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COMBINED REDUCED FORCED EXPIRATORY VOLUME IN 1-SECOND (FEV1) AND PERIPHERAL ARTERY DISEASE IN SEDENTARY ELDERLY WITH FUNCTIONAL LIMITATIONS

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Abstract

Objectives—Because they are potentially modifiable and may coexist, we evaluated the combined occurrence of a reduced forced expiratory volume in 1-second (FEV1) and peripheral artery disease (PAD), including its association with exertional symptoms, physical inactivity, and impaired mobility, in sedentary elders with functional limitations.

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Author Contributions: Dr. Vaz Fragoso had full access to all of the data in the study and takes responsibility for the integrity of the data and the accuracy of the data analysis. All authors made substantial contributions to study concept and design, to data acquisition, analysis and interpretation, and to drafting the submitted article. Research investigators for the LIFE Study group are listed in Appendix B.

Sponsor's Role: The investigators retained full independence in the conduct of this research and report no conflicts of interest.

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Design—Cross-sectional.

Setting—Lifestyle Interventions and Independence in Elder (LIFE) Study.

Participants—1307 sedentary community-dwelling persons, mean age 78.9, with functional limitations (Short Physical Performance Battery [SPPB] <10).

Measurements—A reduced FEV1 was defined by a Z-score <-1.64 (< lower limit of normal), while PAD was defined by an ankle-brachial index <1.00. Exertional dyspnea was defined as moderate-to-severe (modified Borg index), immediately after a 400-meter walk test (400MWT). Exertional leg symptoms were established by the San Diego Claudication Questionnaire. Physical inactivity was evaluated by percent of accelerometry wear-time with activity <100 counts/min (top quartile established high sedentary-time). Mobility was evaluated by the 400MWT (gait-speed <0.8 m/s defined as slow) and SPPB (<7 defined moderate-to-severe mobility impairment).

Results—A combined reduced FEV1 and PAD was established in 6.0% (78/1307) of participants. However, among those who had a reduced FEV1, 34.2% (78/228) also had PAD, while 20.8% (78/375) of those who had PAD also had a reduced FEV1. The two combined conditions were associated with exertional dyspnea (adjusted odds ratio [adjOR] 2.59 [1.20, 5.60]) and slow gait-speed (adjOR 3.15 [1.72, 5.75]) but not with exertional leg symptoms, high sedentary-time, and moderate-to-severe mobility impairment.

Conclusions—In sedentary community-dwelling elders with functional limitations, a reduced FEV1 and PAD frequently coexisted and, in combination, were strongly associated with exertional dyspnea and slow gait-speed (a frailty indicator that increases the risk of deleterious outcomes).

Keywords

FEV1; peripheral artery disease; mobility; sedentary

INTRODUCTION

Older persons are at risk of having respiratory disease, a consequence of frequent exposures to tobacco smoke, respiratory infections, air pollutants, and occupational dusts, and of an age-related vulnerability for developing disease.¹ The diagnosis of respiratory disease is often based on spirometric measures, including a reduced forced expiratory volume in 1-second (FEV1).¹⁻³ Because it predicts the maximal attainable ventilation during exercise, a reduced FEV1 can lead to exercise intolerance and exertional dyspnea.¹⁻³

The risk of peripheral artery disease (PAD) also increases in older age.⁴ For example, the prevalence of PAD increases exponentially across groups aged ≥40, doubling each decade for most ethnicities.⁴ PAD increases the risk of having lower-extremity functional impairment, including exertional leg symptoms and exercise intolerance.^{5,6} Because it is associated with tobacco smoke, PAD may coexist with a reduced FEV1.⁷⁻¹¹

Older age is additionally characterized by sedentary status and functional limitations. Prior work has shown that only 17.4% of Americans aged ≥75 reported any regular leisure-type physical activity,¹² and that 53.4% of community-dwelling elders who reported no disability had functional limitations (Short Physical Performance Battery [SPPB] <10).¹³ Importantly,

older persons who are sedentary and have functional limitations are at increased risk of future disability,^{13,14} and hence represent a highly vulnerable population wherein identifying potentially modifiable factors has strong clinical relevance.

