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Assessing the association between daily self-reported health symptoms and mental health among respiratory patients during high-pollution period in Thailand

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Abstract

This study aimed to explore the relationship between daily self-reported health symptoms and mental health among respiratory patients during a high-pollution period in Thailand. A cross-sectional study was conducted at the pulmonary clinic of King Chulalongkorn Memorial Hospital in Bangkok, Thailand in February 2022. Patients with respiratory diseases were enrolled and asked to self-evaluate their health via ChulaAir mobile application. Daily respiratory symptoms were assessed using a checklist for a month. The DASS21 questionnaire was used to identify depression, anxiety, and stress at the end of the month. Binary logistic regression was performed to find the associations. A total of 98 patients participated in the study, and the prevalence of depression, anxiety, and stress was 30.6%, 28.6%, and 26.5%, respectively. Cough and Phlegm were the most common health symptoms during the high-pollution period. An increase in the number of days with self-reported sore eyes was associated with depression (AOR=1.307; p=0.001), anxiety (AOR=1.261; p=0.001), and stress (AOR=1.178; p=0.001). Health symptoms are related to the presence of depression, anxiety, and stress during the high-pollution period. For individuals with respiratory symptoms, measures are required to alleviate mental health problems.

Keywords: Air pollution, Health symptoms, Mental health, Respiratory patients, Depression, Anxiety, Stress.

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1. Introduction

Chronic respiratory patients are considered individuals who have been diagnosed with a long-term respiratory disorder characterised by persistent airway symptoms, including cough, sneezing, difficulty to breath, excessive phlegm, and nasal mucus, among others [1]. Airway and respiratory diseases pose a global public health concern, contributing to 695.1 thousand deaths and 15.4 million disability-adjusted life years (DALYs) [2].

There is plenty of evidence indicating that a person's mental health can affect respiratory sensations, and some individuals may experience respiratory symptoms regardless of the presence of a respiratory ailment [3]. However, it is possible that certain chronic respiratory conditions may exhibit pertinent mental health symptoms, and that some respiratory conditions may be impacted by psychological distress [4]. The connections between respiratory health, illness, and mental health are

intricate and may have implications for clinical practice. Research on the relationship between respiratory symptoms and psychological health suggests that individuals with higher psychological symptoms are more likely to report respiratory problems, [5]. A study assessing the physical and psychological effects of respiratory-related dyspnoea (difficulty breathing) reveals that some patients experience anticipatory worry about developing dyspnoea, which aggravates their symptoms [6]. Anxiety and depression, when prevalent in respiratory patients, are linked to higher mortality, longer hospital admissions, and a decline in functional status and quality of life [7]. However, the link between respiratory symptoms and psychological conditions is not well understood.

Air pollutants, such as particulate matter (PM2.5), can adversely impact both the respiratory and psychological health of affected individuals [8, 9]. Although many studies have highlighted the link between respiratory disorders and mental health, it is still unclear which health symptoms of these diseases are associated with the risk of mental health symptoms, especially in the time of high air pollution intensity. Our objective was to investigate the relationship between daily self-reported health symptoms and mental health among respiratory patients during a high-pollution period in Thailand.

2. Methods

2.1. Study Design

A one-month cross-sectional study was conducted among patients with respiratory disorders who were followed up on a regular basis at King Chulalongkorn Memorial Hospital. Patients were recruited in January 2022, and data collection started from February 1st to 28th, 2022. The month of February was chosen for data collection because of the highest air pollution period in Bangkok and its surrounding areas [10]. This study was authorized by the Chulalongkorn Hospital's Ethical Research Committee (number: 326/64). Each participant provided written consent to participate, and they were informed that declining to participate would have no impact on the quality of their medical treatment.

2.2. Study Population

The sample size was determined using G*Power software version 3.1, with a medium effect size of 0.20, assuming a type 1 error rate of 5%, and a power (1- β error probability) of 0.95. Based on these parameters, it was anticipated that complete outcome data would be available on 81 participants. To account for possible participant dropouts, an additional 20% was added, resulting in a total of 100 respiratory patients.

This study applied the non-probability sampling method, which is a sampling technique where the researcher selects samples based on subjective judgment rather than random selection. In this study, all respiratory patients who met the inclusion criteria were recruited from the division of Pulmonary and Critical Care Medicine until the expected total number of participants was reached.

