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Sleep disturbance and fatigue as depressive symptom expressions among men with chronic obstructive pulmonary disease (COPD): a population-based analysis of NHANES data

Samuel Grimwood[1*], Joanna Dilks[2], Kisane Prutton[1]

Abstract

Background: Men with chronic obstructive pulmonary disease (COPD) may underreport mood disturbance and instead present with somatic symptoms. This study aimed to examine the social patterning of sleep disturbance and fatigue as item-level depressive symptoms and their associations with disease burden among men with spirometry-defined COPD.

Methods: Data were obtained from 982 men (mean age = 62 years) in the 2007–2012 U.S. National Health and Nutrition Examination Survey; 58% were Non-Hispanic White, 21% Non-Hispanic Black, 9% Mexican American, 7% Other Hispanic and 5% other/multiracial. Logistic regression assessed associations of race/ethnicity, socioeconomic position, lung function, smoking, and multimorbidity with each symptom.

Results: Older age was associated with lower odds of sleep disturbance, whereas multimorbidity was associated with higher odds (adjusted OR = 1.62, 95% CI [1.09, 2.42]). Fatigue was associated with socioeconomic position, with higher odds among participants in PIR Category 0 compared with Category 3 (adjusted OR = 2.39, 95% CI [1.51, 3.78]), FEV_1/FVC (adjusted OR = 0.11, 95% CI [0.02, 0.81]), smoking status (overall p = .024), and multimorbidity (OR = 1.52, 95% CI [1.05, 2.20]). Race/ethnicity was associated with fatigue (overall p = .001), but not sleep disturbance (overall p = .071).

Conclusion: Sleep disturbance and fatigue showed distinct patterns of association with socioeconomic position and clinical characteristics among men with COPD. Future assessment of these individual depressive symptoms may complement broader depression screening and inform gender-sensitive clinical interventions.

Keywords: COPD, Depressive Symptoms, Sleep Disturbance, Fatigue; Socioeconomic Position, Race/Ethnicity, NHANES, UK

Correspondence: Samuel Grimwood (Samuel.grimwood@googlemail.com)
[1]Independent Researcher, United Kingdom.

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Background

Chronic obstructive pulmonary disease (COPD) is a leading cause of global morbidity and mortality [1] and is increasingly conceptualised as a long-term condition characterised by substantial psychological as well as physical burden [2]. Anxiety and depression are among the most prevalent comorbidities in COPD [3] and are associated with poorer quality of life, increased symptom burden, reduced treatment concordance, higher healthcare utilisation, and increased mortality risk [4,5,6]. COPD has been linked not only with high rates of depression but also with elevated suicidal ideation and suicide attempts in epidemiologic and clinical studies, highlighting the broader psychological burden of this condition [7,8,9]. Recent cross-sectional and cohort studies consistently demonstrate elevated rates of depression and anxiety in COPD populations. Albarrati et al. [4] found that 60% of Saudi patients with COPD screened positive for depression using the Patient Health Questionnaire-9 (PHQ-9), with higher prevalence among those with more severe disease. Similarly, Wang et al. [6], using diagnostic interviews rather than screening measures, showed that depression and anxiety disorders meeting DSM-5 criteria were associated with worse dyspnoea, poorer sleep quality, and significantly reduced health-related quality of life. Importantly, most affected patients were not receiving psychological or pharmacological treatment, for anxiety and depression disorders, highlighting a persistent gap between evidence and practice. From a health psychology perspective, increased attention has been given to the

heterogeneity of depressive symptom presentation. Total scores on screening tools such as the PHQ-9 may obscure clinically meaningful symptom patterns, particularly in populations with chronic physical illness. The PHQ-9 includes somatic symptoms, importantly sleep disturbance and fatigue, that overlap with core COPD symptoms such as nocturnal dyspnoea, hypoxia, and reduced exercise tolerance. Furthermore, Wang et al. [6] demonstrated that depression in COPD was strongly associated with poor sleep quality, and evidence from large longitudinal COPD cohorts consistently links fatigue with adverse clinical outcomes. Gender further complicates the interpretation of depressive symptoms in COPD. Research indicates that female COPD patients tend to report higher levels of anxiety and depressive symptoms and that symptom clusters involving poor sleep, fatigue, and mood disturbances (including depression) cluster together more strongly for women than for men, whereas in men these general symptoms are more closely associated with respiratory symptoms such as dyspnoea and chest tightness [10]. Such findings suggest that women with COPD may be more likely to express psychological distress through affective and general symptom reporting, while men with COPD may demonstrate different patterns of symptom expression, with psychological symptoms presenting alongside or masked by physical complaints such as poor sleep and fatigue [10]. This gender-specific presentation highlights the importance of tailoring clinical assessment and management of depressive symptoms to account for how men and women with COPD may report and experience psychological comorbidity differently.