Although prior work has shown that a reduced FEV1 and PAD may coexist, study populations were limited to those who had chronic obstructive pulmonary disease or had undergone major vascular surgery.⁸⁻¹¹ As a result, the combined prevalence of a reduced FEV1 and PAD, including its clinical relevance, remains to be established in sedentary elders with functional limitations.¹⁵ Accordingly, and because they are potentially modifiable, we have evaluated the combined occurrence of a reduced FEV1 and PAD, including cross-sectional associations with exertional symptoms, physical inactivity, and impaired mobility in a large sample of sedentary community-dwelling elders with functional limitations (SPPB<10) — i.e., Lifestyle Interventions and Independence for Elders (LIFE) Study.^{16,17} At baseline, the LIFE Study administered validated questionnaires of exertional dyspnea and leg symptoms, as well as recorded objective measures of physical activity and mobility, spirometry (FEV1), and ankle-brachial index (PAD).^{16,17} In addition, the LIFE study has evaluated the FEV1 as a Z-score, providing a more age-appropriate method for defining the lower limit of normal (LLN) than the current standard.^{1,2,18,19} In particular, an FEV1 Z-score <-1.64 (<LLN) is likely to establish respiratory disease because it rigorously accounts for age-related changes in lung function, including variability in spirometric performance.^{1,2,18,19}

METHODS

Study Population

The LIFE Study is a multicenter randomized controlled trial designed to compare a moderate intensity physical activity program with a successful aging health education program in 1635 sedentary community-dwelling persons aged 70-89.¹⁶ The study design has been described in detail elsewhere.¹⁷ In brief, eligibility criteria included low physical activity and functional limitations (SPPB <10), but participants were otherwise non-disabled (able to walk 400 meters in 15 minutes without assistance). The Institutional Review Boards of the eight participating centers approved all study procedures. The present study reports on the baseline evaluation of participants who had valid measurements for both FEV1 and ABI (described below).

Demographic and Clinical Characteristics

The baseline characteristics included age, sex, ethnicity, body mass index (BMI), smoking status, chronic conditions, and health status. Chronic conditions were self-reported, physician-diagnosed, and included hypertension, diabetes mellitus, symptomatic arthritis, chronic lung disease, coronary artery disease, stroke, hip fracture, and heart failure. To assess health status, participants were asked, “Would you say your health in general is excellent, very good, good, fair, or poor?” Reduced health was defined as a rating of “fair-to-poor.”

Exertional Dyspnea and Leg Symptoms

The modified Borg index is a multilevel scale that evaluates dyspnea after a physical activity — the higher the Borg, the more severe the dyspnea.²⁰ Using this scale immediately after a 400MWT (described below), dyspnea was categorized as none to just-noticeable (Borg <1), mild (Borg 1 and 2), and moderate-to-severe (Borg >2).²⁰

Exertional leg symptoms were established by a “Yes” response to the following question from the San Diego claudication questionnaire:²¹ “Do you get pain in either leg or either buttock when walking?” We chose not to categorize further by intermittent claudication because only 20 (1.5%) participants who completed the questionnaire had this symptom. Although intermittent claudication is considered the most classic manifestation of PAD, most men and women with PAD do not have classic intermittent claudication symptoms.²²

Spirometry

The spirometric protocol involved at least three trials of a forceful exhalation maneuver, starting from maximal inspiration and concluding with a 6-second end-of-test criterion.² The FEV1 was recorded as the highest value achieved during the spirometric trials which had attained a quality grade C or higher for FEV1. Of the 1,635 LIFE participants, 1362 (83.3%) achieved a valid FEV1. For comparisons between measured and predicted FEV1 values, we used reference equations from the Global Lung Function Initiative (GLI).²³ Using the GLI reference equations, Z-scores for FEV1 were calculated for each participant, with a Z-score of -1.64 defining the lower limit of normal (LLN) as the 5th percentile of the distribution.²³ Hence, participants were classified as having a reduced FEV1 if the Z-score was less than -1.64.

Peripheral Artery Disease (PAD)

The presence or absence of PAD was established by the leg with the lower ABI, measured after the participant rested supine for five minutes and using a hand-held Doppler probe to obtain systolic pressures at the right brachial artery, right posterior tibial artery, left posterior tibial artery, and left brachial artery in the order listed.²⁴ Pressures were repeated in reverse order. The ABI was calculated for each leg by averaging the two posterior tibial artery pressures and dividing them by the average of the four brachial artery pressures.

