelines.[9] Predictive equations derived from NHANESIII were used to calculate percent predicted pulmonary function values.[10]

Analysis

Differences between individuals who were available for the 1-year follow-up and those who were lost to followup were tested with *t*-tests and χ^2 analyses. Bivariate differences between individuals stratified by baseline physical inactivity and between individuals stratified by an increase in VLA disability were also tested with *t*-tests and χ^2 analyses. Logistic regression tested the risk of mortality conferred by physical inactivity, with and without adjustment for FEV_1% predicted. Multivariate logistic regression tested the relationship between baseline physical inactivity and a prospective increase in disability, with adjustment for sex, comorbidities, smoking status, education, forced expiratory volume in 1 second, % of predicted (FEV_1% predicted), and baseline VLA disability.

RESULTS

The analysis sample was 64.2% female, with mean age 65.8 (± 6.0) years (Table 1). Physician diagnoses of COPD or emphysema were reported by 44%; 32% reported chronic bronchitis without COPD or emphysema; and 24% reported asthma without COPD, emphysema, or chronic bronchitis. Three quarters had 1 or more nonrespiratory comorbid conditions, and 15% were current smokers. The mean proportion of VLAs affected at baseline was 25.6 (± 28.8), and 27.3% of subjects (n=48) met the study definition of physical inactivity.

Individuals who did not participate in an interview in the 1-year following their home visit (ie, were lost to followup) were more likely to be male (60% vs. 36% of those who remained in the study; *P*=.01) and had greater baseline VLA disability (40.2% of VLAs affected vs. 25.6%; *P*=.02). Overall loss to followup for any reason was not associated with physical inactivity (*P*=.50), but those who were physically inactive at baseline had a significantly

higher likelihood of loss-to-follow-up due to death: among the physically inactive, 10.2% (n=6) died prior to follow-up, compared to 3.3% (n=5) of those who were not inactive (*P*=.05, unadjusted OR = 3.3 [1.0, 11.3]). The relationship between physical inactivity and mortality was somewhat attenuated when the analysis controlled for FEV_1 % predicted, but the odds ratio remained elevated (adjusted OR = 3.2 [0.9, 11.0]).

Physical inactivity

Approximately one quarter (27.3%) of the sample met the study definition for physical inactivity at baseline (Table 1). Those who were physically inactive were more likely to have nonrespiratory comorbid conditions (*P*=.04), and to be current smokers (*P*=.02). There were no significant differences in FEV_1 by activity status. Those who were physically inactive also reported greater VLA disability at baseline (39.3% of VLAs affected vs. 20.4%, *P*<.001).

Prospective increase in disability

Disability increased for 19.9% of the sample (n=35) over the 1-year follow-up period (Table 2). Individuals in the COPD cohort were over-represented in the VLA disability group (69%) when compared to their representation in the entire population at the 1-year followup assessment (44%), and had worse pulmonary function as measured by FEV_1 % predicted (77.9 vs. 87.3, *P*=.01). There were no significant differences between individuals who did and did not experience a prospective increase in disability for age, sex, education, number of comorbid conditions, smoking status, or baseline disability (Table 2).

Physical inactivity at baseline was a strong predictor of a prospective increase in disability (unadjusted OR 2.5 [95% CI 1.1, 5.3]). Almost half of individuals whose disability increased (42.9%) were inactive at baseline compared to 23.4% of those who did not experience an increase in disability. Adjusting for covariates, including FEV_1 % predicted as a marker of disease severity, as well as sex, comorbidities, smoking, education, and baseline VLA disability, the odds of an increase in disability after 1 year remained almost 2.5 times higher among individuals who were inactive at baseline (adjusted OR = 2.4 [1.02, 5.9]).

DISCUSSION

About 25% of this sample of older adults with OLD were physically inactive, and 20% experienced an increase in disability over a relatively brief 1-year followup period. In our longitudinal analysis, we found that individuals who were physically inactive had more than double the odds of an increase in disability over the subsequent year, even after controlling for baseline disability, lung function, and other potential confounders. Given the relatively brief followup period (one year), these results are striking and provide strong support for the importance of maintaining physical activity among individuals with OLD. The unexpected findings that inactivity was associated with one-year mortality even after controlling for lung function, further underscores the clinical relevance of inactivity.

The cross-sectional associations noted in this study illustrate both the difficulty in disentangling the relationship between physical inactivity, health status, and the development of disability and the importance of controlling for confounding in evaluating the relationship between physical inactivity and development of disability. For example, participants who were inactive reported more comorbid conditions and were more likely to be current smokers, both factors that could independently contribute to the development of further disability. It was surprising that FEV_1 was not associated with baseline inactivity, given that lower FEV_1, by virtue of worse dyspnea, might be expected to contribute to greater inactivity. This result may have been due to a lack of statistical power, given the

marginally higher, although not statistically significant (P=.25), estimate for FEV_1 in active vs. inactive subjects. The fact that lower FEV_1 was indeed associated with the development of further disability is consistent with the importance of lung function in relation to activity level, and suggests the importance of controlling for this factor in examining additional risk factors for worsening disability.

