

Factors Associated with Severity of Dyspnea in Patients with Chronic Obstructive Pulmonary Disease in Zhejiang Province, China: A Cross-sectional Study

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ABSTRACT

Introduction: Chronic obstructive pulmonary disease (COPD) is a chronic, progressive, and debilitating disease that causes dyspnea. Many factors are closely associated with the severity of dyspnea among COPD patients. The study aimed to assess the severity of dyspnea among COPD patients and determine the factors related to low symptom severity of dyspnea in Zhejiang Province, China.

Methods: An analytical cross-sectional study was conducted to collect data in the Zhejiang tertiary hospitals. A validated questionnaire was used to collect the clinical characteristics, demographics, medical histories, and laboratory results of participants. The modified Medical Research Council (mMRC) scale, was utilized to measure the severity of dyspnea. The questionnaires were completed via face-to-face and phone interviews. Binary logistic regression was applied to predict factors associated with low symptom severity of dyspnea among COPD patients at a significance level of $\alpha = 0.05$.

Results: A total of 420 participants, selected by random sampling, were enrolled in this study. About 36.2% of the participants had low symptom severity of dyspnea. Those who were employed were 2.26 times more likely (95% CI = 1.01-5.09) to have low symptom severity than those who were unemployed. Those with an annual income greater than CNY 100,000 were 3.09 times more likely (95% CI=1.32-7.23) to have low symptom severity than those with an annual income less than CNY 100,000. Those whose COPD treatment cost less than CNY 5,000 per year were 4.39 times more likely (95% CI = 1.53-12.61) to have low symptom severity than those whose COPD treatment cost more than CNY 5,000 per year. Those with mild and moderate airflow limitation had a 6.39-fold (95% CI = 1.94-21.00) higher chance of having low symptom severity than those with severe and very severe airflow limitation. Those with less than 60 months of illness had a 7.02-fold (95% CI = 1.70-28.98) higher chance of experiencing low symptom severity than those with more than 120 months of illness. Those who had not been hospitalized in the past 3 months were 7.91 times more likely (95% CI = 1.37-45.73) to have low symptom severity than those who had been hospitalized more than twice in the past 3 months.

Conclusion: The results showed that the severity of dyspnea among COPD patients was strongly related to duration of illness, airflow limitation severity and the cost of COPD treatment. Early detection and treatment, including exacerbation strategies, are crucial to reducing the severity of dyspnea.

Keywords: COPD, Associated factors, mMRC, Severity of dyspnea

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Introduction

Chronic obstructive pulmonary disease (COPD) is a major health concern around the world [1], imposing significant economic and living burdens on patients, their families, and society. More than 65 million people

are affected by moderate or severe respiratory diseases, which are the third leading cause of death worldwide, accounting for 3.23 million deaths in 2019 [2]. According to epidemiological survey data, there are nearly 100 million COPD patients in China, and the

prevalence of COPD among people aged 40 and above is 13.7%, with an increasing trend [3, 4]. COPD is distinguished by persistent respiratory symptoms and airflow limitation, which result in breathing difficulties due to impaired lung function [5].

Dyspnea is one of the most common types of suffering [6]. It has been linked to functional decline and mortality in studies of the elderly population [7]. While assisting in the optimal treatment of the underlying cause can often help improve dyspnea, the symptom frequently persists [8]. In addition to the limitations of their symptoms and medical channels, most COPD patients experience severe distress due to dyspnea. Dyspnea has been connected to poorer physical and mental health, a lower quality of life, and increased healthcare utilization [9, 10]. The gold standard for diagnosing COPD is typically pulmonary function testing [11], but it does not fully reflect the severity of the patients' breathing difficulties or the severity of the disease [12]. As a supplement to pulmonary function testing, COPD symptom scoring can help provide a more comprehensive assessment of the disease. The current global initiative guidelines recommend using the modified British Medical Research Council (mMRC) scale [13]. In this study, it is a quantitative assessment tool for breathlessness.

When it comes to COPD prevalence, Zhejiang Province ranks among the top five in China, with 12.8%-14.5% of people aged 40 and up suffering from the disease [14-17]. The significance of persistent dyspnea as a symptom of COPD and its associated factors are still not fully understood in China [18], particularly in the COVID-19 era and influenza. The studies on measuring the severity of dyspnea in COPD patients in Zhejiang Province are limited. As a result, this study sought to determine the factors associated with a low risk of dyspnea among COPD patients in Zhejiang Province, China.