To optimize the available number of outcomes for analyses, we established the presence and absence of PAD based on an ABI <1.00 and 1.00-1.40, respectively.²⁵ An ABI <1.00 included both definite and borderline PAD.^{24,25} In sensitivity analysis, however, we also used an ABI <0.90 and 0.90-1.40 to establish the presence and absence of definite PAD, respectively.^{24,25} Of the 1,635 LIFE participants, 1566 (95.8%) achieved a valid ABI.

Physical Inactivity and Mobility Impairment

Physical inactivity was established by accelerometry, using the ActiGraph GT3X and ActiLife software (version 5) (ActiGraphTM LLC, Pensacola, FL), over a planned 7-day monitoring period. Briefly summarized, after dressing each morning, participants placed the accelerometer on their right hip (waistline belt), thereafter removing the monitor just prior to going to bed at night. Sedentary-time was defined by percent of accelerometry wear-time

with activity <100 counts/minute, averaged across days.²⁶ Participants who were in the top quartile of sedentary-time were classified as having high sedentary-time.

Mobility measures included the 400MWT and the SPPB.¹⁶ The 400MWT was completed at the participant's usual walking pace over a 40-meter course. A gait-speed of <0.8 m/sec was operationalized as slow.²⁷ The SPPB is a summary performance measure consisting of time to walk 4-meters at usual pace, time to complete five chair stands, and three increasingly difficult standing balance maneuvers.¹³ An SPPB ≤ 7 was selected to identify participants as having moderate-to-severe mobility impairment (relative to scores of 8 and 9, which were considered mild mobility impairment).¹³

Statistical Analysis

The baseline clinical characteristics, including exertional dyspnea and leg symptoms, were summarized as means accompanied by standard deviations or as counts accompanied by percentages. Similarly, the FEV1, ABI, and measures of physical inactivity and mobility were also summarized, first as continuous variables and then as dichotomous variables.

Next, we evaluated the associations of a combined reduced FEV1 and PAD on exertional dyspnea and leg symptoms, high sedentary-time, slow gait-speed, and moderate-to-severe mobility impairment, respectively, by calculating odds ratios and 95% confidence intervals using logistic and multinomial logistic regression models (a multinomial model was required for the 3-level dyspnea variable). In these analyses, the reference group included a normal FEV1 without PAD (FEV1 $\geq$ LLN and ABI 1.00-1.40, respectively), while the comparison groups included 1) PAD with normal FEV1, 2) reduced FEV1 without PAD, and 3) reduced FEV1 with PAD. Covariates in the adjusted models included age, height, sex, race, BMI, smoking, chronic conditions (number and type), fair-to-poor health status, and LIFE Study site. In sensitivity analysis, these same associations were evaluated using an ABI <0.90 and 0.90-1.40 to establish the presence or absence of PAD.

All statistical analyses were performed using SAS v9.3 (Cary, NC), and assuming a Type I error rate of 0.05.

RESULTS

Of the 1,635 LIFE participants, 1307 (79.9%) had a valid FEV1 and ABI. Table 1 summarizes the clinical characteristics of the analytical sample. The mean age was 78.8; 68.3% were female and 75.8% were white. The mean BMI was 30.3 kg/m². A smoking history was reported by 48.1% (former and current smokers). The mean number of chronic conditions was 1.5, with the five most frequent being hypertension, diabetes mellitus, symptomatic arthritis, chronic lung disease, and coronary artery disease. A reduced health status was reported by 34.5%. Exertional dyspnea was reported as mild by 34.4% and moderate-to-severe by 31.0%, while exertional leg symptoms were reported by 25.4%.

Of the 1,635 LIFE participants, 328 (20.1%) were excluded from the analytical sample because they did not have a valid FEV1 and ABI. In comparison with participants in the analytical sample, those who were excluded were less likely to be female (62.5% vs. 68.3%;

$p = .045$) and had a higher prevalence of coronary artery disease (11.1% vs 7.1%; $p = .019$). There were no significant differences according to age, ethnicity, BMI, smoking status, number of chronic conditions, health status, or exertional symptoms.