Health inequities related to race, ethnicity, and socioeconomic position also shape COPD risk, diagnosis, and outcomes. Racial and ethnic minority populations, and individuals living in disadvantaged neighbourhoods, experience disproportionate exposure to environmental risks such as ambient air pollutants. Exposure to such hazards has been associated with increased COPD risk and worse outcomes in racially and ethnically minoritised groups and residents of low-socioeconomic status neighbourhoods [11,12]. Structural disadvantage, including racial residential segregation, has been linked to greater COPD morbidity and more severe respiratory symptoms, lower lung function, and higher exacerbation rates among urban Black adults with or at risk for COPD, even after adjusting for smoking and other risk factors [13]. Barriers to healthcare access and insurance inequities persist among adults with COPD, with racial/ethnic and economic disparities in health coverage, affordability of care, and delayed or forgone medical care due to cost reported over time [14,15]. Socioeconomic disadvantage at individual and neighbourhood levels has been shown to partly explain racial disparities in COPD outcomes, with lower socioeconomic status associated with worse respiratory symptoms, quality of life, and increased risk of severe exacerbations [15,16]. These intersecting social determinants, including differential access to preventive services and structural inequalities, contribute to cumulative disadvantage that shapes long-term respiratory health trajectories for racial and ethnic minority populations with COPD. Large-scale studies have demonstrated complex patterns in which racial and ethnic minority groups may exhibit lower prevalence of spirometrically defined airflow obstruction but greater symptom burden and dyspnoea compared to non-Hispanic White individuals [17]. Cultural norms regarding emotional expression may also influence how distress is communicated. In some cultural contexts, psychological difficulties may be less socially acceptable than physical symptoms, potentially increasing the likelihood that distress is expressed somatically in clinical encounters [18]. While NHANES data does not permit direct examination of cultural beliefs, these dynamics may partially contribute to observed patterns of symptom reporting and warrant further qualitative investigation. Concerns have been raised that race-adjusted spirometry reference equations may contribute to underestimation of disease severity in African American patients, potentially delaying diagnosis and treatment [19]. Socioeconomic disadvantage is similarly associated with higher COPD prevalence, increased multimorbidity, and greater economic burden. Cai et al. [20] demonstrated marked socioeconomic gradients in COPD prevalence and costs, with men, ethnic minority groups, and individuals with lower income and education experiencing greater disease burden. Rea et al. [21] further highlighted substantial gaps in the COPD literature relating to social inequities, noting limited attention to sex, gender, and intersecting social determinants, despite their clear relevance to clinical outcomes. Furthermore, there is also a risk that broad demographic categories become proxies for assumptions about motivation, concordance, or treatability, rather than prompting deeper exploration of structural and contextual barriers to change. A more nuanced understanding of intersecting socioeconomic, cultural, and clinical factors is therefore necessary to avoid deficit-based interpretations of disparity. Although racial, socioeconomic, and psychological factors have been examined separately in COPD research, few studies have integrated these domains at a symptom-specific level. In particular, it remains unclear whether distinct depressive symptoms such as sleep disturbance and fatigue vary systematically by race/ethnicity and socioeconomic position among men with COPD, and whether these symptoms are associated with broader indicators of disease burden such as multimorbidity. Furthermore, psychological comorbidities in COPD remain under-recognised and undertreated in routine clinical care, particularly among men where physical symptomology may be attributed solely to physical disease, resulting in missed opportunities for psychological assessment and intervention. Addressing these gaps may yield clinically actionable insights, informing screening, medication review, pulmonary rehabilitation referral, and tailored psychological intervention. The present study adopts a health psychology framework to examine item-level depressive symptoms among men with COPD using data from the U.S. National Health and Nutrition Examination Survey (NHANES). By integrating objective lung function data with sociodemographic, behavioural, and psychological measures in a large, nationally representative sample, this study aims to advance understanding of how social determinants intersect with symptom-level psychological distress in COPD, with implications for more equitable and holistic models of care.