Methodology

Study design

An analytical cross-sectional study was used to determine the severity of dyspnea and assess the possible associations of low risk of dyspnea among COPD patients in hospitals located in a Zhejiang Province.

Study samples

The study was conducted in the respiratory department of the tertiary hospitals in Zhejiang Province. The samples from each research area were selected by stratified random sampling and proportional distribution methods. Firstly, the 108 tertiary hospitals with respiratory departments in Zhejiang Province were divided into two categories: 56 were tertiary class A hospitals and 52 were tertiary class B hospitals.

According to the ratio of 1.08:1, three (3) tertiary Class A hospitals and three (3) tertiary Class B hospitals were selected. Secondly, the total number of COPD patients in 2019 in the six (6) tertiary care general hospitals was known to be 170,206, and the sample size was 420. Dividing the sample size by the total number of COPD patients and multiplying by 100.0% give a mean proportion of 0.25% per sample site. Then, the tertiary Class A hospital one (1) get 107 samples, the tertiary Class A hospital two (2) get 78 samples, the tertiary Class A hospital three (3) get 94 samples, the tertiary Class B hospital one (1) get 65 samples, the tertiary Class B hospital two (2) get 28 samples, the tertiary Class B hospital three (3) get 48 samples. Finally, participants in each hospital were selected using simple random sampling.

All participants were physician-confirmed COPD patients aged 40 and older who agreed to take part in this study. The exclusion criteria included COPD patients with a clinical diagnosis of lung cancer, bronchiectasis, pneumoconiosis, or other lungs with restrictive ventilation dysfunction.

Sample size calculation

The sample size was calculated by a standard formula for a cross-sectional study [19], $n = [Z^2_{\alpha/2} PQ]/e^2$, where $Z = 1.96$ for 95% CI; P is the prevalence of low symptom severity of dyspnea in patients with COPD, $58.2\% = 0.582$; Q is the difference of one and P ($1-P$); and e is desired precision (0.05 or 5%). P is the prevalence of low symptom severity of dyspnea in patients with COPD, $58.2\% = 0.582$ [20]. The missingness rate in the sample size was approximately 10%; thus, the sample size was roughly 411 cases. The sample size was increased to 420 cases to improve the accuracy of the results.

Research instruments

The research instruments were a validated questionnaire and the standard COPD symptom scoring tool.

Part 1: With the professional assistance of consultants and co-consultants, an effective questionnaire was developed in accordance with the relevant literature, WHO and CDC guidelines, and the findings of the literature review. Finally, it was divided into two sections and included 17 questions about age, gender, marital status, educational level, occupational status, family income, cost of COPD treatment, BMI, medical insurance, the comorbidities, current cigarettes and so on.

For validity testing, the questionnaire will be submitted to three external experts: clinicians, epidemiologists and nurses. Item-Objective Consistency (IOC) indicators are used to improve content validity [21]. IOC score for the questionnaire which was found

to be more than 0.5 for each item. For the reliability test, the questionnaire was created in English and translated into Chinese. A pilot test will be conducted in a sample of 30 other tertiary hospitals in Zhejiang Province with similar characteristics to the study sample prior to data collection. Questions will be tested for reliability, feasibility and ranking. Alpha values ≥ 0.7 are based on coefficients from the Cronbach Acceptable Questionnaire [22].

Part 2: The modified British Medical Research Council (mMRC) scale was utilized [23]. The mMRC is a widely used scale designed specifically for large-scale epidemiological research [9]. It uses a five-point (0-4) ordinal sequence. Higher scores reflect greater disability and functional impairment because of breathing difficulties. Based on mMRC scores (0-1 vs ≥ 2), the patients are classified into two categories: low symptom severity and high symptom severity [2]. A score of ≥ 2 may indicate a disability related to daily breathing difficulties.

Data collection

After the official letters were sent, the science and education department granted the researcher permission to access the hospitals. The respiratory department staff was then contacted and informed about the study's purpose and the questionnaire, as well as asked for permission to collect data in the outpatient and inpatient units. Before beginning data collection, all participants were explained about the purpose of the study and the content of the questionnaire and signed a written informed consent form. Due to coronavirus disease 2019 (COVID-19), 229 participants were interviewed over the phone while 191 participants were interviewed in person. Each face-to-face interview took 30 minutes, and each phone interview took 40 minutes. The researchers examined the questionnaire to see if it was complete and if any answers were missing. The severity of the airflow limitation, the course of the disease, and the number of hospitalizations within 3 months were obtained from the patients' hospital records.

