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ORIGINAL RESEARCH

Investigation of Smoking Cessation Status and Its Influencing Factors in Patients with Chronic Obstructive Pulmonary Disease

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Purpose: Chronic obstructive pulmonary disease (COPD) is a common disease with high prevalence, high mortality and high costs across the globe. Small airways are major sites contributing to airway resistance and the small airway disorder (SAD) is frequently implicated in early-stage COPD. Smoking is recognized as the leading cause of COPD and SAD. This study aimed to investigate the status quo and influencing factors of smoking cessation in patients with SAD or COPD, which is crucial for improving prevention and treatment of chronic airway diseases.

Patients and Methods: In this multicenter, prospective cohort investigation, questionnaire survey and one-year follow-up study were conducted in SAD and COPD patients with smoking history. The rate of quitting intention, quitting attempt and recent smoking cessation of SAD or different stages of COPD and their influencing factors were recorded, compared and analyzed.

Results: A total of 386 valid questionnaires were collected. The rate of quitting intention was 91.7% (95% CI: 88.53–94.07%), and quitting attempt was 73.6% (95% CI: 68.96–77.73%). Regular bronchodilator use, alcohol abstinence, and the lower Fagerstrom Test for Nicotine Dependence (FTND) scores were associated with a higher intention to quit smoking. Further, inpatients with higher mMRC scores, non-smoking parents, engagement in pulmonary rehabilitation exercises, and receipt of medical advice to quit were more likely to attempt quitting smoking. In the one-year follow-up survey, the overall recent smoking cessation rate was 23.9%. The multivariate logistic regression analysis revealed that higher mMRC grade, carrying out pulmonary rehabilitation exercise and the quitting intention were positive factors for quitting smoking, while outpatients with lower educational level, higher FTND score and Tobacco Craving Questionnaire-Short Form (TCQ-SF) scores were negative influencing factors for recent smoking cessation.

Conclusion: Patients with SAD and COPD generally had a high willingness to quit smoking, but a significant reduction in the success rate of smoking cessation. Factors influencing smoking cessation included the severity of the illness, nicotine dependence, patient self-control, lifestyle and environment.

Keywords: chronic obstructive pulmonary disease, small airway dysfunction, smoking cessation, questionnaire survey, influencing factors

Introduction

Chronic obstructive pulmonary disease (COPD) has emerged as a significant global public health and medical challenge, characterized by high prevalence, high mortality rates, and increased burden of disease.[1] COPD is reportedly one of the most important causes of death in most countries.[2] With increasing smoking prevalence in low-income countries and ageing populations in high-income countries, more than 5.4 million people are expected to die each year from COPD and related diseases by 2060.[3] In China, a recent cross-sectional study revealed an overall COPD prevalence of 8.6% among adults aged ≥20 years and 13.7% in the population aged ≥40 years.[4] Small airway dysfunction (SAD) is frequently implicated in early-stage COPD, spirometry-defined SAD is prevalent with an estimated incidence of 43.5% in China.[5] Smoking is widely recognized as the leading cause of both COPD and SAD, with an estimated 80% of patients with COPD being smokers or former smokers,[6] and the prevalence among smokers and former smokers is 15.2% and 7.6%,[7] respectively. There were over 1 billion current smokers globally in 2019,[8] but the successful smoking cessation rates of smoking COPD patients were only 24%.[9] The persistently low smoking cessation rate underscores the need for vigilant development of disease control and public health strategies. Elevating the smoking cessation rate holds significant importance in enhancing the prevention, control, and standardized management of chronic airway diseases. Despite the critical role of smoking in the development of COPD and SAD, the current understanding of smoking cessation behaviors at different stages of COPD remains unclear. Previous studies had revealed that high income levels,[10] high quit intention[11] and low nicotine dependence,[12] as well as anxiety,[13] might contribute to smoking cessation attempts and successful quitting in smokers. Therefore, this study expanded a questionnaire survey to investigate the current status and influencing factors of smoking cessation among patients with SAD and COPD. The findings of this research are expected to contribute valuable insights for the development of public health policies, effective management strategies, and the implementation of early prevention and treatment measures for chronic airway diseases.

