

A Predicted FEV₁/FVC Model Based on a Simple Respiratory Questionnaire for Early Diagnosis of COPD in Shimane Cohort, Japan

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Purpose: Early detection of chronic obstructive pulmonary disease (COPD) remains challenging in primary care settings where spirometry is not always available. We aimed to develop a simple questionnaire-based approach to estimate the forced expiratory volume in one second (FEV₁)/forced vital capacity (FVC) ratio for COPD screening.

Patients and Methods: This was a single-center retrospective observational study based on the Shimane cohort. From 2008 to 2014, respiratory questionnaires and spirometry were performed during health check-ups of individuals aged ≥ 40 years. Among 2230 participants who underwent spirometry, 727 current or former smokers without a history of bronchial asthma were included for model development. Multiple regression analysis was used to identify questionnaire items associated with FEV₁/FVC and to construct a simplified estimation model.

Results: Four variables—age, smoking intensity, exertional dyspnea, and paroxysmal dyspnea—were independently associated with FEV₁/FVC and were incorporated into the model. The model demonstrated modest explanatory power ($R^2 = 0.136$), with no significant lack-of-fit ($F = 1.152$). Based on these variables, a simple four-item model enabled estimation of FEV₁/FVC and identification of individuals at risk for airflow limitation.

Conclusion: We developed a simple questionnaire-based model to estimate FEV₁/FVC using four easily obtainable variables. Although the model is exploratory and requires external validation, it may serve as a practical screening tool to identify individuals at risk for COPD in settings where spirometry is not readily available.

Plain Language Summary: Chronic obstructive pulmonary disease (COPD) is an important respiratory disease, but the need for spirometry for diagnosis makes early diagnosis difficult in primary care settings. We analyzed data from 727 smokers, selected from 13,280 patients aged 40 years or older, who underwent a respiratory interview and spirometry during an annual check-up. We found statistically significant differences in four parameters: age, smoking index, exertional breathlessness, and paroxysmal breathlessness in COPD patients compared with non-COPD patients. Therefore, we used these parameters to create a four-item-only predictive model for COPD screening. This model can be used to identify patients with possible COPD without spirometry for early diagnosis and appropriate COPD management.

Keywords: chronic obstructive pulmonary disease, COPD screening, questionnaire, spirometry, international primary care airways group, IPAG

Introduction

Chronic obstructive pulmonary disease (COPD) is a progressive lung disease caused by the inhalation of toxic particles and gases.¹ According to the Global Initiative for Chronic Obstructive Lung Disease (GOLD) report, COPD is a major

cause of morbidity and mortality worldwide and represents a substantial economic and social burden.² Although smoking is the most well-established risk factor, COPD is now recognized as a multifactorial disease influenced by environmental exposures, aging, and host susceptibility, and should not be attributed solely to smoking.^{1,2}

A patient survey conducted by the Japanese Ministry of Health, Labour and Welfare in 2023 reported that the estimated number of patients with COPD being treated was 382,000, and the estimated prevalence of COPD in Japan was 0.2%.³ However, a nationwide COPD epidemiological survey conducted in Japan in 2001 reported that the estimated number of patients was more than 5.3 million, and there are many unexamined and undiagnosed patients.⁴ Limited public awareness of COPD in Japan likely contributes to the low rate of diagnosis.

COPD is a systemic inflammatory disease that not only causes airflow obstruction but also has various comorbidities such as hypertension, diabetes, osteoporosis, and lung cancer.^{5,6} Regardless of the degree of airflow obstruction, patients with COPD may have impaired physical activity due to comorbidities, which also affects their prognosis. Therefore, COPD is a disease that requires early diagnosis and early intervention.

Spirometry is essential for the definitive diagnosis of COPD, which is diagnosed if the post-bronchodilator forced expiratory volume in one second (FEV₁)/forced vital capacity (FVC) is less than 70%.² According to the patient survey by the Japanese Ministry of Health, Labour and Welfare, 82% of COPD patients visit primary clinics (non-respiratory medical institutions) instead of hospitals as the first consultation.³ However, spirometry may not be possible in primary clinics, which makes the early detection of COPD challenging. Consequently, questionnaire-based screening tools have been developed to identify individuals at risk for COPD.

Several screening questionnaires, including the International Primary Care Airways Group (IPAG) questionnaire,⁷ the COPD Population Screener (COPD-PS),⁸ and the COPD Screening Questionnaire (COPD-Q),⁹ have demonstrated moderate diagnostic performance in primary care settings. However, these tools require multiple questions with weighted scoring systems and often include multi-level response options, which may limit their practicality in busy clinical settings or large-scale screening programs.