Data analysis

All completed questionnaires were coded and entered into an Excel spreadsheet. The data were checked and managed for errors and missing data before being uploaded to the SPSS program (version 24, Chicago, IL) for analysis. For continuous data with a normal distribution, the mean and standard deviations are shown. In both univariate and multivariate models. Binary logistic regression was used to detect the association at a significance level of $\alpha = 0.05$, that based on the outcome of mMRC scores (0-1: low symptom severity) vs ≥ 2 : high symptom severity) are classified into two categories. The "ENTER" mode was used to select independent variables in the model, and the final

model was found to be suitable by the Hosmer-Lemeshow Chi-square test.

Ethical considerations

Ethical approval was obtained from Mae Fah Luang University (NO. EC 21073-18) and permission from the hospitals in the research area. All participants were notified of the study, and participation was completely voluntary.

Results

A total of 420 COPD patients were enrolled in this study. The participants in this study had an average age of 69.2 years, with more males than females. Approximately 43.6% of the participants were unemployed. The average family income of the participants was CNY 147,839.30. The average cost of COPD treatment was CNY 6,638.40 (Table 1).

Table 1 General characteristics of participants

Characteristics	n	%
Total	420	100.0
Age (year) = 69.2 years, Mean (SD) = 12.5		
Sex		
Male	237	56.4
Female	183	43.6
Marital status		
Married	285	67.9
Single	17	4.1
Divorced or separated	36	8.6
Widow/Widower	82	19.5
Educational		
Illiterate school	103	24.5
Primary school	139	33.1
Secondary school	115	27.4
Tertiary school	63	15.0
Occupational		
Employed	237	56.4
Unemployed	183	43.57
Family annual income in CNY: Mean (SD) 147,839.3 (164,647.5)		
Cost of COPD treatment per year in CNY: Mean (SD) 6,638.4 (6,458.0)		

Approximately one-fourth of the participants were overweight, and 39.8% of them had comorbidities, with hypertension being the most common. Over 60% of patients had a history of smoking or were current smokers. Patients who were exposed to second-hand smoking totaled 170. The average duration of illness among the patients was 108.2 months (Table 2).

Table 2 Medical history and laboratory results

Characteristics	n	%
BMI		
Underweight	79	18.8
Healthy weight	238	56.7
Overweight	103	24.5
Medical Insurance		
Medical Insurance for employees	174	41.4
Basic Medical Insurance for urban and rural Residents	246	58.6
Number of comorbidities		
0	257	61.2
1-2	109	26.0
3-4	54	12.8
Type of comorbidities (Answer more than one question)		
Hypertension	201	47.9
Diabetes	118	28.1
Osteoporosis	53	12.6
Others	156	37.1
Current cigarette smoking behavior		
Current smoker	77	28.3
Ex-smoker of cigarettes	176	41.9
Non-smoker of cigarettes	167	39.8
Exposed to second-hand smoke		
Yes	170	40.5
No	250	59.5

Characteristics	n	%
Airflow limitation severity (FEV1/FVC)		
Mild and moderate	212	50.5
Severe and very severe	208	49.5
Duration of illness(months)		
<60	160	38.1
60-120	92	21.9
>120	168	40.0
Home oxygen therapy		
Do not use	188	44.8
Short term home oxygen therapy	164	39.0
Long-term home oxygen therapy (>15 hours/ day)	68	16.2
Numbers of hospitalizations within 3 months		
0	214	51.0
1	83	19.8
>2	123	29.2

There were 152 participants having low symptom severity of dyspnea while 268 having high symptom severity (Table 3).

Table 3 Classifications of dyspnea severity in patients with chronic obstructive pulmonary disease (COPD) using mMRC scores (n = 420)

Severity of dyspnea	n	%
Low symptom severity (mMRC 0-1)	152	36.2
High symptom severity (mMRC ≥2)	268	63.8

According to the univariable analysis, 13 variables were found to be associated with low symptom severity of dyspnea: age, family annual income, COPD treatment cost, BMI, medical insurance, number of comorbidities and the types of comorbidities, such as hypertension, diabetes, current cigarette smoking behavior, exposure to secondhand smoke, airflow limitation severity, duration of illness, home oxygen therapy, and number of hospitalizations within the past 3 months. Other variables were not found to be associated with low symptom severity of dyspnea (Table 4).