Materials and Methods

Subject Recruitment

Patients were recruited from the outpatient and inpatient departments of seven medical centers across China between October 2021 and December 2022. Patients received face-to-face questionnaire survey at the outpatient and inpatient departments, whilst all the participants provided informed consent once they made a hospital visit. All subjects underwent a 1-year follow-up via telephone calls.

Inclusion and Exclusion Criteria

The inclusion criteria comprised patients aged ≥18 years diagnosed with SAD or COPD, reporting a smoking history of more than 20 pack-years and expressing willingness to participate. We diagnosed SAD on the basis of at least two of three indicators of pulmonary function less than 65% of predicted: maximal mid-expiratory flow, forced expiratory flow 50% and forced expiratory flow 75%.[5] We defined and graded COPD based upon the international guidelines: I (mild): FEV_1≥80% predicted; II (moderate): FEV_1 50–79% predicted; III (severe): FEV_1 30–49% predicted; and IV (very severe): FEV_1 <30% predicted.[14] Exclusion criteria included patients with cardiopulmonary comorbidities such as asthma, bronchiectasis, airway stenosis or cardiac insufficiency, those lacking recent lung function results, or unable to complete the questionnaire or participate in telephone follow-up.

Demographic Survey

Demographic information was recorded and collected, including gender, age, education, marital status, employment, income, as well as psychological, social, and family conditions. The degree of psychological anxiety was assessed using the Self-Rating Anxiety Scale (SAS).

Smoking Status Survey

Smoking-related information, such as age of smoking onset, daily cigarette consumption and smoking duration, was self-reported. Current smokers were defined as those who had smoked at least 100 cigarettes and reported daily smoking

during the interview, while former smokers had a lifetime history of smoking but were not current smokers. "Smoking cessation intention" indicated the patient's willingness to quit smoking during recruitment, and "smoking cessation attempt" denoted quitting smoking for more than one day at will. Nicotine addiction was evaluated using the Fagerstrom Test for Nicotine Dependence (FTND), and smoking craving was assessed using the Tobacco Craving Questionnaire-Short Form (TCQ-SF).

Follow-Up Survey

Patients underwent lung function tests, assessments of Modified Medical Research Council (mMRC) dyspnea scale, COPD Assessment Test (CAT), and St. George's Respiratory Questionnaire (SGRQ). All the functional assessments were conducted by following the standard guidelines, and the scoring protocols were provided by the respective questionnaire manuals. "Recent smoking cessation" referred to patients who had successfully quit smoking for more than six months during the one-year follow-up period. This study recorded the rates of smoking cessation willingness, smoking cessation attempts, and recent smoking cessation in patients with SAD and different stages of COPD, while the related influencing factors were also collected and analyzed.

Statistical Analysis

Data were analyzed using SPSS version 22.0 (SPSS Inc., Chicago, USA). Continuous variables were expressed as mean ± standard deviation (SD) or median (interquartile range) and tested with t-tests or Mann–Whitney U-test. The association between smoking status and clinical rating scale was determined with Pearson's or Spearman correlation model when appropriate. Categorical variables were presented as frequency (percentage) and tested using chi-square or Fisher tests. Logistic regression analysis identified relevant factors, with a multivariate model including variables with $P < 0.1$ in univariate analysis. A significance level of $P < 0.05$ was applied unless otherwise specified.

Results

Participant Recruitment and Characteristics

A total of 400 participants were initially assessed for eligibility, and 14 failed to complete the relevant questionnaires effectively. The flowchart delineated the distribution of smoking status alongside the three cessation outcomes within the study cohort (Figure 1). Consequently, we obtained 386 valid questionnaires, achieving a response rate of 96.5%. The mean age of the participants was 62.86 ± 9.09 years, with 374 (96.9%) being male. Furthermore, there were 132 (34.2%) patients with SAD and 254 (65.8%) patients with COPD, including 272 (70.5%) inpatients and 114 (29.5%) outpatients, with an overall CAT score of 15.26±8.10 (Table 1).