Therefore, there remains a need for a simpler and more practical screening approach that can be easily implemented without complex scoring systems. In this study, we used data from the Shimane cohort to develop a simplified questionnaire-based model to estimate FEV₁/FVC and facilitate early identification of individuals at risk for COPD. Such simplified tools may be particularly valuable in resource-limited or rural settings.

Materials and Methods

Shimane Cohort

Shimane University conducted a prospective cohort study (Shimane Cohort, Shimane University School of Medicine, Ethics Committee, Research Approval Number: 2646) to identify risk factors for lifestyle-related diseases. The Shimane Cohort aimed to predict and prevent lifestyle-related diseases by tracking a healthy general population over a long period in collaboration with multiple municipalities in Shimane Prefecture. Consequently, we conducted a single-center retrospective observational study to identify the factors contributing to airflow obstruction using data from the Shimane cohort (Shimane University School of Medicine, Ethics Committee, Research Approval Number: 5175).

This study was conducted in accordance with the Declaration of Helsinki.

Study Participants

We used data from medical examinations conducted in eight towns in Shimane Prefecture (Takeya-cho, Kamo-cho, Daito-cho, Kisuki-cho, and Mitoya-cho in Unnan City; Sada-cho in Izumo City; and Okinoshima-cho and Onan-cho) during the 7 years from April 2008 to March 2014 from the Shimane cohort. The sample size was not determined a priori but was based on all eligible participants available in the cohort dataset. Data from this 7-year period were included to maximize sample size and ensure sufficient statistical power for model development. We received written consent for this study and enrolled patients aged 40 years or older (excluding those with a history of bronchial asthma) who answered a respiratory-related questionnaire (Figure 1) and underwent spirometry (HI-105 and HI-801, CHEST M.I., INC., Japan). The questionnaire was created by adding original items to Q12 based on the IPAG questionnaire, which was originally written in Japanese.

	Item	Response categories
Q1(1)	Smoking intensity, pack-years	Current (pack-years) Former (pack-years) Never
Q1(2)	Are there smokers around you? (Are you exposed to passive smoking?)	Yes/No
Q2	Are you currently being treated for any disease?	Yes (Details) / No
Q3	Have you ever had a lung disease?	Yes (Details) / No
Q4	Are you in (or have been) at workplace inhaling irritating gas or dust?	Yes (Details) / No
Q5	Do you have any of the following symptoms now or in winter? (1)cough, (2)sputum, (3) dyspnea when you climb stairs or slopes	(1) Yes/No (2) Yes/No (3) Yes/No
Q6	Do you have a chronic cough that lasts more than 3 months?	Yes/No
Q7	Does the weather affect your cough?	cough(+); Yes/ No cough(-)
Q8	Do you have chronic sputum that lasts more than 3 months?	Yes/ No
Q9	Do you ever expel sputum when you don't have a cold?	Yes/ No
Q10	Do you usually expel sputum when you wake up in the morning?	Yes/ No
Q11	Do you have exertional dyspnea when you climb stairs or slopes, or when you walk at the same speed as people of the same generation?	Yes/ No
Q12	Do you ever feel paroxysmal dyspnea when you don't have a cold within the last year?	Yes/ No
Q13	Do you have (or have you had) allergic symptoms such as rhinitis?	Yes/ No

Figure 1 Questionnaire items used in this study. The questionnaire consisted of items related to smoking exposure, medical history, occupational exposure, and respiratory symptoms. Smoking status was assessed using smoking intensity (pack-years) for current and former smokers, and never-smoking status. Environmental and clinical factors included passive smoking (Q1 [2]), current treatment for disease (Q2), history of lung disease (Q3), and occupational exposure to irritant gases or dust (Q4). Respiratory symptoms were assessed using multiple items, including cough, sputum, and dyspnea. These included general symptoms (Q5), chronic cough lasting more than 3 months (Q6), weather-related cough (Q7), chronic sputum (Q8), sputum without a cold (Q9), morning sputum (Q10), exertional dyspnea (Q11), paroxysmal dyspnea (Q12), and allergic symptoms such as rhinitis (Q13). All symptom-related questions were answered in a binary format (Yes/No). Pack-years were used as an index of cumulative smoking exposure.

Data Collection

Researchers obtained access to the Shimane Cohort database and collected the following information on study participants: 1) Age and sex, 2) Smoking history, 3) Past medical history and comorbidities, 4) Responses to the respiratory health questionnaire, and 5) Results of pulmonary function testing.