In the multivariable analysis, six (6) variables were found to be associated with low symptom severity of dyspnea. Those who were employed had a 2.26-fold (95%CI = 1.01-5.09) higher likelihood of experiencing low symptom severity of dyspnea than those who were unemployed. Those whose annual income was higher than CNY 100,000 were 3.09 times more likely (95% CI = 1.32-7.23) to have low symptom severity of dyspnea than those whose annual income was lower than CNY 100,000. Those whose cost of COPD treatment was less than CNY 5,000 per year had a 4.39-fold (95% CI = 1.53-12.61) higher chance of having low symptom severity of dyspnea than those whose cost of COPD treatment per year was CNY 5,000 or more. Low

symptom severity of dyspnea were 6.39 times (95%CI = 1.94-21.00) more prevalent in those whose stages of airflow limitation was mild and moderate than those whose stage of airflow limitation was severe and very severe. Those whose duration of illness was less than 60 months were 7.02 times (95%CI = 1.70-28.98) more likely to experience low symptom severity of dyspnea than those whose duration of illness was more than 120 months. Those who had not been hospitalized within the past 3 months had a 7.91-fold (95% CI = 1.37-45.73) higher chance to have low symptom severity of dyspnea than those who were hospitalized more than twice over the past 3 months (Table 4).

Factors	Severity of dyspnea				OR	95% CI	p value	AOR	95%CI	p-value
	Low risk		High risk							
	n	%	n	%						
Sex										
Male	79	33.3	158	66.7	1.00	0.827-1.991	0.266			
Female	73	39.9	110	60.1	1.28					
Age (years)										
<60	70	66.7	35	33.3	18.62	9.55-36.28	<0.001*			
60-70	53	46.9	60	53.1	5.54	2.81-10.91	<0.001*			
>70	29	14.4	173	85.6	1.00					
Education										
Illiterate	33	37.1	56	62.9	1.00					
Primary	40	31.0	89	69.0	0.90	0.47-1.71	0.743			
Secondary	50	39.4	77	60.6	1.33	0.72-2.48	0.367			
Postsecondary	29	38.7	46	61.3	1.34	0.67-2.70	0.406			
Occupational status										
Unemployed	115	37.3	193	62.7	1.00			1.00		
Employed	37	33.0	75	67.0	1.22	0.75-1.98	0.420	2.26	1.01-5.09	0.048*
Family annual income in CNY										
< 100,000	56	23.0	187	77.0	1.00			1.00		
>100,000	96	54.2	81	45.8	4.96	3.08-7.99	<0.001*	3.09	1.32-7.23	0.009*
Cost of COPD treatment per year in CNY										
<5,000	134	54.3	113	45.7	19.58	8.34-45.94	<0.001*	4.39	1.53-12.61	0.006*
>5,000	18	10.4	155	89.6	1.00			1.00		
BMI										
Underweight	10	12.7	69	87.3	1.00					
Healthy weight	93	39.1	145	60.9	3.87	1.69-8.83	0.001*			

Factors	Severity of dyspnea				OR	95% CI	p value	AOR	95%CI	p-value
	Low risk		High risk							
	n	%	n	%						
Overweight	49	47.6	54	52.4	5.53	2.30-13.26	<0.001*			
Type of medical insurance										
Medical insurance for employees	58	45.7	69	54.3	2.23	1.41-3.53	0.001*			
Basic medical insurance	94	32.1	199	67.9	1.00					
Having comorbidities										
No	54	48.2	58	51.8	3.58	1.54-8.32	0.003*			
Having 1-2 diseases	84	33.1	170	66.9	1.66	0.74-3.73	0.216			
Having 3-4 diseases	14	25.9	40	74.1	1.00					
Types of comorbidities										
Hypertension										
Yes	59	29.4	142	70.6	1.00					
No	93	42.5	126	57.5	2.02	1.28-3.17	0.002*			
Diabetes										
Yes	30	25.4	88	74.6	1.00					
No	122	40.4	180	59.6	2.18	1.26-3.77	0.006*			
Current cigarette smoking behaviour										
Ex-smoker	39	22.2	137	77.8	1.00					
Current smoker	52	67.5	25	32.5	6.19	3.43-11.53	<0.001*			
Non-smoker	61	36.5	106	63.5	1.74	1.01-2.99	0.046*			
Exposed to secondhand smoke										
Yes	51	30.0	119	70.0	1.00					
No	101	40.4	149	59.6	1.98	1.12-2.84	0.015*			
Airflow limitation severity										
Mild and moderate	132	62.3	80	37.7	49.11	17.61-136.95	<0.001*	6.39	1.94-21.00	0.002*
Severe and very severe	20	9.6	188	90.4	1.00			1.00		

