P-69

Association Between Intensity and Type of Physical Activity and Lung Function in Patients with COPD : A Population-based Study

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Background & Objective

Chronic respiratory symptoms, particularly dyspnea in chronic obstructive pulmonary disease (COPD) often result in reduced physical activity (PA). Higher PA has been associated with improvements in symptoms and functional state in COPD patients; however, few studies have explored the association of PA with lung function. We investigated associations between intensity and type of PA and lung function in COPD patients.

Methods

This nationwide cohort study included data of 14,679 participants from the Korea National Health and Nutrition Examination Survey (KNHANES) from 2014 to 2019. All participants underwent a health survey and a series of health examinations, including a pulmonary function test. Each association between lung function and PA intensity, PA types (walking, strengthening, and aerobic exercise), as well as PA intensity stratified by age and sex, was assessed using analysis of covariance.

Results and Conclusion

Table 1 shows the demographic and clinical characteristics of participants. In the COPD group, higher levels of PA were associated with increased forced expiratory volume in one second (FEV1), forced vital capacity (FVC), and peak expiratory flow (PEF) across all models (Table 2). Among PA types, adherence to aerobic exercise was significantly associated with increases in FEV1, FVC, and PEF across all models in the COPD group. Additionally, significant interaction effects were observed between the COPD group and adherence to aerobic exercise for both FEV_1 and FVC in Models 2 and 3 (FEV1: p-value for interaction = 0.0294 in Model 2 and 0.0297 in Model 3; FVC: p-value for interaction = 0.0067 in Model 2 and 0.0069 in Model 3). There were no significant differences in lung function based on PA intensity level when stratified by age and sex in COPD patients.

This study demonstrated a significant positive association between physical activity intensity and lung function in patients with COPD. Particularly, the association between aerobic exercise and better lung function was more pronounced in patients with COPD. Therefore, our results support the integration of personalized PA interventions, including structured aerobic training, into comprehensive COPD management.

Table 1. The demographic and clinical characteristics of participants.

	Normal (n=12386)	COPD (n=2293)	*p*-value
Age (years)			<.0001*
40 – 49	40.1(0.63)	11.7(0.97)	
50 – 59	35.3(0.55)	25.6(1.23)	
60 – 69	17.0(0.43)	32.8(1.16)	
≥ 70	7.6(0.27)	29.9(1.07)	
Sex			<.0001*
Male	43.8(0.46)	74.9(1.02)	
Female	56.2(0.46)	25.1(1.02)	
Low income	34.8(0.78)	23.0(1.23)	<.0001*
Education			<.0001*
Education years < 12	27.0(0.60)	46.3(1.35)	
Education years ≥ 12	73.0(0.60)	53.7(1.35)	
Smoking			<.0001*
Non-smoker	61.2(0.51)	31.8(1.13)	
Former smoker	21.2(0.43)	37.3(1.22)	
Current smoker	17.6(0.45)	30.9(1.21)	
Drinking			<.0001*
Non	25.9(0.47)	27.1(1.08)	
Mild	65.6(0.52)	60.1(1.23)	
Heavy	8.5(0.32)	12.9(0.83)	
Dynapenia	5.8(0.27)	8.2(0.63)	0.0787
BMI level (kg/m^2)			0.0399*
< 18.5	1.8(0.14)	2.3(0.36)	
18.5 ≤ < 23	37.5(0.50)	37.4(1.18)	
23 ≤ < 25	26.5(0.45)	26.4(1.15)	
25 ≤ < 30	30.5(0.48)	31.5(1.19)	
≥ 30	3.8(0.20)	2.4(0.37)	
Waist circumference	82.7±0.10	85.7±0.21	<.0001*
Comorbidities			
Hypertension	31.2(0.52)	44.9(1.21)	<.0001*
Diabetes mellitus	12.8(0.36)	20.8(0.96)	<.0001*
Dyslipidemia	24.7(0.48)	24.2(1.05)	0.7104
Asthma	1.5(0.13)	7.2(0.60)	<.0001*
CVD	2.8(0.16)	6.6(0.53)	<.0001*
Depression	4.7(0.21)	3.8(0.50)	0.1453
Fasting Glucose	101.7±0.25	105.6±0.57	<.0001*
Total cholesterol	198.3±0.40	188.8±0.95	<.0001*
HDL-C	51.4±0.14	47.9±0.29	<.0001*
Triglyceride	117.9(116.3-119.4)	127.8(124.2-131.4)	0.0207*
FEV1	2.9±0.01	2.3±0.02	<.0001*
FVC	3.6±0.01	3.7±0.03	0.5964
Peak expiratory flow	7.4±0.02	6.2±0.05	<.0001*
Physical activity-intensity			0.1861
Low	60.6(0.54)	62.9(1.24)	
Moderate	30.0(0.48)	27.7(1.14)	
High	9.5(0.33)	9.5(0.82)	
Physical activity-type			
Walking	38.9(0.55)	38.9(1.22)	0.9614
Strengthening exercise	21.3(0.44)	25.8(1.14)	<.0001*
Aerobic exercise	46.7(0.56)	44.6(1.28)	0.1155