Data Analysis

Statistical analyses were performed using JMP 16.0 (SAS Institute Inc., Cary, NC, USA). To search for questionnaire items that contribute to FEV1/FVC, we performed variance analyses according to age group and questionnaire items. Results were considered statistically significant at $p < 0.05$. We then performed stepwise multiple regression analysis with FEV1/FVC as the dependent variable and age, smoking history, and questionnaire items as independent variables to construct a predictive model. No predefined scoring system or cutoff value was used, as the aim of this study was to develop a regression-based predictive model rather than a scoring-based screening tool.

Model performance was assessed using the coefficient of determination (R^2) and lack-of-fit testing. The R^2 value reflects the explanatory power of the model, while the lack-of-fit test evaluates whether the model adequately fits the observed data.

Given the limited number of elderly participants, particularly those at higher risk for COPD, the dataset was not divided into separate training and validation cohorts to avoid loss of statistical power. Therefore, the model was developed using the entire dataset and is considered exploratory.

Results

Participants' Characteristics

From 2008 to 2014, 13,280 individuals participated in the Shimane cohort. Of these, the number of participants who consented to this study and underwent a respiratory function test, aged ≥ 40 years (excluding those with a history of bronchial asthma), was 2230 ([Figure 2](#)). More than half of the participants were female (56.0%), and the majority were aged 60–79 years (79.7%) ([Table 1](#)). [Supplementary Table 1](#) shows smoking prevalence according to sex and age. Smoking rates were high in middle-aged males and very low in females. Airflow limitation based on $FEV_1/FVC < 70\%$ on spirometry was observed in 12.9% of all males and 5.9% of all females ([Table 2](#)).

Analysis of Responses to Questionnaires by Age

We considered smoking to be the most influential factor on FEV_1/FVC ; therefore, we examined the questionnaire items that contribute to FEV_1/FVC in 727 smokers based on the results of respiratory-related questionnaires and spirometry.