Factors	Severity of dyspnea				OR	95% CI	p value	AOR	95%CI	p-value
	Low risk		High risk							
	n	%	n	%						
Duration of illness (months)										
<60	109	68.1	51	31.9	78.33	23.96-256.05	<0.001*	7.02	1.70-28.98	0.007*
60-120	30	32.6	62	67.4	7.47	2.03-27.52	0.003*	1.38	0.30-8.90	0.903
>120	13	7.7	155	92.3	1.00			1.00		
Home oxygen therapy										
Do not use	112	59.6	76	40.4	62.86	8.55-462.20	<0.001*			
Short term home oxygen therapy	39	23.8	125	76.2	7.24	0.94-55.75	0.057			
Long-term home oxygen therapy (>15 hours/day)	1	1.5	67	98.5	1.00					
Numbers of hospitalizations within past 3 months										
0	132	61.7	82	32.3	55.10	13.28-228.59	<0.001*	7.91	1.37-45.73	0.021*
1	16	19.2	67	80.7	3.06	0.55-17.12	0.202	1.14	0.145-8.90	0.139
>2	4	3.3	119	96.7	1.00			1.00		

Discussion

In this study, the severity of dyspnea among COPD patients was explored. About 36.2% of the participants had low symptom severity of dyspnea, which was different from study in South Korea [24]. The outbreak of COVID-19, many control measures in China have increased the panic of participants, causing more severe symptoms of dyspnea [25], which may be the reason why the proportion of COPD patients with obvious symptoms of dyspnea in Zhejiang Province is higher than that in South Korea. One possible reason may be that this study was limited to tertiary hospitals, where there are more patients with severe conditions. Moreover, a study showed that the misdiagnosis rate of COPD in China is as high as 77% [26]. By the time of diagnosis, the disease has often become rather advanced, which is one reason why there are more participants with severe dyspnea in this study than in other studies.

People in high-income areas in China have better access to healthcare resources and a higher quality of life than those in poverty, who have lower levels of health insurance coverage [27, 28]. Breathlessness is

linked to worse physical and mental health as well as a lower quality of life [9], which means that a higher income influences the level of breathlessness severity. When a patient's family has a higher income, they have more opportunities for early diagnosis, treatment, and continuous care, such as access to more medical equipment for breathlessness. When a patient receives careful and continuous care, their disease progression can be slowed, and the likelihood of hospitalization due to poor disease management and symptoms of breathlessness also decreases. Patients who are employed tend to have more stable disease conditions, better social value, and more stable emotions, which can help alleviate breathlessness symptoms [29]. Studies have shown that COPD patients who are unable to work are more likely to report physical discomfort than those who are employed/self-employed, unemployed, retired, or identified as homemakers with COPD [30]. Therefore, patients who are employed tend to have less severe symptoms of breathlessness than those who are not. In addition, this study discovered that the number of COPD patients suffering from dyspnea was higher among those whose annual COPD treatment costs were less than CNY 5,000 than among those whose annual COPD treatment costs were higher than CNY 5,000.

One study suggested that depression and anxiety may be related to patient medical expenses [31], while increased respiratory rates in patients with anxiety disorders may increase gas trapping, resulting in respiratory difficulty [32,33].

Dyspnea is very common in all stages of airflow limitation [34]. In late-stage COPD, physiological dead space increases due to a ventilation/perfusion mismatch [35]. Therefore, for late-stage COPD patients with relatively fixed pathological and physiological damage, respiratory difficulty symptoms cannot be eliminated [34]. Thus, the greater the degree of airflow limitation, the more severe the respiratory difficulty. This finding is consistent with previous observational studies [36]. While duration of illness does not necessarily indicate that the patient's condition is more severe, Kieczka [37] and Jankowska-Polańska et al. [38] reported that longer illness duration leads to more negative effects of the disease on patients. This study discovered that having COPD for a longer period causes more severe dyspnea, possibly due to age-related factors and the disease progression associated with having the disease for a long time. Müllerová's [36] study suggested that the intensity of increased dyspnea grade increases with age. More hospitalizations signal the severity of the disease, and patients who are readmitted have more severe respiratory difficulties. Hutchinson's [39] and Currow's [40] studies indicated that people with chronic dyspnea experienced moderate to severe dyspnea when deciding to seek medical attention and were twice as likely to be hospitalized.

As a developing country with a large population, China has limited access to medical resources per capita [41]. Community hospitals can increase public awareness and conduct pulmonary function tests for target populations in order to achieve early prevention and treatment and avoid disease aggravation and delay, as well as severe dyspnea. If the government continues to deepen healthcare reform by focusing on issues such as the difficulty and high cost of medical treatment, adjusting the reimbursement scope of medical insurance [42], and lowering costs for patients with chronic diseases such as COPD, the severity of dyspnea in COPD patients can be reduced indirectly.