Table 2 summarizes the FEV1 and ABI, including the FEV1/PAD groups. A reduced FEV1 and PAD were established in 17.4% and 28.7%, respectively, with 6.0% having both conditions. However, among participants who had a reduced FEV1, 34.2% (78/228) also had PAD, whereas 20.8% (78/375) of those who had PAD also had a reduced FEV1. Table 2 additionally summarizes measures of physical inactivity and mobility. Physical inactivity, defined by sedentary-time, was observed during 77.0% of accelerometry wear-time. A slow gait-speed was present in 43.2% of participants and moderate-to-severe mobility impairment in 44.7%. These features did not differ between participants who were included versus excluded from the analytic sample.

Table 3 shows the associations of a combined reduced FEV1 and PAD on exertional dyspnea and leg symptoms, respectively. In these analyses, the reference group included a normal FEV1 without PAD, while the three comparison groups included PAD with a normal FEV1, reduced FEV1 without PAD, and reduced FEV1 with PAD. In adjusted models, significant differences were found across the comparison groups regarding their associations with exertional dyspnea ($p=0.002$), but not with exertional leg symptoms ($p=0.060$). In particular, a reduced FEV1 with and without PAD was strongly associated with moderate-to-severe exertional dyspnea — adjusted odds ratios (adjOR) of 2.59 (1.20, 5.60) and 2.38 (1.41, 4.02), respectively. In contrast, PAD with a normal FEV1 was not associated with moderate-to-severe exertional dyspnea — adjOR of 0.75 (0.48, 1.17). In sensitivity analysis, results were comparable when using an ABI <0.90 (rather than <1.00) for establishing PAD (Appendix A).

Table 4 shows the associations of a combined reduced FEV1 and PAD on high sedentary-time, slow gait-speed, and moderate-to-severe mobility impairment, respectively. The reference and comparison groups were the same as described in Table 3. In adjusted models, significant differences were found across the three comparison groups for slow gait-speed ($p<0.001$), but not for high sedentary-time ($p=0.127$) or moderate-to-severe mobility impairment ($p=0.087$). In particular, a reduced FEV1 with PAD was strongly associated with slow gait-speed, yielding an adjOR of 3.15 (1.72, 5.75) — this effect was additive, rather than multiplicative (p -value for interaction was 0.452). In contrast, PAD with a normal FEV1 and reduced FEV1 without PAD yielded adjORs for slow gait-speed of only 1.57 (1.11, 2.24) and 1.50 (0.99, 2.27), respectively. In sensitivity analysis, results were comparable when using an ABI <0.90 (rather than <1.00) for establishing PAD (Appendix A).

DISCUSSION

In a large sample of sedentary community-dwelling elders with functional limitations, a reduced FEV1 and PAD were prevalent (17.4% and 28.7%, respectively), with 6.0% of participants having both conditions. Similarly, prevalence rates were high for moderate-to-severe exertional dyspnea (31.0%), exertional leg symptoms (25.4%), slow gait-speed

(43.2%), and moderate-to-severe mobility impairment (44.7%), and most physical activity was spent in the sedentary range (77.0% of accelerometry wear-time).

In models adjusted for multiple potential confounders, we also found that a combined reduced FEV1 and PAD increased significantly the odds of having slow gait-speed by 215%, but not the odds of having exertional leg symptoms, high sedentary-time, or moderate-to-severe mobility impairment. Although a combined reduced FEV1 and PAD increased significantly the odds of having moderate-to-severe exertional dyspnea by 159%, the association was only significant for reduced FEV1 alone, and not for PAD alone. Lastly, in sensitivity analysis, these results were comparable when using an ABI <0.90 (rather than <1.00) for establishing PAD.

Our results suggest that the combined occurrence of reduced FEV1 and PAD has clinical relevance among sedentary community-dwelling older persons, for at least two reasons. First, although seemingly modest, the prevalence of these combined conditions was nonetheless similar to that of coronary artery disease, stroke, and heart failure in the LIFE Study (6.0% versus 7.1%, 6.5%, and 4.2%, respectively). Second, these combined conditions had a strong association with slow gait-speed. Prior work has shown that slow gait-speed in older persons is strongly associated with adverse outcomes, including falls, cognitive impairment, disability, institutionalization, and mortality.^{27,28}

The effect of a combined reduced FEV1 and PAD on slow gait-speed was additive, not multiplicative (p-value for interaction was 0.452). Namely, the odds ratios of having slow gait-speed for a combined reduced FEV1 and PAD was similar to adding together the odds ratios from reduced FEV1 alone and PAD alone. An additive effect is especially meaningful when two conditions frequently coexist.⁸ In particular, among LIFE participants who had PAD based on ABI <1.00, we found that 20.8% also had reduced FEV1 (Table 2). Conversely, among those who had reduced FEV1, 34.2% also had PAD based on ABI <1.00 (Table 2). These prevalence rates were comparable when using an ABI <0.90 (rather than <1.00) for establishing PAD (Appendix A, Table 2A).