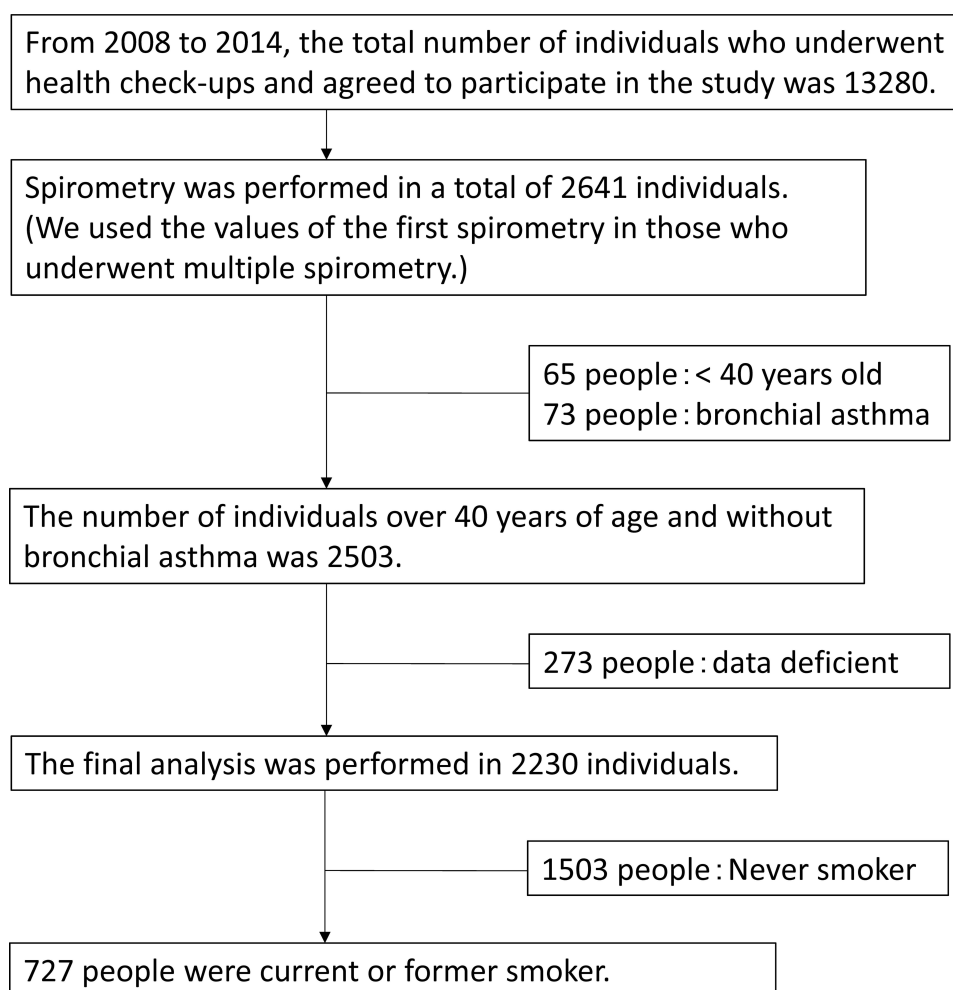


Figure 2 Study enrollment flowchart. A total of 13,280 individuals participated in health check-ups between 2008 and 2014 and consented to the Shimane Cohort. Spirometry was performed in 2641 participants, and the first spirometry result was used for individuals who underwent multiple tests. After excluding individuals younger than 40 years ($n = 65$), those with bronchial asthma ($n = 73$), and those with incomplete data ($n = 273$), 2230 participants were included in the final analysis. Among them, 727 were current or former smokers and 1503 were never smokers.

Table 1 Patient Characteristics

Characteristics	n=2230
Sex	
Male	981(44.0)
Female	1249(56.0)
Median age (range)	68(40–93)
Age categories	
40–49 years (%)	112(5.0)
50–59 years (%)	253(11.3)
60–69 years (%)	899(40.3)
70–79 years (%)	878(39.4)
≥80 years (%)	88(3.9)
Smoking status	
Male	
Current (%)	240(24.5)
Former (%)	442(45.0)
Never (%)	299(30.5)
Female	
Current (%)	22(1.8)
Former (%)	23(1.8)
Never (%)	1204(96.4)
Current and former smoker (n=727)	
Median pack-year (range)	30.75(0–111)
0 to <20 pack-year (%)	206(28.3)
20 to <30 pack-year (%)	124(17.1)
30 to <40 pack-year (%)	156(21.5)
40 to <50 pack-year (%)	121(16.6)
≥50 pack-year (%)	120(16.5)

Table 2 Percentage of People with Airflow Limitation (FEV1/FVC <70%) in Spirometry. A) Male, B) Female

A						
Male	Age Categories					
Overall	40–49 years n=63	50–59 years n=125	60–69 years n=373	70–79 years n=376	≥80 years n=44	Total N=981
FEV1/FVC<70%	6(9.5)	6(4.8)	37(9.9)	69(18.4)	9(20.5)	127(12.9)
GOLD I/II/III/IV	4/2/0/0	4/2/0/0	23/12/1/1	40/22/6/1	5/4/0/0	76/42/7/2
B						
Female	Age Categories					
Overall	40–49 years n=49	50–59 years n=128	60–69 years n=526	70–79 years n=502	≥80 years n=44	Total N=1249
FEV1/FVC<70%	1(2.0)	4(3.1)	21(4.0)	41(8.2)	7(15.9)	74(5.9)
GOLD I/II/III/IV	0/1/0/0	2/2/0/0	13/7/1/0	31/9/1/0	4/3/0/0	50/22/2/0

Abbreviations: FEV1, forced expiratory volume in one second; FVC, forced vital capacity.

Using the FEV₁/FVC of spirometry in 727 smokers, we performed a significant difference test of FEV₁/FVC based on the presence or absence of symptoms in a total of 11 questions (Q5–13 in Figure 1) by age category (Supplementary Figure 1). In patients in the 60–69 age group who had a cough in winter (Figure 3A), those who had sputum when they woke up (Figure 3B), those aged between 70–79 years who had shortness of breath during exertion (Figure 3C), and those aged between 70–79 years who had paroxysmal shortness of breath (Figure 3D), it was found that the group with each symptom had a significantly lower FEV₁/FVC ratio than the group without symptoms. Among the items with these significant differences, for shortness of breath during exertion and paroxysmal shortness of breath in the 70–79 year age group, the p-value was <0.05, and the mean value of FEV₁/FVC in the symptomatic group was <70% (Figure 3C and D). However, there were no significant differences in FEV₁/FVC between the other age groups and questionnaire items. We conducted Tukey's test on the symptomatic group with a p-value <0.05 and a mean value of FEV₁/FVC <70. We found that the mean value of FEV₁/FVC decreased in the group with either symptoms or in the group with both symptoms compared with the group without symptoms (Figure 4).