There are some limitations to this study that may affect the results and interpretations. Firstly, the severity of dyspnea may not be an exact result of the aforementioned factors due to the cross-sectional nature of assessing both exposure and outcome at the same time. Secondly, collecting data over the phone may affect the completeness and quality of the data because body language cannot be evaluated. Finally, this study was conducted in tertiary hospitals and lacks data from community hospitals or family physicians.

Conclusion

A large proportion of COPD patients living in Zhejiang experienced severe dyspnea. Some disease-related factors and the inability to afford treatment costs may contribute to the severity of dyspnea in patients to some extent. Public health policy makers must improve healthcare services, especially by addressing the issue of high medical costs, which can sometimes help COPD patients reduce the severity of dyspnea. Health institutions should strengthen publicity and conduct lung function tests for the target populations to achieve early prevention and treatment, avoiding exacerbation and delay of the disease. To ensure early treatment, regular check-ups for COPD patients are necessary. Healthcare professionals for COPD patients should educate them on how to recognize early changes in their conditions. Early detection and treatment are crucial to ensuring lower symptom severity of dyspnea for COPD patients.

Competing interests

The authors had no competing interests to declare.

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References

- [1] Park HY, Kang D, Lee H, Shin SH, Kang M, Kong S, et al. Impact of chronic obstructive pulmonary disease on mortality: a large national cohort study. *Respirology*. 2020;25(7):726-734. DOI: doi.org/10.1111/resp.13678
- [2] Chronic obstructive pulmonary disease (COPD). Available from: [https://www.who.int/news-room/fact-sheets/detail/chronic-obstructive-pulmonary-disease-\(copd\)](https://www.who.int/news-room/fact-sheets/detail/chronic-obstructive-pulmonary-disease-(copd)). Accessed 17th March 2023.
- [3] Office of the State Council. Notice of the general office of the state council on printing and distributing China's mid- and long-term plan for the prevention and treatment of chronic diseases (2017-2025). Available from: http://www.gov.cn/zhengce/content/2017-02/14/content_5167886.htm. Accessed on 20 May 2022.
- [4] Meng X, He Y, Mao R and Chen Z. 'Application of St. George's Respiratory Questionnaire, CAT and mMRC Scores in Chronic Obstructive Pulmonary Disease'. *Fudan Journal: Medical Edition*. 2022; 49(6):8. DOI : 10.3969/j.issn.1672-8467.2022.06.004