Future work should evaluate the mechanisms that underlie the association of a combined reduced FEV1 and PAD on slow gait-speed. One potentially modifiable mechanism may relate to exercise intolerance that is due to multiple types of cardiopulmonary disease.³ LIFE participants, for example, frequently reported a smoking history and other cardiovascular risk factors (hypertension, diabetes, and obesity), as well as chronic lung disease and other types of cardiovascular disease (coronary artery disease, stroke, and heart failure).

Although strongly associated with slow gait-speed, a combined reduced FEV1 and PAD was not significantly associated with other measures of mobility (moderate-to-severe mobility impairment), nor associated with physical inactivity (high sedentary-time). These results suggest that, among sedentary older persons, a reduced FEV1 and PAD are likely to jointly affect endurance (slow gait-speed was determined during the 400MWT), but not measures that require a short walking distance (moderate-to-severe mobility impairment was based on the SPPB, which included only 4 meters of walking) or establish very low levels of physical activity (high sedentary-time).

In regards to exertional symptoms, we found that a combined reduced FEV1 and PAD increased significantly the odds of having moderate-to-severe exertional dyspnea but the association was entirely due to a reduced FEV1, and not PAD. These results were comparable regardless of whether the ABI threshold was 1.00 and 0.90, suggesting that PAD may not be an important contributor to exertional dyspnea in older persons. Because it impairs walking ability, PAD may limit exercise to a low workload that is otherwise insufficient to increase ventilatory demand to levels that would lead to dyspnea. Nonetheless, future work should evaluate whether dyspnea limits the therapeutic response to a moderate intensity physical activity program among participants who have PAD. We posit that, in contrast to the 400MWT which is performed at the participant's usual pace, a moderate intensity physical activity program may increase ventilatory demand in PAD (higher exercise workloads may increase CO₂ flux due to bicarbonate buffering of an earlier lactate threshold).³

We also found that the combined occurrence of reduced FEV1 and PAD was not associated with exertional leg symptoms, regardless of whether the ABI threshold was 1.00 and 0.90. However, among participants who had PAD alone, the adjOR of having exertional leg symptoms increased from 0.98 (0.67, 1.44) to 1.43 (0.87, 2.35) when the ABI threshold was reduced from 1.00 to 0.90, respectively (Table 3 and Appendix A [Table 3A]). Future work should evaluate whether progressively lower ABI thresholds increase the association with exertional leg symptoms (and dyspnea) among participants who have both a reduced FEV1 and PAD. If not, an alternative explanation is that a reduced FEV1, with or without exertional dyspnea, may limit exercise to a workload that is insufficient to lead to leg symptoms.

The present study has two major strengths. First, it evaluated a highly vulnerable population of older persons, whose sedentary status and functional limitations increase the risk of future disability.^{13,14} Second, it evaluated objective measures of physical inactivity, performance-based mobility, lung function, and PAD, as well as a validated rating of exertional dyspnea based on the 400MWT. Lung function was additionally based on a novel, more age-appropriate method for reporting the FEV1,^{1,18,19,23} not previously evaluated regarding the combined occurrence of a reduced FEV1 and PAD.⁸⁻¹¹

We acknowledge, however, at least two potential study limitations. First, we excluded from analysis 16.7% of participants who had not achieved an acceptable FEV1. Prior work has shown that an acceptable spirometric test may be difficult to perform among older persons who are physically frail,²⁹ and, as a result, these same individuals may also be sedentary and have impaired mobility.^{21,22} Nonetheless, participants who were excluded had a similar sedentary time, frequency of having a slow gait speed, and SPPB score as those in the analytical sample. Second, because the LIFE Study only included individuals who had low levels of physical activity and functional limitations, the range of scores on measures of physical activity and mobility was constrained. These two limitations likely attenuated the associations of interest. Importantly, on completion of the LIFE randomized controlled trial, we will evaluate longitudinally the association of a combined reduced FEV1 and PAD with exertional dyspnea and leg symptoms, physical inactivity, and mobility, as well as evaluate the effects of increased physical activity on these same associations.