Factors Contributing to FEV₁/FVC

Multiple regression analysis was performed with FEV₁/FVC as the objective variable and age, smoking status, and 11 questions (Q5–13 in Table 1) as the explanatory variables. Some questionnaire items, including allergic symptoms (Q13), were not retained in the final model due to a lack of statistical significance. Sex was included as a candidate variable in the initial analysis but was not retained in the final model, as it was not significantly associated with FEV₁/FVC in the multivariable analysis. This may reflect the strong correlation between sex and smoking exposure, with very low smoking prevalence among women in this cohort. As a result of multiple regression analysis, four variables remained

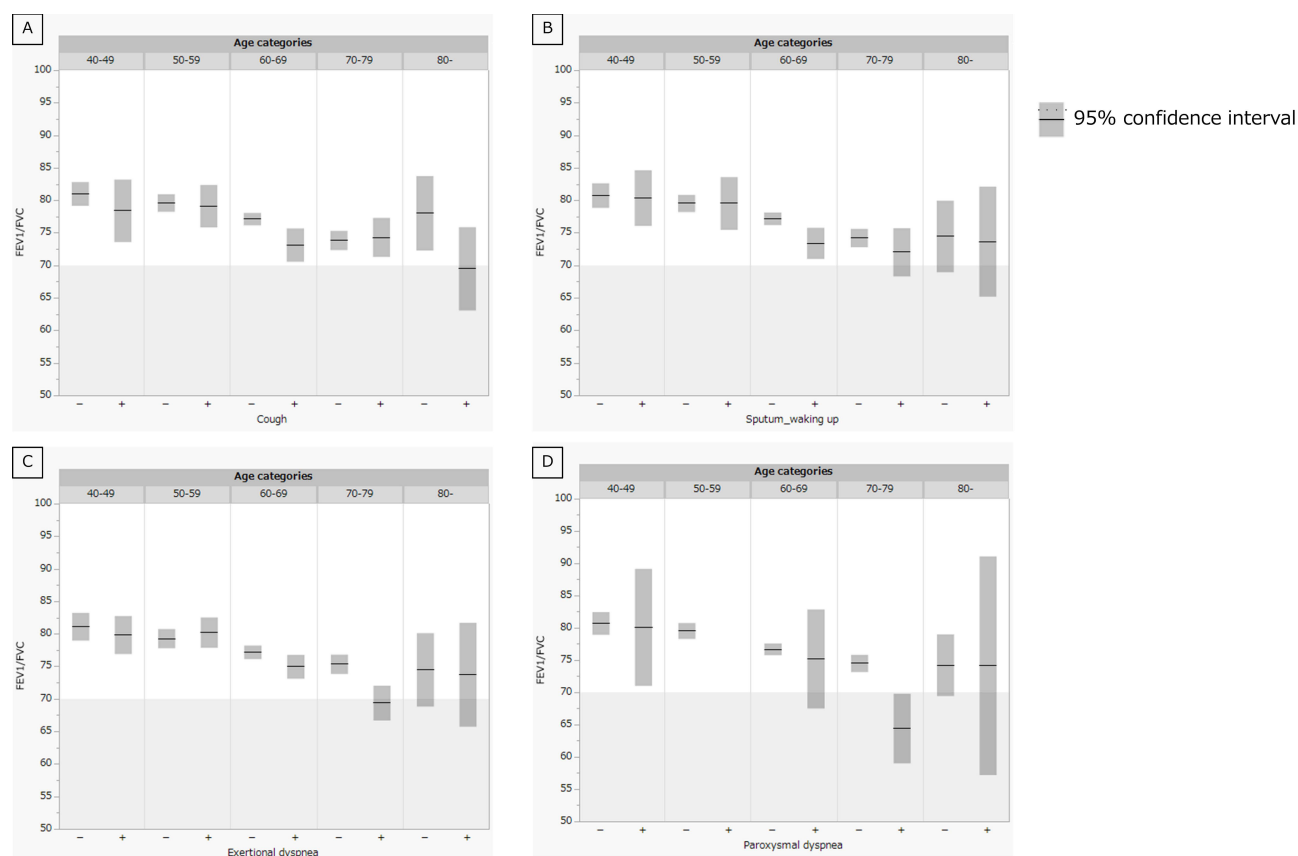


Figure 3 Age-stratified differences in FEV₁/FVC according to questionnaire responses among 727 smokers. Mean FEV₁/FVC values with 95% confidence intervals are shown for symptom-positive and symptom-negative groups in each age category. (A) Q5(1), cough in winter. (B) Q10, morning sputum. (C) Q11, exertional dyspnea. (D) Q12, paroxysmal dyspnea. Comparisons between groups were performed using t-tests. P values < 0.05 were considered statistically significant.