Compared with outpatients, inpatients were older and had a higher rate of quitting attempt, but similar gender, BMI, quit intention, and comorbidities, compared with outpatients (Table E1). Whereas, patients with SAD had higher TCQ-SF scores, $FEV_1\%$, and FEV_1/FVC but not FTND scores, smoking cigarettes per day, quit interest and quit attempt, than those with COPD (Table E2).

Smoking Status

Among the respondents, 248 (64.2%) were current smokers, while 138 (35.8%) were former smokers (Figure 1). As for current smokers, 98 (39.5%) had SAD, 28 (11.3%) had mild COPD, 52 (21.0%) had moderate COPD, and 70 (28.2%) had severe COPD. The mean duration of smoking was 40.14 ± 10.41 years, with 89.5% of subjects smoking more than 20 cigarettes per day. Additionally, 36.3% were heavily nicotine dependent, as indicated by an average Tobacco Craving Questionnaire-Short Form (TCQ-SF) score of 24.45 ± 12.85.

Recent Smoking Cessation Status

Totally, 354 (91.7%) participants had a willingness to quit smoking, demographic and disease characteristics in terms of gender, residential environment, economic income, as well as COPD stages were comparable across groups (Table 1). The rate of smoking cessation intention was higher in the regular bronchodilator group (98.1%) compared with the
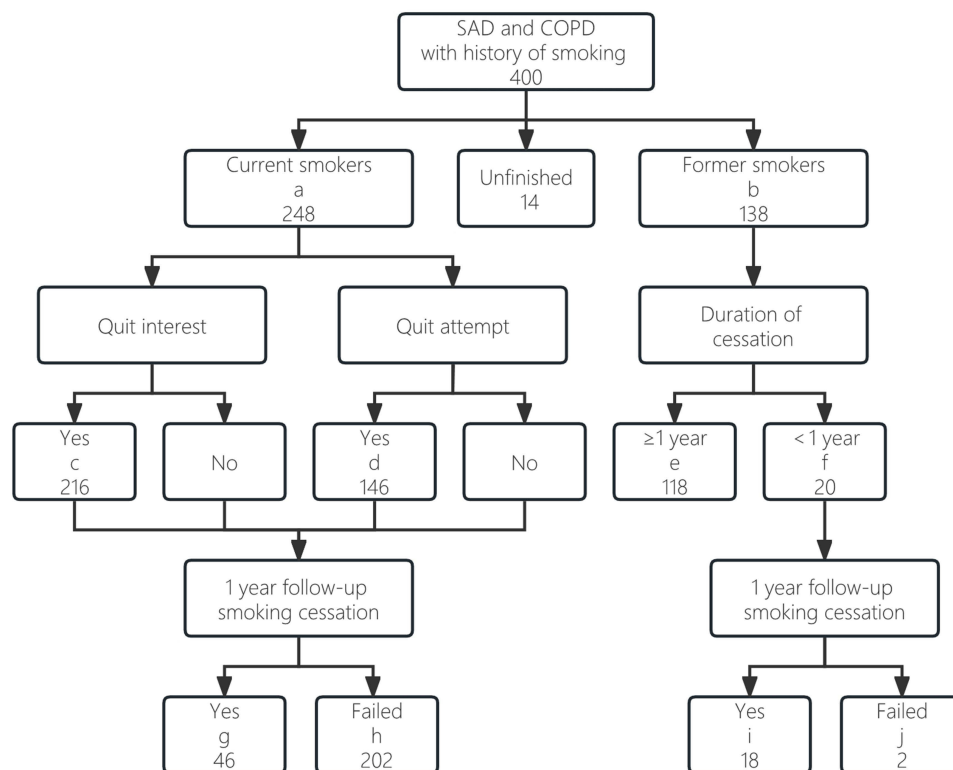
Figure 1 Flowchart of the study.
Notes: Quit interest=b+c+d/a+b, Quit attempt=b+d/a+b, Recent cessation=b+g+h/a+b.

irregular bronchodilator group (89.2%) (Table E3). Abstainers had a higher rate of smoking cessation intention than current alcoholics (100% vs 85.9%, P = 0.005). A lower FTND score was associated with a higher intention to quit smoking (P<0.001).