Patients were selected based on the following criteria: being the age of 18 and above and having chronic respiratory disorders (such as Asthma, Chronic Obstructive Pulmonary Disease: COPD/Bronchiectasis/or Rhinitis), regardless of severity. Patients with severe mental illness, cognitive disability, as well as those residing outside of Bangkok and its vicinity were excluded from the study. All patients who met the inclusion and exclusion criteria were invited to participate in this study. Out of the one-hundred patients approached, 98 respiratory patients finally agreed to participate in the study.

2.3. Data Collection

2.3.1. Questionnaire

After recruiting participants at the respiratory clinic, trained research assistants proceeded to install the “ChulaAir mobile application” on the patients’ devices. The application was specifically developed and used for data collection over a period of a month. At the beginning of the study, participants provided various details that included age (years), gender (male/female), marital status (single/married/separated), education (below bachelor’s/bachelor’s/above bachelor’s), career (employed/unemployed), income (25,000 THB and lower/25,001-50,000/50,001 and above), current smoking status (yes/no), current alcohol use (yes/no), presence of physical illness (yes/no), and the number of family members (2-3 persons/ 4 or more).

The trained research assistants accessed the medical records of patients to collect further information. The respiratory diagnosis was obtained from the records and coded as Asthma (yes/no), COPD (yes/no), Bronchiectasis (yes/no), and Rhinitis (yes/no). All respiratory diagnoses were established through clinical evidence and carried out by two doctors. Body mass index (BMI) and the occurrence of hospital visits within a month (yes/no) were collected from the medical records.

2.3.2. Respiratory Symptoms

Participants reported their daily symptoms related to respiratory disorders, including cough (yes/no), phlegm (yes/no), tiredness (yes/no), runny nose (yes/no), nasal mucus (yes/no), sneeze (yes/no), and sore eye symptoms (yes/no). The ChulaAir mobile application sent a notification reminding text to each participant at the end of the day to prompt them to report their daily health symptoms. Participants were requested to indicate their health symptoms between February 1st and 28th, 2022. The number of days with reported symptoms was recorded and reported.

2.3.3. Depression Anxiety Stress

The Depression Anxiety Stress Scale (DASS21) was used in this study to assess psychological distress. It was developed by Lovibond and Lovibond [11] and consisted of three categories: depression, anxiety, and stress. Each category comprises seven questions, resulting in a total of twenty-one questions. Each question was graded on a scale of zero to three, with zero indicating "did not apply to me at all" and three indicating "applied to me very much, or most of the time"). Following the

DASS21 guideline, the scores for each domain were multiplied by two to represent the total score. The total score for each category ranged from zero to forty-two, with higher scores indicating greater psychological distress. A score of greater than or equal to 10 indicated the presence of depressive symptoms, a score of more than or equal to 7 indicated the presence of anxiety symptoms, and a score of 11 and above indicated the presence of stress [12]. However, due to the skewness of the collected data, individuals with scores higher than the 75th percentile in each category were categorised as 'positive' in this study. The Thai version of DASS21 has been validated in Thai people and demonstrated excellent psychometric qualities by Oei, et al. [13] and colleagues in 2013. Furthermore, this assessment is expected to be useful in a variety of countries for both non-clinical and clinical purposes [14].

2.4. Statistical Analyses

All analyses were performed by using SPSS Statistics, version 26.0 (Chulalongkorn University license). Descriptive statistics such as means, standard deviations, and proportions were used to summarise the clinical and demographic information of each participant. The proportions of negative and positive psychological distress symptoms were compared using Chi-Squared tests or Fisher's Exact Test. The frequency of depression, anxiety, and stress was presented as percentages. As the data was skewness, the descriptive days of respiratory symptoms and psychological distress (Depression/ Anxiety/Stress) across patients were reported using median and interquartile range (IQR). Spearman's correlation was performed to examine the link between respiratory symptoms and depression, anxiety, or stress. Furthermore, a multivariate logistic regression model was used to assess the relationship between the number of days with respiratory symptoms (independent variables) and depression, anxiety, and stress (dependent variables), while controlling for covariates such as age, gender, marital status, employment, smoking, alcohol use, physical illness, and social support. Statistical significance was defined as a p-value of less than 0.05.