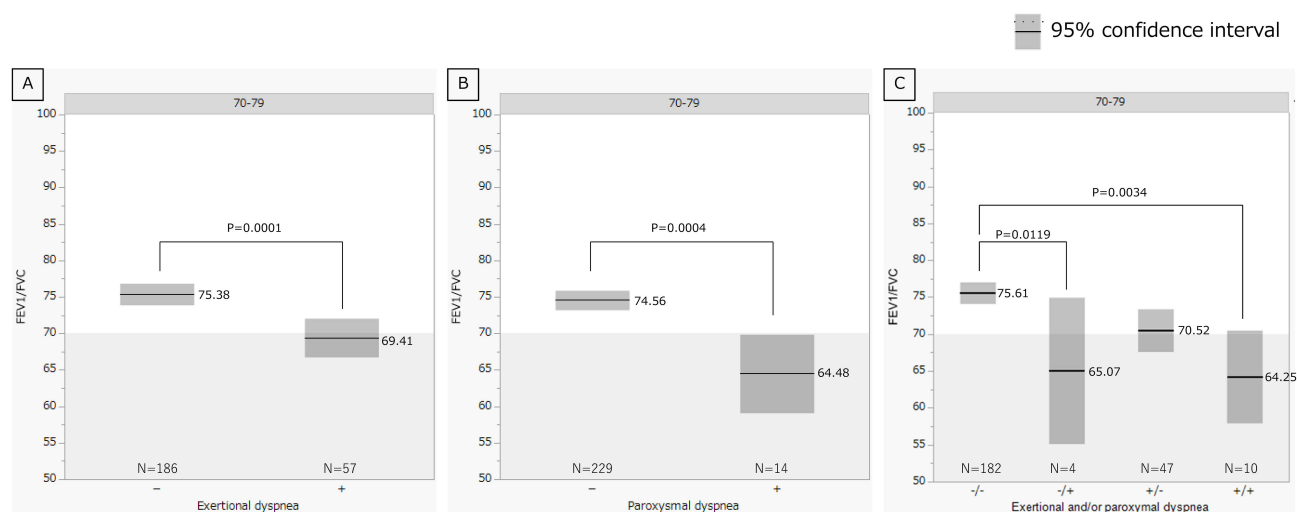


Figure 4 Comparison of mean FEV₁/FVC according to exertional and paroxysmal dyspnea in smokers aged 70–79 years. Among smokers aged 70–79 years, post hoc analyses were performed for symptom groups showing significant differences in Figure 3 and a mean FEV₁/FVC < 70%. (A) Comparison according to the presence (+) or absence (-) of exertional dyspnea (Q11). (B) Comparison according to the presence (+) or absence (-) of paroxysmal dyspnea (Q12). (C) Comparison according to combinations of exertional dyspnea and paroxysmal dyspnea: Q11(-)/Q12(-), Q11(+)/Q12(-), Q11(-)/Q12(+), and Q11(+)/Q12(+). Bars indicate mean FEV₁/FVC values with 95% confidence intervals. Multiple comparisons were performed using Tukey's test. P values are shown for significant pairwise comparisons.

independently associated with FEV₁/FVC: age ($p < 0.001$), smoking intensity ($p < 0.001$), exertional dyspnea ($p = 0.01$), and paroxysmal dyspnea ($p = 0.002$), all of which were significantly different (Table 3).

The overall explanatory power of the model was modest ($R^2 = 0.136$). The lack-of-fit test was not statistically significant ($F = 1.152$), indicating no evidence of major model misspecification.

These findings suggest that while the model captures some of the variability in FEV₁/FVC, other unmeasured factors may also contribute to airflow limitation.

A Model Formula to Calculate the Predicted FEV₁/FVC

Using these four parameters (age, smoking, shortness of breath during exertion, and paroxysmal shortness of breath), we created a model formula to calculate the predicted FEV₁/FVC.

$$*y = 89.60 - 0.205 \times \text{Age} - 0.093 \times \text{Smoking intensity} + Z1 + Z2.$$

$$Z1 \text{ (paroxysmal dyspnea)} = \{- = 2.91, + = -2.91\}$$

$$Z2 \text{ (exertional dyspnea)} = \{- = 0.92, + = -0.92\}$$

In this prediction model, age, smoking intensity, and the presence or absence of exertional and paroxysmal dyspnea were entered as explanatory variables (0 = no symptoms; 1 = with symptoms). Table 4 and the Supplementary Figure 2 present the predicted FEV₁/FVC values according to combinations of exertional and paroxysmal dyspnea based on the model formula. Each panel corresponds to a specific combination of symptom presence or absence: A) when both exertional dyspnea (Q11) and paroxysmal dyspnea (Q12) are absent; B) when exertional dyspnea (Q11) is present but paroxysmal dyspnea (Q12) is absent; C) when exertional dyspnea (Q11) is absent but paroxysmal dyspnea (Q12) is present; and D) when both exertional dyspnea (Q11) and paroxysmal dyspnea (Q12) are present. These four panels allow