In total, 284 subjects (73.6%) attempted to quit smoking. The rate of smoking cessation attempt in inpatients was higher than those in outpatients (81.2% vs 65.2%) ([OR, 95% CI] 2.609, 1.621–4.199, P < 0.001) and those with no parental smoking history (81.2% vs 65.2%) ([OR, 95% CI] 0.434, 0.272–0.692, P < 0.001), engaged in pulmonary rehabilitation exercise (86.2% vs 71.3%) ([OR, 95% CI] 2.511, 1.147–5.498, P = 0.018), or medical advice on quitting

Table 1 Demographic Characteristics and Smoking Status in Patients with SAD and COPD

	Quit Interest,%	X^2/Fisher	P	Quit Attempt%	X^2/Fisher	P
Gender		Fisher	0.61		Fisher	0.525
Male	91.4			73.8		
Female	100			66.7		
Patience source		0.049	0.824		16.137	<0.001*
Outpatient	91.2			59.6	OR	CI (1.621,4.199)
Inpatient	91.9			79.4	2.609	
Education		13.26	0.01*		6.588	0.159
University	80			60		
Technical school	75			62.5		
High school	92.3			79.5		
Junior college	93.3			71.9		
Primary school	95.2			78.6		

(*Continued*)

Table 1 (Continued).

	Quit Interest,%	X^2/Fisher	P	Quit Attempt%	X^2/Fisher	P
Alcohol history		10.795	0.005*		6.169	0.046*
None	93.3			71.2		
Yes	85.9			71.9		
Given up	100			88		
Parents' smoking history		0.076	0.783		12.632	<0.001*
No	92.1			81.2	OR	CI (0.272,0.692)
Yes	91.3			65.2	0.434	
FTND scores		18.712	<0.001*		6.236	0.044*
0–3	98.6			77.8		
4–6	90.5			75.7		
≥7	83			63.8		
GOLD		2.483	0.478		6.337	0.096
SAD	90.9			71.2		
Mild COPD	87			60.9		
Moderate COPD	94.7			76.3		
Severe COPD	92.4			78.8		
mMRC		Fisher	0.109		21.233	<0.001*
0	91.8			67.2		
1	86.9			65.6		
2	93.3			86.7		
3	96.2			92.3		
4	100			73.3		
Medications for COPD regularly		8.176	0.004*		0.426	0.514
No	89.2	OR	CI (1.50,27.313)	72.7		
Yes	98.1	6.411		75.9		
Pulmonary rehabilitation exercise		Fisher	0.604		5.602	0.018*
No	92.1			71.3	OR	CI (1.147,5.498)
Yes	89.7			86.2	2.511	
Comorbidities		1.304	0.253		0.194	0.659
No	93.4			72.5		
Yes	90.2			74.5		
Recommendation from doctors to quit smoking		Fisher	0.557		7.919	0.005*
No	95			55	OR	CI (1.306,
Yes	91.3			75.7	2.552	4.985)

Notes: The statistical methods employed in this study are the Chi-square test or the Fisher's exact test. * denoted a *P*-value less than 0.05, indicating a statistically significant difference. The italicized "Fisher" indicates no statistically significant difference.

smoking (75.7% vs 55%) ([OR, 95% CI] 2.552, 1.306–4.985, *P* = 0.005). The increase in cessation attempt rate was associated with higher mMRC and SGRQ scores (mMRC: r=0.163. *P* <0.001, SGRQ: r = 0.151, *P* = 0.003).

A total of 268 patients with SAD or COPD were followed up for one year, and 64 (23.9%) of them achieved recent smoking cessation. There was no statistical difference in age, BMI, duration of smoking, daily consumption of cigarettes, and cost of smoking between recent quitters and current smokers (all *P* > 0.05, Table 2). The age of smoking onset was 20 vs 19 (Z = −2, *P* = 0.048) in the recent cessation group and the current smoking group, respectively. However, patients with smoking cessation had lower FTND score (4.2 ± 2.2 vs 5.9 ± 1.7, T = 5.6, *P* < 0.001), lower TCQ-SF scores (r= −0.21, *P* <0.001), as well as higher CAT scores (r=0.107, *P*=0.036), and SAS scores (r=0.173, *P* = 0.001) than current smokers.