Aims of study

The primary aim of this study was to examine associations between race/ethnicity, socioeconomic position, and item-level depressive symptoms, specifically sleep disturbance and fatigue, among men with spirometry-defined COPD. A secondary aim

was to explore whether these symptoms were associated with greater disease burden, including multimorbidity.

Research objectives

The objectives were to estimate the prevalence of sleep disturbance and fatigue among men with COPD; to examine differences in these symptoms across racial/ethnic and socioeconomic groups; to assess associations between sleep disturbance, fatigue, and indicators of disease burden; and to determine whether these associations persist after adjustment for lung function severity and smoking status.

Research Questions

What is the prevalence of sleep disturbance and fatigue among men with COPD?

Do these symptoms differ by race/ethnicity and socioeconomic position?

Are sleep disturbance and fatigue associated with multimorbidity?

Do these associations remain significant after controlling for COPD severity and smoking status?

Hypotheses

Sleep disturbance and fatigue would be prevalent among men with COPD and would be reported more frequently by those from minoritised racial and ethnic groups and lower socioeconomic backgrounds. Lower socioeconomic position would be independently associated with higher levels of sleep disturbance and fatigue. Sleep disturbance and fatigue would be associated with greater multimorbidity and these associations would remain significant after controlling for lung function severity and smoking status.

Methods

Study Design

This study employed a cross-sectional secondary data analysis of the US National Health and Nutrition Examination Survey (NHANES), pooling multiple survey cycles to ensure adequate sample size.

Participants

Chronic obstructive pulmonary disease (COPD) was defined using spirometry data collected during the NHANES mobile examination centre assessments. Consistent with Global Initiative for Chronic Obstructive Lung Disease (GOLD) guidelines, participants with a pre-bronchodilator forced expiratory volume in one second to forced vital capacity ratio (FEV1/FVC) of less than 0.70 were classified as having COPD.

The analytic sample comprised men aged 40 years and older with spirometry-defined COPD, operationalised as a forced expiratory volume in one second to forced vital capacity ratio (FEV_1/FVC) of less than 0.70. Participants were included in the descriptive sample if they met the age and spirometry-based eligibility criteria. Complete-case analysis was used for the multivariable logistic regression models. Data were pooled from three NHANES cycles (2007–2008, 2009–2010, and 2011–2012). Across these cycles, participants completed spirometry assessment (n = 20,176). Of these, 1,887 participants met the (GOLD) criterion for airflow obstruction (FEV1/FVC < 0.70). 671 participants were excluded as the participants were female. The analytic sample was further restricted to men aged 40 years and older, as this reflects the adult-onset COPD population typical of clinical practice [22]. Of the 1,216 participants with spirometry-defined COPD across the NHANES 2007–2012 cycles, 234 were excluded due to age <40 years or missing or implausible age values, leaving a final analytic sample of 982 men aged ≥40 years. Of these 982 participants, 831 had complete data for the variables included in each adjusted logistic regression model. The final sample included 572 non-Hispanic White participants, 208 non-Hispanic Black participants, 83 Mexican American, 69 Other Hispanic and 50 from Other Race/Multi-racial groups. In NHANES, race and ethnicity are self-reported and categorized according to U.S. Census guidelines. The primary groups involved in this analysis were: Mexican American, Other Hispanic, Non-Hispanic White, Non-Hispanic Black, Other race/multi-racial. For example, 'Hispanic' includes individuals with origins in multiple countries with distinct cultural backgrounds, while 'Non-Hispanic Black' may include African Americans as well as individuals with ancestral or national origins in Africa or the Caribbean. It should be noted that these categories are broad and may not capture cultural, national, or linguistic diversity within each group. International readers should be aware that these U.S. categories do not directly map onto the ethnic classifications commonly used in other countries, such as the UK, where ethnic groups are often defined more granularly (e.g. Black British African, Black British Caribbean, South Asian British). Providing this information ensures clarity and allows readers to interpret findings in context, particularly when considering the potential for within-group heterogeneity in psychological and clinical outcomes.