Table 3 The Result of Multiple Regression Analysis in Smokers

Item	Estimated Value	Standard Error	T value	P value
Intercept	89.604084	2.424002	36.97	<0.0001
Age	-0.205218	0.033855	-6.06	<0.0001
Smoking intensity, pack-years	-0.093086	0.016149	-5.76	<0.0001
Do you have shortness of breath when you climb stairs or slopes? -Yes	-0.921185	0.361194	-2.55	0.011
Do you feel paroxysmal shortness of breath when you do not have a cold? -Yes	-2.921864	0.917851	-3.18	0.0015

Table 4 Predicted FEV1/FVC by Age, Smoking Index, and Presence/Absence of Symptoms Based on Model Formula

		Pack-year										
		0	10	20	30	40	50	60	70	80	90	100
A												
Age	40	85.2	84.3	83.4	82.4	81.5	80.6	79.7	78.7	77.8	76.9	75.9
	50	83.2	82.3	81.3	80.4	79.5	78.5	77.6	76.7	75.7	74.8	73.9
	60	81.1	80.2	79.3	78.3	77.4	76.5	75.5	74.6	73.7	72.8	71.8
	70	79.1	78.2	77.2	76.3	75.4	74.4	73.5	72.6	71.6	70.7	69.8
	80	77.0	76.1	75.2	74.2	73.3	72.4	71.4	70.5	69.6	68.7	67.7
	90	75.0	74.0	73.1	72.2	71.3	70.3	69.4	68.5	67.5	66.6	65.7
B												
Age	40	83.4	82.5	81.5	80.6	79.7	78.7	77.8	76.9	75.9	75.0	74.1
	50	81.3	80.4	79.5	78.6	77.6	76.7	75.8	74.8	73.9	73.0	72.0
	60	79.3	78.4	77.4	76.5	75.6	74.6	73.7	72.8	71.8	70.9	70.0
	70	77.2	76.3	75.4	74.4	73.5	72.6	71.7	70.7	69.8	68.9	67.9
	80	75.2	74.3	73.3	72.4	71.5	70.5	69.6	68.7	67.7	66.8	65.9
	90	73.1	72.2	71.3	70.3	69.4	68.5	67.5	66.6	65.7	64.8	63.8
C												
Age	40	79.4	78.5	77.5	76.6	75.7	74.7	73.8	72.9	71.9	71.0	70.1
	50	77.3	76.4	75.5	74.5	73.6	72.7	71.8	70.8	69.9	69.0	68.0
	60	75.3	74.4	73.4	72.5	71.6	70.6	69.7	68.8	67.8	66.9	66.0
	70	73.2	72.3	71.4	70.4	69.5	68.6	67.7	66.7	65.8	64.9	63.9
	80	71.2	70.3	69.3	68.4	67.5	66.5	65.6	64.7	63.7	62.8	61.9
	90	69.1	68.2	67.3	66.3	65.4	64.5	63.5	62.6	61.7	60.8	59.8
D												
Age	40	77.6	76.6	75.7	74.8	73.8	72.9	72.0	71.0	70.1	69.2	68.2
	50	75.5	74.6	73.6	72.7	71.8	70.8	69.9	69.0	68.1	67.1	66.2
	60	73.4	72.5	71.6	70.7	69.7	68.8	67.9	66.9	66.0	65.1	64.1
	70	71.4	70.5	69.5	68.6	67.7	66.7	65.8	64.9	63.9	63.0	62.1
	80	69.3	68.4	67.5	66.6	65.6	64.7	63.8	62.8	61.9	61.0	60.0
	90	67.3	66.4	65.4	64.5	63.6	62.6	61.7	60.8	59.8	58.9	58.0

Notes: The gray color represents when FEV1/FVC < 70% and COPD is suspected. A) When Q11 is "No" and Q12 is "No". B) When Q11 is "Yes" and Q12 is "No". C) When Q11 is "No" and Q12 is "Yes". D) When Q11 is "Yes" and Q12 is "Yes".

Abbreviations: FEV1, forced expiratory volume in one second; FVC, forced vital capacity.

visual comparison of the predicted FEV₁/FVC decline associated with different symptom combinations. For example, if the patient is 60 years old and has 60 pack-years of smoking, the predicted FEV₁/FVC will be 75.5% (Table 4) if both exertional and paroxysmal dyspnea are absent. If only exertional dyspnea is present and paroxysmal dyspnea is absent, the predicted FEV₁/FVC decreases to 73.7% (Table 4), whereas if only paroxysmal dyspnea is present and exertional dyspnea is absent, it decreases further to 69.7% (Table 4). Moreover, the predicted FEV₁/FVC ratio falls to 67.9% (Table 4) when both exertional and paroxysmal dyspnea are present, suggesting the presence of COPD.