Overall, 13.7% (14/102) of patients with SAD, 37.5% (12/32) mild COPD, 28.6% (16/56) moderate COPD, and 28.2% (22/78) severe COPD achieved recent smoking cessation. Regular bronchodilator use, pulmonary rehabilitation, and stronger cessation intentions and attempts were associated with higher cessation success (Table 2). Pairwise

Table 2 Recent Smoking Cessation and the Related Influencing Factor

	Recent Cessation, %	X²/Fisher	P
Gender		*Fisher*	I
Male	23.8		
Female	25		
Patience source		0.242	0.623
Outpatient	22		
Inpatient	24.7		
Education		6.128	0.19
University	30.8		
Technical school	28.6		
High school	12.5		
Junior college	23.1		
Primary school	32		
Alcohol history		7.863	0.02*
None	21.3		
Yes	21.7		
Given up	46.2		
Parents' smoking history		2.018	0.155
None	27.7		
Yes	20.3		
GOLD		10.532	0.015*
SAD	13.7		
Mild COPD	37.5		
Moderate COPD	28.6		
Severe COPD	28.2		
Medications for COPD regularly		8.039	0.005*
None	20	OR 2.4	CI (1.303–4.585)
Yes	37.9		
Pulmonary rehabilitation exercise		9.674	0.002*
None	20.7	OR 3.1	CI (1.478–6.364)
Yes	44.4		
Recommendation from doctors to quit smoking		3.73	0.053
None	11.1		
Yes	25.9		
FTND		23.01	<0.001*
0–3	52.4		
4–6	20.6		
≥7	15.6		
Quit interest		6.214	0.013*
None	6.3	OR 5.345	CI (1.241–23.024)
Yes	26.3		
Quit attempt		4.369	0.037*
None	15.4	OR 2.072	CI (1.037–4.144)
Yes	27.4		

Notes: The statistical methods employed in this study are the Chi-square test or the Fisher's exact test. *denoted a *P*-value less than 0.05, indicating a statistically significant difference. The italicized "Fisher" indicates no statistically significant difference.

comparison revealed that patients who lived alone (40% vs 0%, $P = 0.02$), and those who were abstained from alcohol (46.2% vs 21.3% vs 21.7%, $P=0.02$) had higher smoking cessation rates. Furthermore, patients with mild COPD achieved a higher rate of recent smoking cessation than those with moderate or severe COPD (37.5% vs 13.7%, $P < 0.05$). Whereas, the higher rate of recent smoking cessation was associated with a lower FTND score (0–3 score: 52.4%; 4–6 score: 20.6%; ≥7 score: 15.6%, respectively, all $P < 0.05$).

Multivariate Logistic Regression Analysis

We conducted multivariate logistic regression analysis to explore the influencing factors of recent smoking cessation, incorporating demographic characteristics, disease features, smoking and cessation status, as well as psychological anxiety (variables with $P < 0.1$ in the univariate analysis) (Table 3), of which seven variables achieved statistical significance ($P < 0.05$): inpatient status, higher education level, lower mMRC score, participation in pulmonary rehabilitation exercise, lower FTND score, lower TCQ-SF score, and stronger smoking cessation intention. The multivariate logistic regression model was statistically significant, with a likelihood ratio test indicating $P < 0.001$, and the observed Hosmer–Lemeshow goodness of fit was 10.529 ($P = 0.23$).