- [5] Global Initiative for Chronic Obstructive Lung Disease. Global strategy for the diagnosis, management, and prevention of chronic obstructive pulmonary disease (2022 report). Available from: <https://goldcopd.org/2022-gold-reports-2/>. Accessed 17th March 2023.
- [6] Johnson MJ, Yorke J, Hansen-Flaschen J, Lansing R, Ekström M, Similowski T, et al. Towards an expert consensus to delineate a clinical syndrome of chronic breathlessness. *European Respiratory Journal*. 2017;49(5). DOI: 10.1183/13993003.02277-2016.
- [7] Ho SF, O'Mahony MS, Steward JA, Breay P, Buchalter M, Burr ML, et al. Dyspnoea and quality of life in older people at home. *Age and Ageing*. 2001;30(2):155-159. DOI:10.1093/ageing/30.2.155
- [8] Fang L, Gao P, Bao H, Tang X, Wang B, Feng Y, et al. Chronic obstructive pulmonary disease in China: a nationwide prevalence study. *The Lancet Respiratory Medicine*. 2018;6(6):421-430. DOI: 10.1016/S2213-2600(18)30103-6.
- [9] Office for National Statistics. China's economic performance in the first three quarters of 2022. Available from: <http://www.gov.cn/zhuanti/2022sjdjjsj/index.htm>. Accessed on 24 October 2022.
- [10] Hutchinson A, Pickering A, Williams P, Bland JM, and Johnson MJ. Breathlessness and presentation to the emergency department: a survey and clinical record review. *BMC Pulmonary Medicine*. 2017; 17:1-7. DOI: 10.1186/s12890-017-0396-4.
- [11] Bodduluri S, Reinhardt JM, Hoffman EA, Newell Jr JD, and Bhatt SP. Recent advances in computed tomography imaging in chronic obstructive pulmonary disease. *Annals of the American Thoracic Society*. 2018;15(3):281-289. DOI: 10.1513/AnnalsATS.201705-377FR.
- [12] Agusti A, Calverley P, Celli B, Coxson HO, Edwards LD, Lomas DA, et al. Characterisation of COPD heterogeneity in the ECLIPSE cohort. *Respiratory Research*. 2010;11(1):1-4. DOI: 10.1186/1465-9921-11-122.
- [13] Bestall JC, Paul EA, Garrod R, Garnham R, Jones PW, and Wedzicha J. Usefulness of the medical research council (MRC) dyspnoea scale as a measure of disability in patients with chronic obstructive pulmonary disease. *Thorax*. 1999;54(7):581-586. DOI: 10.1136/thx.54.7.581.
- [14] Wang M, Zhong JM, Fang L, and Wang H. Prevalence and associated factors of smoking in middle and high school students: a school-based cross-sectional study in Zhejiang Province, China. *BMJ Open*. 2016;6(1): e010379. DOI: 10.1136/bmjopen-2015-010379.
- [15] Yang H, Chen S, Zheng P, Chen W, Jianying X, Lan Y et al. Survey on the prevalence and risk factors of chronic obstructive pulmonary disease among residents in Yongjia County. *Zhejiang Preventive Medicine*. 2016;28(6):4. DOI: <http://www.cnki.com.cn/Article/CJFDTot-ZYFX201606008.htm>
- [16] Lv X, Chen W, Liu J, Yang Q, Fang Z, Zhang Y et al. Epidemiological investigation and risk factor analysis of chronic obstructive pulmonary disease in Jiaying City, Zhejiang Province. *Chinese Journal of Evidence-Based Medicine*. 2015; 15(6):5. DOI: <https://d.wanfangdata.com.cn/periodical/zgxyzyx201506003>.
- [17] Lin F. Investigation and recommendations on the prevalence and risk factors of chronic obstructive pulmonary disease in the community at high risk. *Journal of Chinese Medicine Management*. 2016; 22; 30-32. DOI: 10.16690/j.cnki.1007-9203.2016.22.010.
- [18] Ahmadi Z, Sandberg J, Shannon-Honson A, Vandersman Z, Currow DC, and Ekström M. Is chronic breathlessness less recognised and treated compared with chronic pain? A case-based randomised controlled trial. *European Respiratory Journal*. 2018;52(3). DOI: 10.1183/13993003.00887-2018
- [19] Pourhoseingholi MA, Vahedi M, and Rahimzadeh M. Sample size calculation in medical studies. *Gastroenterology and Hepatology from Bed to Bench*. 2013;6(1):14.
- [20] Zhao C. 'The value and difference of CAT, mMRC, CCQ, and SGRQ scoring systems in evaluating pulmonary function and quality of life in patients with COPD.' *Journal of Clinical Pulmonary Medicine*. 2018; 23.11(5). DOI: 10.3969/j.issn.1009-6663.2018.11.031.
- [21] Turner RC and Carlson L. Indexes of item-objective congruence for multidimensional items. *International Journal of Testing*. 2003;3(2):163-171. Doi: 10.1207/S15327574IJT0302_5.
- [22] George D and Mallery P. *SPSS for Windows Step by Step: a simple guide and reference*, 17.0 Update. 2010. Available from: <https://wps.ablongman.com/wps/media/objects/385/394732/george4answers.pdf>. Accessed on 17 April, 2023.
- [23] Vestbo J, Hurd SS, Agustí AG, Jones PW, Vogelmeier C, Anzueto A, et al. Global strategy for the diagnosis, management, and prevention of chronic obstructive pulmonary disease: GOLD executive summary. *American Journal of Respiratory and Critical Care Medicine*. 2013;187(4):347-65. DOI : 10.1164/rccm.201204-0596PP.
- [24] Kim S, Oh J, Kim YI, Ban HJ, Kwon YS, Oh IJ, et al. Differences in classification of COPD group using COPD assessment test (CAT) or modified Medical Research Council (mMRC) dyspnea scores: a cross-sectional analysis. *BMC Pulmonary Medicine*. 2013;13(1):1-5. DOI: 10.1186/1471-2466-13-35.