In conclusion, among sedentary community-dwelling elders who have functional limitations, we found that the prevalence of a combined reduced FEV1 and PAD was modest but nonetheless strongly associated with slow gait-speed (a frailty indicator that confers an increased risk of deleterious outcomes) and moderate-to-severe exertional dyspnea.

Supplementary Material

Refer to Web version on PubMed Central for supplementary material.

Acknowledgments

IRB Review: The Lifestyle Interventions and Independence for Elders (LIFE) study was conducted in accordance with the amended Declaration of Helsinki. Local institutional review boards approved the protocol, and written informed consent was obtained from all patients.

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Table 1

Clinical characteristics

Characteristic	N *	Mean ± SD or No. (%)
Age (years)	1,307	78.8 ± 5.2
Females		893 (68.3)
White		990 (75.8)
BMI (kg/m ²)		30.3 ± 6.1
Smoking status		
Never	1,285	667 (51.9)
Former		580 (45.1)
Current		38 (3.0)
Number of chronic conditions [†]	1,303	1.5 ± 1.0
Hypertension	1,295	926 (71.5)
Diabetes mellitus	1,300	328 (25.2)
Symptomatic arthritis [‡]	1,307	271 (20.7)
Chronic lung disease [§]	1,301	204 (15.7)
Coronary artery disease	1,302	93 (7.1)
Stroke		85 (6.5)
Hip fracture	1,301	56 (4.3)
Heart failure	1,297	55 (4.2)
Fair to Poor Health status	1,301	449 (34.5)
Exertional dyspnea		
Borg index (400MWT) ^{//}	1,304	1.7 ± 1.5
None to just-noticeable dyspnea (Borg <1)		452 (34.7)
Mild dyspnea (Borg 1 and 2)		448 (34.4)
Moderate-to-severe dyspnea (Borg >2)		404 (31.0)
Exertional leg symptoms ^ℓ	1,306	332 (25.4)

Abbreviations: BMI, body mass index; SD, standard deviation; 400MWT, 400-meter walk test.

* N includes all participants who had a valid spirometric FEV1 and an ABI 1.40 (analytical sample: N = 1,307). Otherwise, N may vary for a specific variable as a consequence of missing values.

† Self-reported, physician-diagnosed.

‡ Defined by arthritic pain of knee, hip, back/spine, or foot.

§ Included asthma, chronic bronchitis, emphysema, or chronic obstructive pulmonary disease.

// Recorded immediately after the 400MWT, and included the following scale: 0, 0.5, 1, and continuing as integers up to 10.

† Based on the San Diego Questionnaire, namely a Yes response to: "Do you get pain in either leg or either buttock when walking?" The questionnaire was administered at rest, and is unrelated to the 400MWT.

Table 2

FEV1, ABI, FEV1/PAD groups, physical inactivity, and mobility

Characteristic	N *	Mean ± SD or No. (%)
FEV1, liters	1,307	1.85 ± 0.56
FEV1, Z-score		−0.66 ± 1.06
Normal FEV1 †		1,079 (82.6)
Reduced FEV1 ‡		228 (17.4)
ABI		1.04 ± 0.16
PAD absent >§		932 (71.3)
PAD present //		375 (28.7)
FEV1/PAD groups		
Normal FEV1 without PAD	1,307	782 (59.8)
PAD with normal FEV1		297 (22.7)
Reduced FEV1 without PAD		150 (11.5)
Reduced FEV1 with PAD		78 (6.0)
Physical inactivity		
Sedentary-time ℓ	1,028	77.0 ± 8.0
Mobility		
400-meter walk time (minutes)	1,307	8.4 ± 1.9
Slow gait-speed **		564 (43.2)
SPPB score		7.4 ± 1.6
Moderate-to-severe mobility impairment ††		584 (44.7)

Abbreviations: ABI, ankle-brachial index; FEV1, forced expiratory volume in 1-second; LLN, lower limit of normal; PAD, peripheral artery disease; SD, standard deviation; SPPB, short physical performance battery; 400MWT, 400-meter walk test.

* N includes all participants who had a valid spirometric FEV1 and an ABI $\geq$ 1.40 (analytical sample: N = 1,307). Otherwise, N may vary for a specific variable as a consequence of missing values.