Table 3 Multivariate Logistic Regression Analysis for Smoking Cessation

Factor	Regression Coefficient	Standard Error	Wald Value	OR	95% CI	P
Patience source						
Outpatient (Ref)						
Inpatient	−1.327	0.647	4.204	0.265	(0.075, 0.943)	0.04*
Education						
University (Ref)						
Technical school	−2.65	1.274	4.323	0.071	(0.006, 0.859)	0.038*
High school	−2.661	1.009	6.961	0.07	(0.01, 0.504)	0.008*
Junior college	−1.486	0.814	3.331	0.226	(0.046, 1.116)	0.068
Primary school	−2.328	0.933	6.23	0.098	(0.016, 0.607)	0.013*
Alcohol history						
None (Ref)						
Yes	0.149	0.593	0.063	1.161	(0.363, 3.71)	0.802
Given up	1.401	0.806	3.017	4.058	(0.835, 19.708)	0.082
GOLD						
SAD (Ref)						
Mild COPD	0.956	0.964	0.983	2.601	(0.393, 17.208)	0.321
Moderate COPD	0.084	0.727	0.013	1.087	(0.261, 4.523)	0.908
Severe COPD	0.054	0.664	0.007	1.055	(0.287, 3.874)	0.936
mMRC						
0 (Ref)						
1	1.751	0.668	6.877	5.76	(1.556, 21.318)	0.009*
2	2.228	0.896	6.186	9.279	(1.603, 53.698)	0.013*
3	2.082	1.084	3.686	8.018	(0.958, 67.141)	0.055
4	1.985	1.241	2.557	7.277	(0.639, 82.891)	0.11
CAT score	−0.022	0.051	0.179	0.978	(0.885, 1.082)	0.672
SAS score	−0.021	0.018	1.312	0.979	(0.945, 1.015)	0.252
Medications for COPD regularly						
None (Ref)						
Yes	0.516	0.548	0.888	1.676	(0.573, 4.904)	0.346
Pulmonary rehabilitation exercise						
None (Ref)						
Yes	1.491	0.681	4.794	4.443	(1.169, 16.88)	0.029*
Comorbidities						
None (Ref)						
Yes	−0.206	0.535	0.149	0.814	(0.285, 2.322)	0.7
Age of initial attempt	0.061	0.046	1.772	1.063	(0.972, 1.163)	0.183
Smoking per day	0.041	0.027	2.408	1.042	(0.989, 1.098)	0.121

(*Continued*)

Table 3 (Continued).

Factor	Regression Coefficient	Standard Error	Wald Value	OR	95% CI	P
Smoking cost (RMB)	−0.002	0.001	2.124	0.998	(0.996, 1.001)	0.145
Parents' smoking history						
None (Ref)						
Yes	−0.999	0.633	2.49	0.368	(0.107, 1.274)	0.115
FNTD score	−0.465	0.175	7.079	0.628	(0.446, 0.885)	0.008*
TCQ-SF score	−0.109	0.03	13.491	0.897	(0.846, 0.951)	<0.001*
Recommendation from doctors to quit smoking						
None (Ref)						
Yes	0.078	1.045	0.006	1.081	(0.139, 8.385)	0.941
Quit interest						
None (Ref)						
Yes	2.579	1.17	4.859	13.189	(1.331,130.683)	0.027*
Quit attempt						
None (Ref)						
Yes	0.611	0.563	1.18	1.843	(0.612, 5.551)	0.277

Notes: Ref, reference; denoted the control group. The statistical method was binary logistics regression, enter method. *indicated P<0.05, with statistical difference.

We identified that a higher FTND score was associated with a lower rate of recent smoking cessation ([OR, 95% CI] 0.628, 0.446–0.885, $P = 0.008$), and a higher TCQ-SF score ([OR, 95% CI] 0.897, 0.846–0.951, $P < 0.001$). Outpatient subjects were more likely to have a lower rate of recent smoking cessation compared to inpatient subjects ([OR, 95% CI] 0.265, 0.075–0.943, $P = 0.04$). Patients who took pulmonary rehabilitation had a higher rate of recent smoking cessation compared to those who do not ([OR, 95% CI] 4.443, 1.169–16.88, $P = 0.029$).

Patients categorized as mMRC-1 and mMRC-2 had a higher rate of recent cessation than those with mMRC-0 ([OR, 95% CI] 5.76, 1.556–21.318, P = 0.009 and [OR, 95% CI] 9.279, 1.603–53.698, P = 0.013, respectively). Furthermore, patients with a declared intention to quit smoking had a higher rate of recent cessation compared to those without a declared intention ([OR, 95% CI] 13.189, 1.331–130.683, P = 0.027).