- [25] Dash G. A bibliometric analysis of panic-buying behavior during a pandemic: insights from COVID-19 and recommendations. *Sustainability*. 2023;15(2):1352. DOI: 10.3390/su15021352.
- [26] Casas HA, Montes de OM, López VMV, Aguirre C, Schiavi E, Jardim JR, et al. COPD underdiagnosis and misdiagnosis in a high-risk primary care population in four Latin American countries. A key to enhance disease diagnosis: the PUMA study. *PlosOne*. 2016;11(4): e0152266. DOI: 10.1371/journal.pone.0152266.
- [27] Bi J. Research on the correlation between COPD patients' perception of chronic disease management, self-management ability and quality of life. 2017. Available from: <https://kns.cnki.net/KCMS/detail/detail.aspx?dbname=CMFD201702&filename=1017081287.nh>. Accessed on 19 March 2023.
- [28] National Bureau of Statistic. China statistical yearbook. Available from: <http://www.stats.gov.cn/tjsj/ndsj/>. Accessed on 19 March 2023.
- [29] Trevisan C, Vianello A, Zanforlini BM, Curreri C, Maggi S, Noale M, et al. The mutual association between dyspnea and depressive symptoms in older adults: a 4-year prospective study. *Aging & Mental Health*. 2020;24(6):993-1000. DOI: 10.1080/13607863.2019.1582005
- [30] Stellefson M, Ford CD, Wang MQ, Cline I, and Kinder C. Role of socioeconomic factors on physical and mental distress reported by Alabama adults with COPD. *Southern Medical Journal*. 2022;115(6):374-380. DOI: 10.14423/smj.0000000000001407.
- [31] Wallace K, Zhao X, Misra R, and Sambamoorthi U. The humanistic and economic burden associated with anxiety and depression among adults with comorbid diabetes and hypertension. *Journal of Diabetes Research*. 2018. DOI: 10.1155/2018/4842520.
- [32] Cooper CB. The connection between chronic obstructive pulmonary disease symptoms and hyperinflation and its impact on exercise and function. *Am J Med*. 2006; 119: 21-31. DOI: 10.1016/j.amjmed.2006.08.00416996896.
- [33] Wu Y, Jin S, Guo J, Zhu Y, Chen L, Huang Y et al. The economic burden associated with depressive symptoms among middle-aged and elderly people with chronic diseases in China. *International Journal of Environmental Research and Public Health*. 2022; 19(19): 12958. DOI: 10.3390/ijerph191912958.
- [34] O'Donnell DE, Milne KM, James MD, de Torres JP, and Neder JA. Dyspnea in COPD: new mechanistic insights and management implications. *Advances in Therapy*. 202; 37: 41-60. DOI: 10.1007/s12325-019-01128-9.
- [35] Hanania NA and O'Donnell DE. Activity-related dyspnea in chronic obstructive pulmonary disease: physical and psychological consequences, unmet needs, and future directions. *International Journal of Chronic Obstructive Pulmonary Disease*. 2019;1127-38. DOI: 10.7326/M15-0288.
- [36] Müllerová H, Lu C, Li H, and Tabberer M. Prevalence and burden of breathlessness in patients with chronic obstructive pulmonary disease managed in primary care. *PlosOne*. 2014; 9(1): e85540. DOI: 10.1371/journal.pone.0085540.
- [37] Kieczka KM. and Dariusz Z. The impact of socioeconomic status on the quality of life in patients with chronic obstructive pulmonary disease. *Pneumonol. Alergol*. 2010; 78(1): 3–13 Available from: https://journals.viamedica.pl/advances_in_respiratory_medicine. Accessed on 17 April, 2023.
- [38] Jankowska B, Kasprzyk M, Chudiak A, and Uchmanowicz I. Effect of disease acceptance on quality of life in patients with chronic obstructive pulmonary disease (COPD). *Pneumonol Alergol Pol*. 2016; 84(1); 3-10. DOI: 10.5603/PiAP.a2015.0079.
- [39] Hutchinson A, Pickering A, Williams P, Bland JM, and Johnson MJ. Breathlessness and presentation to the emergency department: a survey and clinical record review. *BMC Pulmonary Medicine*. 2017; 17: 1-7. DOI: 10.1186/s12890-017-0396-4.
- [40] Currow DC, Plummer JL, Crockett A, and Abernethy AP. A community population survey of prevalence and severity of dyspnea in adults. *Journal of Pain and Symptom Management*. 2009; 38(4) :533-45. DOI: 10.1016/j.jpainsymman.2009.01.006.
- [41] Health and Health Commission. Statistical bulletin on the development of my country's health and health undertakings in 2021. Available from: http://www.gov.cn/xinwen/2022-07/12/content_5700670.htm. Accessed on 17 April, 2023.
- [42] Wu M, Zhao Q, Chen Y, Fu C, and Xu B. Quality of life and its association with direct medical costs for COPD in urban China. *Health and Quality of Life Outcomes*. 2015; 13(57). DOI : 10.1186/s12955-015-0241-5 34.