3. Result

This study included 98 respiratory patients who were categorised into three groups based on their psychological distress levels: depression, anxiety, and stress. The prevalence rates of depression, anxiety, and stress were found to be 30.6%, 28.6%, and 26.5%, respectively. The mean age of the participants was 55.3, with the majority being women (69.4%). More than half of the patients were in a partnership. The majority of them had obtained a bachelor's degree or higher (72.4%). Additionally, over 80% of respiratory patients reported never having smoked or consumed alcohol. Among this group of patients, asthma was the most common chronic respiratory diagnosis, accounting for 50% of the cases (see Table 1).

A Chi-square test of independence was performed to examine the relationship between sociodemographic characteristics and psychological distress. The proportion of individuals who reported being depressed differ significantly at a significant level of 0.05 for age and .01 for education, monthly income, physical illness, and BMI. There was a significant association between anxiety and education ($p < 0.05$), career employment ($p < 0.05$), and monthly income ($p < .01$). Regarding stress, significant associations were found with gender, marital status, education, income, and alcohol consumption ($p < .05$). However, the presence of depression, anxiety, and stress did not differ based on smoking status, respiratory diagnoses, hospital visit within a month, number of family members.

The number of days with respiratory symptoms in a month among patients with different types of psychological distress is presented in Table 2, providing the median and interquartile range. The result showed that patients experiencing stress had a higher number of days with cough symptoms (median = 11.5, IQR = 17). Patients with anxiety had a higher number of days with phlegm symptoms (median = 8.5, IQR = 18). Increased frequency of tiredness was associated with anxiety (median = 8, IQR = 19). Patients with anxiety (median = 8, IQR = 13) and stress (median = 8, IQR = 11) reported more days with runny nose symptoms. Depressive symptoms were associated with more days of nasal mucus (median = 8, IQR = 12). Patients experiencing stress had a higher number of days with sneezing symptom (median = 6, IQR = 12), and those with stress also reported more days with sore eyes (median = 4.5, IQR = 8).

Table 1.
Sociodemographic characteristics of respiratory patients (N = 98).