Discussion

In the light of the Global Burden of Disease Study 2017, COPD contributed to a large part of chronic respiratory disease-attributable deaths, with approximately 41.9 deaths from COPD per 100,000 patients.[14] In China, the prevalence of COPD was 13.7% of the population aged over 40 years, while the estimated number of patients with COPD was 100 million in 2018.[4] Smoking cessation would most likely play a vital role to influence the natural history of COPD, and it has long been a consensus that smoking cessation reduces respiratory symptoms in patients with COPD.[15,16] It was reported that 92.7% of COPD patients were mild to moderate,[17] whose lung function declined rapidly with high risk of acute exacerbation. Smoking cessation was recognized as an important intervention for COPD,[18] which was conducted to improve respiratory symptoms and relieving airway obstruction. In the current study, we recruited inpatient and outpatient with COPD and SAD for questionnaire investigation and a one-year follow-up survey from multi-center in China. The study findings have demonstrated the smoking cessation status in SAD and different stage of COPD patients, which might contribute to the development of public health policies, effective management strategies, and the implementation of early prevention and treatment measures for chronic airway diseases.

In this survey investigation, 64.2% respondents were current smokers (39.5% had SAD, 11.3% mild COPD, 21.0% moderate COPD and 28.2% severe COPD), while 89.5% of subjects smoking more than 20 cigarettes per day. The enrolled subjects had an average TCQ-SF score of 24.45 ± 12.85, while 36.3% of them had severe nicotine dependence. The FTND analysis showed that

the lower quit intention, quit attempted and smoking cessation rate were correlated with higher FTND scores, which was consistent with previous findings that high nicotine dependence poses a significant barrier to smoking cessation.[19]

This study embarked on a comprehensive exploration of smoking cessation dynamics among patients with SAD or COPD, indicating that 91.7% respondents had intentions to quit smoking and 73.6% attempted to quit, but only 23.9% achieved smoking cessation. The previous epidemiological survey conducted from 2018 to 2020 showed that 64.0% of COPD patients have the intention to quit smoking,[20] and 18.3% of them could achieve smoking cessation without intervention, which were similar to our study. An investigation indicated that quitting smoking would require willpower, but the respondents could not explain how to keep their resolution to stop smoking for long.[21] This brings some inspiration to our work, we should screen the current smokers who have intentions to quit smoking in the daily clinical practice, fully understand the reasons of failing to quit smoking, and encourage them to promote the final realization of smoking cessation and put into practice.

The results of our study indicated that the higher mMRC scores might be associated with higher rates of quit attempt and recent smoking cessation (Table E4). The recent smoking cessation rate in patients with moderate and severe COPD was higher than that of SAD patients, which was somewhat due to the aggravation of respiratory symptoms adverse to the exercise tolerance and quality of life. Hence, the deteriorating health status could improve the adherence to smoking cessation treatment and thereby increase the success rate of quitting smoking. The previous large-scale flow modulation study showed that 56.4% of COPD patients in a mild stage,[22] hence, we should emphasize the necessity of quitting smoking in the early stage of disease, and strive for early intervention to avoid symptom aggravation due to smoking.

Having good self-control could be related to the higher intention for smoking cessation, our results reflected that patients who took bronchodilator regularly, who abstained from alcohol, or those with lower FTND scores tended to be more willing to quit smoking. It might suggest to establish the evaluation system of self-control ability and conduct the evaluation of smoking habits in COPD patients, which would be conducive to assessing the self-control ability and promoting the smoking cessation action.