Recruitment and Accessibility

NHANES uses a complex, multistage probability sampling design to recruit a nationally representative sample of the non-institutionalised U.S. population. Data is collected through interviews and standardised examinations in mobile examination centres. All data is publicly available and de-identified, removing the requirement for additional ethical approval. NHANES cycles from 2007 to 2012 were selected to ensure the availability and consistency of key study variables, including spirometry-based COPD classification and item-level depressive symptom data from the Patient Health Questionnaire-9. Later NHANES cycles did not include comparable spirometry assessments, limiting their suitability for defining COPD status. Pooling multiple earlier cycles also allowed for sufficient statistical power to examine sociodemographic differences among men with COPD, particularly across racial/ethnic and socioeconomic subgroups. As the primary aim of the study was to examine symptom-level associations rather than temporal trends, the use of these cycles was considered methodologically appropriate.

Measures

Demographic Variables

Demographic information included age (in years), race/ethnicity (categorised as Non-Hispanic White, Non-Hispanic Black, Mexican American, Other Hispanic and other/multiracial), household income, and the poverty–income ratio as an indicator of socioeconomic position.

Socioeconomic position was measured using the ratio of family income to poverty (PIR = household income ÷ poverty threshold), and stratified into four categories; PIR < 1.0 = below poverty line (category 0), PIR 1.0 to < 2.0 (category 1), PIR 2.0 to < 3.0 (category 2), PIR ≥ 3 = higher income (category 3), which has been widely used in NHANES research as an indicator of economic resources. Education level was not included in the primary analyses to focus on income-related socioeconomic differences.

Clinical Variables

Objective lung function was assessed using spirometry-derived measures, which was used to define COPD status and estimate disease severity. Smoking status was categorized as 'never', 'former', or 'current' smoker using NHANES smoking questionnaire items.

Primary Outcomes

Depressive symptoms were assessed using the Patient Health Questionnaire-9 (PHQ-9). Analyses focused on two item-level symptoms that are particularly relevant to COPD and male presentations of psychological distress: item 3, assessing sleep disturbance ("Trouble falling or staying asleep, or sleeping too much"), and item 4, assessing fatigue ("Feeling tired or having little energy").

PHQ-9 items 3 (sleep disturbance) and 4 (fatigue) were dichotomised (0 = not present, ≥1 = present) to reflect clinically meaningful symptom presence and to align with screening-based approaches commonly used in COPD and population health research.

Secondary Outcomes

Secondary indicators of disease burden included a multi-morbidity variable, defined as the presence of two or more physician-diagnosed chronic conditions (e.g., cardiovascular disease, diabetes, arthritis, or cancer), consistent with common epidemiological definitions of multi-morbidity. The data came from self-reported chronic health conditions, alongside measures of self-rated general health, depending on data availability within the pooled NHANES cycles.

Procedure

NHANES datasets were downloaded from the Centers for Disease Control and Prevention (CDC) NHANES website [23]. Data were pooled across selected cycles (2007–2012) and merged using the unique participant identifier (SEQN). Data were cleaned and restricted to eligible participants with complete data on primary variables.

Quantitative Analysis

Descriptive statistics using SPSS summarised sample characteristics and symptom prevalence. Multivariable regression analyses examined associations between race/ethnicity, socioeconomic indicators, and item-level depressive symptoms, adjusting for age, lung function measures, and smoking status. Interaction terms assessed moderation by race/ethnicity and socioeconomic position. Due to the ordinal nature of PHQ-9 items and the need to include covariates, regression approaches were preferred over ANOVA or MANOVA analyses.

Power Calculation

Pooling multiple NHANES cycles was expected to yield over 1,300 men with COPD and complete data, providing sufficient power to detect small-to-moderate effects.