Characteristics		n (%)	Depression n (%)		*p*	Anxiety n (%)		*p*	Stress n (%)		*p*
			No	Yes		No	Yes		No	Yes	
Age	Mean (SD)	55.3(15.1)	57.9(12.6)	49.3(18.5)	0.026[a]	56.7(13.7)	51.6(17.8)	0.175[a]	57.0(13.8)	50.5(17.8)	0.103[a]
Sex	Male	30(30.6)	23(76.7)	7(23.3)	0.340[b]	23(76.7)	7(23.3)	0.480[b]	27(90.0)	3(10.0)	0.014[c]
	Female	68(69.4)	45(66.2)	23(33.8)		47(69.1)	14(23.0)		45(73.5)	23(33.8)	
Marital	Single	27(27.6)	15(55.6)	12(44.4)	0.111[c]	16(59.3)	11(40.7)	0.119[c]	50(82.0)	11(18.0)	0.043[c]
	Married	61(62.2)	32(64.0)	16(36.0)		38(76.0)	12(24.0)		38(76.0)	12(24.0)	
	Separated	10(10.2)	6(60.0)	4(40.0)		7(70.0)	3(30.0)		6(60.0)	4(40.0)	
Education	< Bachelor	27(27.6)	16(59.3)	11(40.7)	0.008[c]	14(51.9)	13(48.1)	0.025[c]	15(55.6)	12(44.4)	0.025[c]
	Bachelor	50(51.0)	32(64.0)	18(36.0)		38(76.0)	12(24.0)		38(76.0)	12(24.0)	
	> Bachelor	21(21.4)	20(95.2)	1(4.8)		18(85.7)	3(14.3)		19(90.5)	2(9.5)	
Career	Employed	35(35.7)	20(57.10	15(42.9)	0.067[b]	20(57.1)	15(42.9)	0.034[b]	22(62.9)	13(37.1)	0.096[b]
	Unemployed	63(64.3)	48(76.2)	15(23.8)		50(79.4)	13(28.6)		46(73.2)	17(26.8)	
Income*	< 25K	55(56.1)	32(58.2)	23(41.8)	0.006[c]	33(60.0)	22(40.0)	0.007[c]	34(61.8)	21(38.2)	0.008[c]
	25K -50K	24(24.5)	18(75.0)	6(25.0)		19(79.2)	5(20.8)		20(83.3)	4(16.7)	
	> 50K	19(19.4)	18(94.7)	1(5.3)		18(94.7)	1(5.30		18(94.7)	1(5.30)	
Smoking	No	83(84.7)	56(67.5)	27(32.5)	0.543[c]	59(71.1)	24(28.9)	1.000[c]	59(71.1)	24(28.9)	0.341[c]
	Yes	15(15.3)	12(80.0)	3(20.0)		11(70.0)	4(30.0)		13 (86.7)	2(13.3)	
Alcohol	No	80(81.6)	53(66.3)	27(33.7)	0.257[c]	56(70.0)	24(30.0)	0.578[c]	55(68.8)	25(31.3)	0.036[c]
	Yes	18(18.4)	15(83.3)	3(16.7)		14(77.8)	4(22.2)		17(94.4)	1(5.6)	
Disease	Asthma	49(50.0)	37(75.5)	12(24.5)	0.181[c]	39(79.6)	10(20.4)	0.229[c]	37(75.5)	12(24.5)	0.055[c]
	COPD	11(11.2)	9(81.8)	2(18.2)		7(63.6)	4(36.4)		11(100.0)	0(0.0)	
	Bronchiectasis	18(18.4)	9(50.0)	9(50.0)		10(55.6)	8(44.4)		10(55.6)	8(44.4)	
	Rhinitis	20(20.4)	13(65.0)	7(35.0)		14(70.0)	6(30.0)		14(70.0)	6(30.0)	
Allergy	No	53(54.1)	37(69.8)	16(30.2)	0.547[b]	39(73.6)	14(26.4)	0.386[b]	40(75.5)	13(24.5)	0.397[b]
	Yes	45(45.9)	31(68.9)	14(31.1)		31(68.9)	14(31.1)		32(71.1)	13(28.9)	
Physical illness	No	46(46.9)	25(54.3)	21(45.7)	0.004[b]	31(67.4)	15(32.6)	0.503[b]	30(65.2)	16(34.8)	0.109[b]
	Yes	52(53.1)	43(82.7)	9(17.3)		39(75.0)	13(25.0)		42(80.8)	10(19.2)	
BMI	Low	16(16.3)	7(43.8)	9(56.2)	0.004[b]	9(56.2)	7(43.8)	0.296[b]	9(56.2)	7(43.8)	0.248[b]
	Healthy	49(50.0)	41(83.7)	8(16.3)		38(77.6)	11(22.4)		38(77.6)	11(22.4)	
	High	33(33.7)	20(60.6)	13(39.4)		23(69.7)	10(30.3)		25(75.8)	8(24.2)	
Family members	2-3 Persons	49(50.0)	33(67.3)	16(32.7)	0.827[b]	35(71.4)	14(28.6)	1.000[b]	37(75.5)	12(24.5)	0.819[b]
	4 and more	49(50.0)	35(71.4)	14(28.6)		35(71.4)	14(28.6)		35(71.4)	14(28.6)	
Hospital visit	No	74(75.5)	51(68.9)	23(31.1)	1.000[b]	54(73.0)	20(27.0)	0.607[b]	57(77.0)	17(23.0)	0.188[b]
	Yes	24(24.5)	17(70.8)	7(29.2)		16(66.7)	8(33.3)		15(62.5)	9(37.5)	

Note: * = Monthly income (Thai ฿), [a] = Independent T-test, [b] = Chi square, [c] = Fisher's exact test.

Table 2.
Descriptive of days presenting respiratory symptoms and psychological distress (N =98).

Respiratory symptoms	Depression median (IQR)		Anxiety median (IQR)		Stress median (IQR)	
	Negative	Positive	Negative	Positive	Negative	Positive
Cough	6.5(18.0)	9.0(15.0)	6.5(17.0)	9.5(16.0)	6.5(17.0)	11.5(17.0)
Phlegm	6.5(18.0)	6.5(18.0)	5.0(17.0)	8.5(18.0)	7.0(18.0)	4.0(17.0)
Tiredness	2.0(19.0)	6.5(15.0)	2.0(18.0)	8.0(19.0)	2.0(18.0)	7.0(19.0)
Runny nose	3.0(8.0)	8.0(13.0)	3.0(9.0)	8.0(11.0)	4.0(9.0)	7.0(13.0)
Nasal mucus	1.0(5.0)	8.0(12.0)	1.0(6.0)	7.5(12.0)	1.0(7.0)	3.5(17.0)
Sneeze	3.0(10.0)	6.0(12.0)	3.0(10.0)	5.0(9.0)	3.0(10.0)	5.0(9.0)
Sore eye	0.0(2.0)	2.0(9.0)	0.0(1.0)	4.0(8.0)	0.0(1.0)	4.5(8.0)

Note: IQR = Interquartile range.