Physical inactivity is commonly noted among individuals with COPD.[3,11,12] There is a strong relationship between physical activity and improved outcomes, including reduced lung function decline and hospital admissions, lower incidence of cognitive impairment, and lower risk of mortality.[2,13–15] Moreover, physical inactivity is a risk factor than can be affected by pulmonary rehabilitation or self-management.[2] Participation in a program of at least moderate intensity physical activity may offer older adults with OLD some degree of protection from worsening disability. In fact, studies generally show increased physical activity following pulmonary rehabilitation,[16] and there is recent evidence supporting consideration of pulmonary rehabilitation earlier in the course of COPD.[16] Earlier access to such interventions may be effective in increasing physical activity and thereby decreasing or slowing the progression of disability.

Acknowledgments

This study was supported by the National Institutes of Health [National Heart, Lung and Blood Institute grant number R01 HL067438].

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Table 1

Subject characteristics

	Dropped out after visit 1 (n=30)	Analysis sample (available for followup; n=176)	*P* value[a]	Among analysis sample: Physical activity level at baseline		
				Active 72.7% (n=128)	Inactive 27.3% (n=48)	*P* value[b]
Age, y, mean (SD)	64.5 (6.4)	65.8 (6.0)	.30	65.6 (5.8)	66.4 (6.6)	.39
Female, % (n)	40.0 (12)	64.2 (113)	.01	60.2 (77)	75.0 (36)	.07
Education ≤high school, % (n)	80.0 (24)	77.8 (137)	.79	80.5 (103)	70.8 (34)	.17
Self-reported physician diagnosed, % (n)			.57			.10
COPD or emphysema	53.3 (16)	43.9 (79)		38.3 (49)	56.3 (27)	
Chronic bronchitis alone	30.0 (9)	32.2 (58)		35.2 (45)	25.0 (12)	
Asthma without COPD or CM	16.7 (5)	23.9 (43)		26.6 (34)	18.8 (9)	
Nonrespiratory comorbid conditions, % (n)			.45			.04
0	23.3 (7)	25.0 (44)		29.7 (38)	12.5 (6)	
1	30.0 (9)	39.8 (70)		39.1 (50)	41.7 (20)	
2+	46.7 (14)	35.2 (62)		31.3 (40)	45.6 (22)	
Smoking status, % (n)			.71			.02
Current smoker	20.0 (6)	14.8 (26)		10.2 (13)	27.1 (13)	
Former smoker	56.7 (17)	56.8 (100)		59.4 (76)	50.0 (24)	
Never smoked	23.3 (7)	28.4 (50)		30.5 (39)	22.9 (11)	
FEV_1 % predicted, mean (SD)	81.5 (21.3)	85.4 (19.5)	.31	86.6 (18.4)	82.4 (22.3)	.25
FEV_1/FVC, mean (SD)	0.62 (0.16)	0.65 (0.15)	.28	0.66 (0.14)	0.63 (0.17)	.20
VLA % affected, mean (SD)	40.2 (32.7)	25.6 (28.8)	.02	20.4 (25.7)	39.3 (32)	.0005
Physically inactive, % (n)	33.3 (10)	27.3 (48)	.50	NA	NA	

[a] difference between individuals included in the analysis and those who were lost to followup, assessed by *t*-test or χ^2 analysis

[b] difference between individuals who were physically active and inactive at baseline, assessed by *t*-test or χ^2 analysis

Abbreviations: COPD, CM, FEV_1, FVC, VLA

Table 2

Baseline characteristics of individuals with and without an increase in VLA disability at 1-year followup[a]

Baseline characteristic	No increase in disability (80.1%, n=141)	Increase in disability (19.9%, n=35)	*P* value[b]
Age, y, mean (SD)	65.6 (6.1)	66.7 (5.7)	.33
Female, % (n)	61.7 (87)	74.3 (26)	.16
Education ≤ high school, % (n)	76.6 (108)	82.9 (29)	.42
Self-reported physician diagnosed			.003
COPD	36.9 (52)	68.6 (24)	
Chronic bronchitis	36.2 (51)	17.1 (6)	
Asthma	27.9 (38)	14.3 (5)	
Nonrespiratory comorbid conditions, % (n)			.70
0	26.2 (37)	20.0 (7)	
1	39.7 (56)	40.0 (14)	
2+	34.0 (48)	40.0 (14)	
Smoking status			.22
Current smoker	13.5 (19)	20.0 (7)	
Former smoker	55.3 (78)	62.9 (22)	
Never smoked	31.2 (44)	17.1 (6)	
FEV_1 % predicted, mean (SD)	87.3 (18.9)	77.9 (20.4)	.01
FEV_1/FVC, mean (SD)	0.66 (0.15)	0.59 (0.16)	.02
VLA % affected, mean (SD)	25.6 (30.3)	25.6 (22.1)	.99
Physically inactive, % (n)	23.4 (33)	42.9 (15)	.02

[a] Increase in VLA disability defined as an increase in the proportion of VLAs affected by ≥10%

[b] *P*-value from comparison of individuals with and without increases in disability using *t*-tests or χ^2 analyses

Abbreviations: COPD, FEV_1, FVC, VLA