Results

Sample characteristics

The analytic sample comprised 982 men with spirometry-defined COPD. Participants had a mean age of 62 years (SD = 10.12) and a mean FEV1/FVC ratio of 0.62 (SD = 0.07). Sleep disturbance was reported by 23% of participants, while 35% reported fatigue. Approximately one-fifth of the sample (21%) reported two or more comorbid conditions. Sample characteristics are presented in Table 1. Consistent with the study hypotheses, sleep disturbance was more prevalent among men with multimorbidity, while fatigue showed a broader pattern of associations. Fatigue was more common among younger participants, those with lower lung function, participants in lower-income categories, certain racial/ethnic groups, smokers, and those with multimorbidity. These findings indicate partial support for the hypotheses, with multimorbidity significantly associated with sleep disturbance and fatigue, and socioeconomic and racial/ethnic disparities emerging for fatigue, but not for sleep disturbance.

Table 1. Sociodemographic and clinical characteristics of men with spirometry-defined COPD).

Variable	N	Mean	SD	Range
Age (years)	982	62	10.12	40–79
FEV_1/FVC ratio	982	0.62	0.07	0.32–0.70
Categorical variables			**N**	**%**
Race/ethnicity				
Mexican American			83	9
Other Hispanic			69	7
Non-Hispanic White			572	58
Non-Hispanic Black			208	21
Other race / multi-racial			50	5
Poverty–income ratio (PIR)				
Category 0 (lowest income)			169	17
Category 1			255	26
Category 2			234	24
Category 3 (highest income)			251	26
Smoking status				
Never smoked			223	23
Former smoker			413	42
Current smoker			346	35
Sleep disturbance			222	23
Fatigue			342	35
≥2 comorbid conditions			204	21

Note. Percentages may not total 100 due to rounding or missing data. COPD was defined as FEV_1/FVC < 0.70. PIR Category 0 represents income below the federal poverty threshold; Categories 1 and 2 represent low income above the poverty line; Category 3 represents higher income.

Table 2. Adjusted logistic regression model predicting sleep disturbance among men with COPD

Predictor	**OR**	**95% CI**	**p**
Age (years)	0.97	[0.95-0.99]	< .001
FEV_1/FVC	0.66	[0.07-6.14]	.711
Poverty–income ratio (PIR) (overall)			.292
Category 0 vs 3	1.48	[0.90–2.42]	.118
Category 1 vs 3	1.02	[0.65–1.61]	.901
Category 2 vs 3	0.95	[0.60–1.49]	.837
Category 3 *(reference)*	1.00	---	---
Race/ethnicity (overall)			.071
Other Hispanic vs Mexican American	1.22	[0.53–2.81]	.640
Non-Hispanic White vs Mexican American	1.21	[0.63–2.32]	.562
Non-Hispanic Black vs Mexican American	0.71	[0.34–1.47]	.365
Other Race/Multiracial vs Mexican American	0.43	[0.12–1.46]	.179
Mexican American (reference)	1.00	—	—
Smoking status (overall)			.634
Former vs never smoker	0.91	[0.58–1.43]	.706
Current vs never smoker	1.11	[0.70–1.75]	.642
Never smoker (reference)	1.00	---	---
Two or more comorbidities vs fewer than two	1.62	[1.09-2.42]	.018

Note. Adjusted odds ratios (aORs) and 95% confidence intervals (CIs) were obtained from a multivariable binary logistic regression model. Overall p-values for categorical predictors are based on Wald tests; a single aOR and CI are not applicable. All listed estimates are mutually adjusted for the predictors in the table.

Table 3. Adjusted logistic regression model predicting fatigue among men with COPD

Predictor	OR	95% CI	p
Age	0.97	[0.96-0.99]	< .001
FEV_1/FVC	0.11	[0.02-0.81]	.030
Poverty–income ratio (PIR) (overall)			.002
Category 0 vs 3	2.39	[1.51-3.78]	< .001
Category 1 vs 3	1.28	[0.85–1.92]	.235
Category 2 vs 3	1.32	[0.88–1.99]	.168
Category 3 (reference)	1.00	---	---
Race/ethnicity (overall)			.001
Other Hispanic vs Mexican American	1.16	[0.54–2.48]	.700
Non-Hispanic White vs Mexican American	1.48	[0.83–2.65]	.181
Non-Hispanic Black vs Mexican American	0.68	[0.36–1.31]	.258
Other Race/Multiracial vs Mexican American	0.56	[0.21–1.50]	.254
Mexican American (reference)	1.00	---	---
Smoking status (overall)			.024
Former vs never smoker	0.60	[0.40–0.89]	.012
Current vs never smoker	0.61	[0.40–0.92]	.018
Never smoker (reference)	1.00	---	---
Two or more comorbidities vs fewer than two	1.52	[1.05-2.20]	.026