Values are presented as mean±standard error (SE), percentage (SE), or geometric mean (95% confidence interval).
The p-values were analyzed using t-test for continuous variables or $\chi 2$ test for categorical variables. * p < 0.05.

Table 2. Association between intensity level of physical activity and lung function.

	Group	Physical activity intensity level	Model 1 †	Model 2 ‡	Model 3 §
FEV1	Normal	Low	2.84±0.01	2.81±0.01	2.80±0.01
		Moderate	2.88±0.01	2.82±0.01	2.81±0.01
		High	3.14±0.02	2.86±0.01	2.85±0.01
		p-value	<.0001*	0.0038*	0.0044*
	COPD	Low	2.29±0.02	2.24±0.02	2.23±0.02
		Moderate	2.38±0.03	2.31±0.03	2.29±0.03
		High	2.57±0.06	2.31±0.04	2.29±0.04
		p-value	<.0001*	0.0258*	0.0302*
	***p*-value for interaction**		0.3132	0.1407	0.1479
FVC	Normal	Low	3.58±0.01	3.59±0.01	3.57±0.01
		Moderate	3.63±0.02	3.60±0.01	3.58±0.01
		High	3.98±0.03	3.67±0.02	3.65±0.02
		p-value	<.0001*	0.0001*	0.0001*
	COPD	Low	3.57±0.03	3.47±0.02	3.44±0.02
		Moderate	3.70±0.05	3.56±0.04	3.53±0.04
		High	4.00±0.07	3.62±0.05	3.59±0.05
		p-value	<.0001*	0.0195*	0.0220*
	***p*-value for interaction**		0.3396	0.1053	0.1155
PEF	Normal	Low	7.31±0.03	7.28±0.03	7.26±0.03
		Moderate	7.42±0.04	7.31±0.03	7.29±0.03
		High	8.16±0.07	7.40±0.05	7.38±0.05
		p-value	<.0001*	0.0543	0.0592
	COPD	Low	6.02±0.06	5.66±0.05	5.64±0.05
		Moderate	6.25±0.09	5.76±0.08	5.74±0.08
		High	6.99±0.17	5.98±0.14	5.96±0.14
		p-value	<.0001*	0.0353*	0.0426*
	***p*-value for interaction**		0.5598	0.3667	0.379

Values are presented as mean±standard error (SE).
The p-values were analyzed by analysis of covariance (ANCOVA).
* p < 0.05.
† Not adjusted.
‡ Adjusted for age, sex, body mass index (BMI), income, education, drinking, and smoking.
§ Adjusted for age, sex, BMI, income, education, drinking, smoking, diabetes mellitus, hypertension, and dyslipidemia.
The p-value for interaction was estimated by including a cross-product term in the multivariable model.
FEV1, forced expiratory volume in one second; FVC, forced vital capacity; PEF, peak expiratory flow; COPD, chronic obstructive pulmonary disease.