The findings of this survey have led to the conclusion that inpatients with higher mMRC score, those whose parents had no smoking history, and who received medical advice on smoking cessation and engaged in pulmonary rehabilitation exercise were more likely to attempt quitting smoking, which revealed that the greater severity of disease was correlated with the more smoking cessation enforcement. In a qualitative study, recent smokers believed they would have quit smoking if their spouse agreed to supervise the quit smoking action.[21] Our study also revealed the enrolled subjects whose parents had no smoking history had a higher rate of attempt smoking. Moreover, we also found that patients who made medical consultation from doctor would help smoking cessation actions and were more likely to succeed in quitting smoking based upon quitting smoking advice or pulmonary rehabilitation. These results enlightened that we should screen the potential quit-smokers in order to target smoking cessation education, as well as communicate with the patient's family to encourage them to support the patient's smoking cessation actions. Whereas, the awareness of COPD among the grassroots general practitioners still lack of understanding,[23] suggesting the identification and management of early-stage COPD is urgently needed. The lower success rate of smoking cessation was associated with the early age of starting smoking, and also cohort findings suggest greater benefit from earlier cessation,[24] highlighting the significance of early intervention and tobacco control. Moreover, the lower FTND and TCQ-SF scores, along with higher CAT, SGRQ and SAS scores, were demonstrated to contribute to the success of quitting smoking. Hence, it might uncover that patients with more severe respiratory symptoms and psychological anxiety were more likely to quitting smoking successfully, and the high nicotine dependence posed a significant barrier to smoking cessation. Tobacco dependence might reduce the likelihood of smoking cessation, while COPD patients who were psychologically distressed might adopt positive behaviors to quit smoking.[25] The previous study demonstrated that current smokers were more likely to report symptoms of anxiety and depression than never-smokers, and smokers with higher urge to smoke were more likely to report higher levels of symptoms of anxiety, depression, and overall psychological distress, while smokers with higher levels of mental health symptoms were more likely to be motivated to quit smoking.[26] In our study, patients with COPD or SAD might have stronger tobacco dependence,[20] which should be in urgent need of more encouragement and guidance from medical staff. Whereas, patients with more severe psychological anxiety tend to be more willing to quit smoking, suggesting that medical advice and guidance could serve as the basic medical measures and strategic initiatives for public health.

Some limitations should be acknowledged in this study. First, self-reported smoking habits without biological validation might be biased, and future researches could employ a more rigorous assessment of smoking status. Second, the sample size of this study was relatively small and included few women, more studies should focus on expanding the research scope and

carrying out large-scale epidemiological studies to improve the generality of the study. Third, our study reflected the natural smoking cessation rate, rather than adding the alternative treatment or other auxiliary smoking cessation methods, hence, some results might be less consistent with the results reported in the existing literature. Further investigations could focus on cohort-based follow-up studies, exploring and validating the impact of proactive smoking cessation education and various levels of behavioral interventions on the success rate of smoking cessation.

Conclusion

In conclusion, patients with SAD and COPD generally had a high willingness to quit smoking, but a significant reduction in the success rate of smoking cessation. The presence and severity of respiratory symptoms played a crucial role in reducing the likelihood of smoking cessation. Influencing factors included nicotine dependence, patient self-control, lifestyle and environment. From this perspective, early identification and smoking cessation education for patients and their families could contribute to improving the smoking cessation action in patients with chronic respiratory diseases.

Abbreviations

COPD, chronic obstructive pulmonary disease; SAD, small airway dysfunction; FEV_1, forced expiratory volume in one second; SAS, Self-Rating Anxiety Scale; FTND, Fagerstrom Test for Nicotine Dependence; TCQ-SF, Tobacco Craving Questionnaire-Short Form; mMRC, Modified Medical Research Council; CAT, COPD Assessment Test; SGRQ, St. George's Respiratory Questionnaire.

Data Sharing Statement

The datasets used and analyzed in the current study are available from the corresponding author on reasonable request.

Ethics Approval and Informed Consent

The study complies with the Declaration of Helsinki. All the subjects provided written informed consent, and we ensure that all patients included in this study have willingly agreed to participate. The study received ethical approval from the Ethics Committee of the First Affiliated Hospital of Guangzhou Medical University (Medical Ethics No. 121, 2021).

Consent for Publication

All subjects enrolled in this study gave written informed consent.

Author Contributions

All authors made a significant contribution to the work reported, whether that is in the conception, study design, execution, acquisition of data, analysis and interpretation, or in all these areas; took part in drafting, revising or critically reviewing the article; gave final approval of the version to be published; have agreed on the journal to which the article has been submitted; and agree to be accountable for all aspects of the work.

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