Note. aOR = adjusted odds ratio; CI = confidence interval; PIR = poverty–income ratio; FEV_1/FVC = ratio of forced expiratory volume in one second to forced vital capacity. Odds ratios were estimated using multivariable binary logistic regression. Overall p-values for categorical variables are from Wald tests; a single odds ratio and confidence interval are not applicable. Reference categories are indicated in the table. All estimates are mutually adjusted for the variables shown.

Sleep disturbance

In the adjusted logistic regression model, each one-year increase in age was associated with lower odds of sleep disturbance (OR = 0.97, 95% CI [0.95, 0.99], p < .001), indicating that relatively younger men within the 40–79-year COPD sample were more likely to report sleep disturbance. Multi-morbidity was associated with increased odds of sleep disturbance (OR = 1.62, 95% CI [1.09, 2.42], p = .018). Lung function, socioeconomic position, race/ethnicity, and smoking status were not independently associated with sleep disturbance.

Fatigue

Fatigue demonstrated a broader pattern of associations. Each one-year increase in age was associated with approximately 3% lower adjusted odds of fatigue (OR = 0.97, 95% CI [0.96, 0.99], p < .001), indicating that younger men within the 40–79-year COPD sample had higher adjusted odds of reporting fatigue. Higher FEV_1/FVC was also associated with lower odds of fatigue (OR = 0.11, 95% CI [0.02, 0.81], p = .030). Socioeconomic position was significantly associated with fatigue overall (p = .002), with participants in PIR Category 0 (below the poverty line) showing higher odds of fatigue compared with in Category

3 (highest income group) (OR = 2.39, 95% CI [1.51, 3.78], p < .001). Smoking status and multimorbidity were also independently associated with fatigue. Race/ethnicity was significantly associated with fatigue in adjusted analyses (Wald $\chi^2(4) = 18.70$, p = .001), indicating an overall association between race/ethnicity and fatigue after adjustment for age, lung function, socioeconomic position, smoking status, and multimorbidity. However, none of the individual racial/ethnic comparisons with the Mexican American reference group reached statistical significance (p > .05).).