[†] FEV1 $\geq$ LLN (Z-score $\geq$ -1.64)

[‡] FEV1 < LLN (Z-score < -1.64)

^{>§} ABI 1.00-1.40

^{//} ABI < 1.00

^ℓ Percent of accelerometry wear-time with activity < 100 counts/min, averaged across days.

^{**} < 0.8 meter/sec (400MWT)

^{††} SPPB $\leq$ 7

Table 3
Adjusted odds ratios for exertional dyspnea and leg symptoms, according to FEV1/PAD groups *

FEV1/PAD Groups †	Exertional Dyspnea ‡						Exertional Leg Symptoms § (Yes vs. No)	
	Mild (Borg 1 and 2 vs. <1)		Moderate-to-Severe (Borg >2 vs. <1)					
	No. (%) §	OR (95%CI)	No. (%) §	OR (95%CI)	No. (%) §	OR (95%CI)	No. (%) §	OR (95%CI)
Normal FEV1 without PAD	280 (35.9)	1.00	219 (28.1)	1.00	202 (25.9)	1.00		
PAD with normal FEV1	94 (31.7)	0.83 (0.56, 1.23)	80 (26.9)	0.75 (0.48, 1.17)	83 (28.0)	0.98 (0.67, 1.44)		
Reduced FEV1 without PAD	47 (31.3)	1.31 (0.78, 2.20)	68 (45.3)	2.38 (1.41, 4.02)	27 (18.0)	0.49 (0.29, 0.83)		
Reduced FEV1 with PAD	27 (34.6)	1.52 (0.70, 3.30)	37 (47.4)	2.59 (1.20, 5.60)	20 (25.6)	1.07 (0.58, 1.99)		
P-value //	0.002						0.060	

Abbreviations: ABI, ankle-brachial index; BMI, body mass index; CI, confidence interval; FEV1, forced expiratory volume in 1-second; LLN, lower limit of normal; PAD, peripheral artery disease; 400MWT, 400-meter walk test.

* Logistic regression models (multinomial for dyspnea), with the reference group defined by having both a normal FEV1 and no PAD. Adjusted for age, height, sex, race, BMI, smoking, chronic conditions (# and type), fair-to-poor health status, and LIFE Study site.

† See footnotes to Table 2.

‡ See footnotes to Table 1.

§ Row percent.

// Evaluated the significance of differences in the associations of interest, across the FEV1/PAD groups.

Table 4

Adjusted odds ratios for high sedentary-time, slow gait-speed, and moderate-to-severe mobility impairment, according to FEV1/PAD groups *

FEV1/PAD Groups †	High Sedentary-time ‡		Slow Gait-speed (< vs. 0.8 m/sec)		Moderate-to-Severe Mobility Impairment (SPPB 7 vs. 8 or 9)	
	No. (%) §	OR (95%CI)	No. (%) §	OR (95%CI)	No. (%) §	OR (95%CI)
Normal FEV1 without PAD	133 (21.4)	1.00	292 (37.3)	1.00	327 (41.8)	1.00
PAD with normal FEV1	59 (25.2)	1.57 (1.01, 2.45)	155 (52.2)	1.57 (1.11, 2.24)	139 (46.8)	0.98 (0.70, 1.37)
Reduced FEV1 without PAD	32 (28.3)	1.40 (0.82, 2.39)	67 (44.7)	1.50 (0.99, 2.27)	78 (52.0)	1.54 (1.03, 2.29)
Reduced FEV1 with PAD	19 (32.2)	1.70 (0.83, 3.48)	50 (64.1)	3.15 (1.72, 5.75)	40 (51.3)	1.55 (0.89, 2.70)
P-value //	0.127		<0.001		0.087	

Abbreviations: ABI, ankle-brachial index; CI, confidence interval; FEV1, forced expiratory volume in 1-second; LLN, lower limit of normal; PAD, peripheral artery disease; SPPB, short physical performance battery; 400MWT, 400-meter walk test.

* Logistic regression model, with the reference group defined by having both a normal FEV1 and no PAD. Adjusted for age, height, sex, race, BMI, smoking, chronic conditions (# and type), fair-to-poor health status, and LIFE Study site.

† See footnotes to Table 2.

‡ Top quartile vs. lower three quartiles of sedentary-time (see Table 2).

§ Row percent.

// Evaluated the significance of differences in the associations of interest, across the FEV1/PAD groups.