Table 3 presents the correlation between psychological distresses (depression, anxiety, and stress) and monthly respiratory symptoms among the respiratory patients of Chulalongkorn Hospital. The results indicate that the number of days with symptoms of red eye, tiredness, and runny nose showed a moderate positive correlation with depression, anxiety, and stress (r = 0.242 - 0.424, $p < 0.05$). Symptoms of sneezing and cough were significantly associated with anxiety and stress (r = 0.212 - 0.253, $p < 0.05$). In addition, days with nasal mucus among respiratory patients were found to be positively correlated with depression (r = 0.247, $p < 0.05$) and anxiety (r = 0.268, $p < 0.01$).

Table 3.
Correlation between DASS21 (Depression/Anxiety/Stress) and respiratory symptoms.

Variable	Cough	Phlegm	Tiredness	Runny nose	Nasal mucus	Sneeze	Sore eye
Depression	0.173	0.074	0.260**	0.252*	0.247*	0.186	0.412**
Anxiety	0.229*	0.151	0.398**	0.280**	0.286**	0.253*	0.424**
Stress	0.217*	0.069	0.289**	0.242*	0.156	0.240*	0.350**

Note: * = P-value < 0.05, ** = P-value < 0.01.

Table 4 presents the risk of psychological distress in patients with daily respiratory symptoms, adjusted through multivariate analysis. The results indicate that days presenting symptoms of red eye were identified as a risk factor for depression, anxiety, and stress ($p < 0.01$). An increment of a day with red eyes was associated with increase odds of reporting depression (AOR = 1.307; 95%CI: 1.110-1.540), anxiety (AOR = 1.261; 95%CI: 1.098-1.448), and stress (AOR = 1.178; 95%CI: 1.039-1.337).

An increased number of days with a runny nose (AOR = 1.068; 95%CI: 1.001-1.140), nasal mucus (AOR = 1.128; 95%CI: 1.042-1.221), and sneeze (AOR = 1.071; 95%CI: 1.002-1.146) were associated with reporting depression. Additionally, an increasing number of days with tiredness (AOR = 1.055; 95%CI: 1.003-1.108) and runny nose (AOR = 1.067; 95%CI: 1.002-1.135) were associated with anxiety.

Table 4.
Multivariate logistic regression of respiratory symptoms in relation to depression.

Respiratory symptoms	Depression			Anxiety			Stress		
	AOR	95% CI	*p*	AOR	95% CI	*p*	AOR	95% CI	*p*
Cough	1.020	0.969, 1.073	0.448	1.014	0.965, 1.064	0.585	1.041	0.986, 1.098	0.145
Phlegm	1.031	0.971, 1.095	0.313	1.035	0.978, 1.095	0.233	1.013	0.954, 1.076	0.663
Tiredness	1.030	0.978, 1.084	0.264	1.055	1.003, 1.108	0.036	1.047	0.993, 1.103	0.088
Runny nose	1.068	1.001, 1.140	0.047	1.067	1.002, 1.135	0.042	1.036	0.969, 1.106	0.301
Nasal mucus	1.218	1.042, 1.221	0.003	1.057	0.989, 1.130	0.103	1.055	0.981, 1.134	0.147
Sneeze	1.071	1.002, 1.146	0.045	1.052	0.989, 1.118	0.107	1.035	0.969, 1.105	0.303
Sore eye	1.037	1.110, 1.540	0.001	1.061	1.098, 1.448	0.001	1.178	1.039, 1.337	0.001

Note: 1) The models were adjusted for age, sex, marital status, employment, smoking, alcohol, physical member.
2) AOR = Adjusted odd ratio.