Discussion

In this study, we developed a simple prediction model for the FEV₁/FVC ratio based on only four variables—age, smoking history, exertional dyspnea, and paroxysmal dyspnea. Sex was not retained in the final model, which may reflect the strong correlation between sex and smoking exposure, as smoking prevalence was markedly lower among women in this cohort. This finding suggests that smoking exposure, rather than sex itself, may be the dominant factor influencing FEV₁/FVC in this cohort. The principal strength of this model lies in its simplicity and applicability in primary care settings. Unlike existing questionnaires such as the IPAG,⁷ COPD-PS,⁸ and COPD-Q,⁹ which require multiple questions and graded response options, our model relies on fewer items with straightforward yes/no responses. This streamlined design reduces respondent burden and facilitates implementation in settings where time and resources are limited.

The model's predictive trends are consistent with the pathophysiological basis of COPD: both aging and cumulative smoking exposure reduce FEV₁/FVC, while exertional dyspnea reflects dynamic hyperinflation and ventilatory limitation, hallmarks of COPD progression. Interestingly, paroxysmal dyspnea—typically associated with asthma—also emerged as a significant predictor ($p < 0.01$).^{10,11} Although individuals with a physician-diagnosed history of asthma were excluded, this finding suggests that the model may also capture undiagnosed obstructive airway diseases, highlighting its utility as a broad screening tool for patients requiring spirometry.

From a practical standpoint, our model complements, rather than replaces, spirometry. In Japan, where 82% of COPD patients initially visit non-specialist clinics,³ spirometry may be unavailable. Incorporating this model into routine health checkups, workplace screening, or digital health applications could improve case finding.^{12–14} Moreover, brief and accessible tools can contribute to raising public awareness of COPD, which remains low in Japan despite ongoing campaigns.¹⁵

Nevertheless, this study has several limitations. First, the relatively low R^2 value reflects the inherent limitations of questionnaire-based models, which rely on subjective symptom reporting and cannot fully capture the complexity of airflow limitation. This limitation highlights the need for external validation and potential model refinement in future studies. Second, participants were community-dwelling adults attending routine health checkups, which may have led to underrepresentation of individuals with advanced or highly symptomatic COPD. Third, the number of symptomatic respondents was modest, limiting statistical power. Fourth, as the model was derived from a single Japanese cohort, external validation in diverse populations is needed before widespread adoption. Finally, reliance on self-reported symptoms introduces recall bias, and the exclusion of other common COPD-related symptoms, such as chronic cough and sputum production, may reduce sensitivity in certain subgroups.

Future studies should focus on external validation, prospective testing, and cost-effectiveness analyses to determine whether this tool can improve early diagnosis, facilitate timely intervention, and ultimately enhance long-term outcomes. Once validated, this model could serve as a practical bridge between primary care and specialist practice, strengthening early COPD detection and management in Japan and internationally.

Conclusion

We developed a simple questionnaire-based model to estimate FEV₁/FVC using four readily obtainable variables: age, smoking intensity, exertional dyspnea, and paroxysmal dyspnea. Although the model showed only modest explanatory power and should be considered exploratory, it may serve as a practical screening tool to identify individuals at risk for airflow limitation in settings where spirometry is not readily available. Further prospective validation in an independent cohort is planned as the next step to confirm its clinical utility and generalizability.

Artificial Intelligence (AI) Disclosure

During the preparation of this manuscript, a large language model (ChatGPT) was used solely for language editing and stylistic improvements in select paragraphs. No sections involving the generation, analysis, or interpretation of research data were produced by generative AI. All scientific content was created and verified by the authors. Furthermore, no figures or visual data were generated or modified using generative AI or machine learning-based image enhancement tools.

Abbreviations

FEV₁, Forced expiratory volume in one second; FVC, Forced vital capacity; COPD, Chronic obstructive pulmonary disease; COPD-PS, COPD-population screener; COPD-Q, COPD Screening Questionnaire; IPAG, The International Primary Care Airways Group.

Data Sharing Statement

The data presented in this study are available on request from the corresponding author.

Ethics Approval and Informed Consent

This study was approved by the Ethics Committee of Shimane University School of Medicine (approval numbers: 2646 and 5175). We received written consent for this study.

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Disclosure

The authors report no conflicts of interest in this work.

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