4. Discussion

The present study demonstrated that patients with respiratory diseases, who reported daily health symptoms, are more likely to experience mental health problems such as depression, anxiety, and stress. These findings are consistent with previous studies [15], suggesting that respiratory health symptoms may directly contribute to the development of psychological problems [16]. In addition, during high-pollution periods, people with respiratory comorbidities, particularly air pollution, are vulnerable to the severity of health symptoms [17].

Air pollution consists of various distinctive pollutants, such as particulate matter (PM), vaporous pollutants, and metallic and organic composites. Research has reported an increasing body of evidence suggesting a plausible mechanism through which PM can affect the risk of a variety of mental health consequences [18]. The pathogenesis of depression is thought to be significantly influenced by inflammation in the central nervous system (CNS; neuroinflammation) [19]. Dysregulation of the hypothalamo-pituitary-adrenal (HPA) axis is another factor that has been linked to depression, as claimed by Mikulska,

et al. [20]. The likelihood of these as possible etiological pathways between PM exposure and its related consequences is supported by data from human studies investigating the pathophysiological effects of PM exposure. When examined more closely, exposure to PM has been associated with the release of the stress hormone cortisol, as well as glial activation, oxidative stress, and other neuroinflammatory biomarkers [21, 22]. In order to minimize the risk of exposure to pollution, it has been advised that people spend as much time at home as possible. Hence, during periods of high pollution, the feeling of isolation and the concern of worsening pulmonary exacerbation may have a detrimental impact on mental health [23].

The prevalence rates of depression, anxiety, and stress in this study were 30.6%, 28.6%, and 26.5%, respectively, which are consistent with prior studies that reported high rates of psychological symptoms among respiratory patients. In a study by Kamini, et al. [24], the prevalence rate of mild to moderate could be at the highest of 96% for depression and 56% for anxiety, and the prevalence rate of mild to moderate could be at the highest of 20% for depression and 51% anxiety among chronic respiratory patients depending on types of research measurement. These findings are comparable to a study conducted by Husain, et al. [25], which reported a prevalence of clinical depression and anxiety in respiratory outpatients ranging from 20% and 51%. Another study reported a prevalence of depression of 8.1% and an anxiety prevalence of 13.4% [26]. Moreover, massive population surveys revealed a rise in psychopathology among respiratory patients, including depression, bipolar disorder, panic disorder, phobia, and drug abuse problems [27, 28]. However, it is important to note that in these studies, the diagnosis of respiratory disease was self-reported. The variability of the examined populations, assessment techniques, and study designs are more likely to explain the differences in the reported rates of psychiatric morbidity rather than true differences in the frequency of mental illness in this population. In our study, an experienced consultant respiratory physician made all respiratory diagnoses.

Cough and phlegm were reported as common health symptoms during the high-pollution period, making the sample suitable for evaluating various correlations. The main finding of this study revealed a strong association between experiencing respiratory symptoms and psychological status, although this relationship varied depending on the symptom. The correlation matrix showed that the number of days presenting symptoms of red eye, tiredness, nasal mucus, and runny nose appeared to moderately positively correlate with depression, anxiety, and stress. On the other hand, symptoms of sneezing and cough showed a significant association only with anxiety and stress. These findings are supported by several prior studies conducted in various locations, which have consistently reported high rates of depression and anxiety among respiratory patients, along with a greater incidence of exacerbations [29-31].

When evaluating the outcomes of this study, it is important to consider several limitations. Firstly, the cross-sectional methodology used in this study prevents establishing a causal association between variables. Additionally, while the patients included in this study were referred by physicians with a confirmed diagnosis of respiratory diagnoses, data on the severity of their respiratory disease was not available. Therefore, it was possible to establish a link between depression, anxiety, and stress and the severity of respiratory disease. Another limitation is the lack of information on psychiatric co-morbidity treatment and medication. The study faced challenges in recruiting a large sample size, as 30% of initially approached patients who met the inclusion of smartphone usage did not participate in the survey. The differences between those who agreed to participate and those who could not be compared. Furthermore, the overrepresentation of females in the sample restricts the generalizability of our findings. While self-report measures were utilized as a gold standard to establish the presence of depression, anxiety, and stress, they are susceptible to reporter bias. Given the strong association observed between respiratory health symptoms and mental health problems, interventional trials aimed at relieving depression, anxiety, and stress in patients with respiratory symptoms are needed.

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