Discussion

This study examined the prevalence and social patterning of sleep disturbance and fatigue as item-level depressive symptoms among men with spirometry-defined COPD. Both symptoms were common in this population and showed partially overlapping but distinct patterns of association with demographic, socioeconomic, and clinical factors. The findings support the value of examining individual symptoms rather than relying solely on total depressive symptom scores. Our findings problematise COPD research that operationalises depression using total symptom scores and indicate that composite measures risk obscuring clinically meaningful patterns of distress [33,34]. By disaggregating depressive symptoms into sleep disturbance and fatigue, the present study demonstrated that these symptoms are not interchangeable indicators of psychological burden but show differential relationships with socioeconomic, clinical, and behavioural factors. These findings also bring into question the screening of depression in primary care and respiratory clinics, where screening is often conducted using brief tools, that are reliant on composite scores such as the PHQ-2 or PHQ-9. In terms of demographics, in the present study, sleep disturbance was primarily associated with age and multimorbidity. In relative terms, lower age (between the ages of 40 and 79) was more strongly associated with sleep disturbance. This finding is consistent with evidence that younger patients with COPD report higher levels of psychological distress, including depression and anxiety, compared with older patients. Such distress may contribute to elevated reports of sleep disturbance in younger subgroups [24]. Sleep disturbance in middle-aged adults may also be associated with wider psychosocial factors, including family responsibilities and informal caregiving roles [25,26]. However, these factors were not directly assessed in the present study, and their contribution to the observed association between age and sleep disturbance cannot be determined. In the present study, the dataset did not permit us the ability to determine whether sleep disturbance pre-dated COPD diagnosis or emerged as a consequence of disease progression. Unlike sleep disturbance, fatigue was associated with socioeconomic position, lung function, and smoking status. This distinction, also supports the potential value of symptom-specific approaches to understanding symptom burden in men with COPD [6,20,21]. Sleep disturbance and fatigue may arise from multiple sources, including physiological COPD processes such as nocturnal hypoxaemia and sleep-related oxygen desaturation [27,28], comorbid gastro-oesophageal reflux disease (GORD), which is prevalent in COPD and associated with nocturnal cough, micro-aspiration, and sleep fragmentation [29], and comorbid conditions including cardiovascular disease, multimorbidity, and medication effects [30]. Systemic corticosteroids in particular have been associated with insomnia, mood disturbance, and neuropsychiatric symptoms that may exacerbate sleep disruption [31,32]. The present data did not permit causal differentiation. Therefore, these symptoms should not be interpreted as definitive indicators of clinical depression but rather as clinically meaningful distress signals requiring contextualised assessment. Our findings support and extend quantitative work by Grimwood et al. [35], who showed that fatigue, as measured by the Fatigue Assessment Scale, increased with COPD severity, while sleep quality worsened with increasing disease severity. The present study adds a gendered dimension; it demonstrates that in men, fatigue and sleep disturbance are also socially patterned, highlighting the role of socioeconomic disadvantage, lung function, and multimorbidity in shaping depressive symptom expression. While we did not require participants to meet full diagnostic criteria for major depressive disorder, multi-morbidity may amplify both physiological burden and psychological vulnerability, increasing the likelihood that somatic distress symptoms are taken in to account. Qualitative insights into the lived experience of COPD, using a photovoice methodology, Grimwood et al. [2] identified self-criticism, emotional distress, and strained social relationships as core features of living with COPD, with breathlessness acting as a pervasive experience shaping daily functioning and self-perception. Although that study included mixed-gender samples, its findings provide valuable insight into how functional symptoms translate into psychological distress, particularly relevant for men who may be less likely to articulate distress in emotional terms. By focusing exclusively on men with spirometry-defined COPD, this study addresses a critical gap in both respiratory and health psychology research. Men with chronic illness are less likely to report affective symptoms of depression and less likely to seek psychological support compared with women [36,37,38]. Men with depression often face barriers to help-seeking due to internalised masculine norms that discourage emotional disclosure and reinforce self-reliance [39], with peer-led or male-focused support identified as a potential facilitator of help-seeking behaviour [38]. Instead, men may express distress through somatic or functional complaints, such as fatigue, sleep disturbance, or reduced activity [36,37]. Such physical symptoms are more socially acceptable and congruent with masculine norms [36,37]. Moreover, COPD is linked with increased suicide risk, particularly in more severe disease and when psychiatric comorbidity is present; the tendency for men to underreport affective symptoms underscores the importance of careful screening and interpretation of somatic depressive symptoms [7,40]. The present study suggests that sleep disturbance and fatigue may represent gendered manifestations of psychological distress among men with COPD. Evidence shows that depressive and anxiety symptoms in COPD are closely linked to sleep disruption, breathlessness, and reduced functional capacity rather than purely affective distress [6], suggesting a complex biopsychosocial set of contributors beyond physiological severity alone [41]. In the present study, fatigue showed associations with socioeconomic and clinical factors, whereas sleep disturbance was primarily associated with age and multimorbidity. These findings suggest that the two symptoms may have different correlates, although their underlying mechanisms cannot be determined from the cross-sectional data.

Fatigue demonstrated particularly strong associations with socioeconomic position, lung function impairment, smoking status, and multimorbidity. These findings align with evidence linking socioeconomic disadvantage to worse COPD outcomes and higher psychological burden [20,21,42]. Socioeconomic disadvantage may exacerbate fatigue through increased exposure to environmental pollutants, higher comorbidity burden, reduced healthcare access, financial stress, and limited opportunities for rest. Interestingly, participants in PIR Category 0 (below the poverty line) had significantly higher adjusted odds of fatigue than those in Category 3 (highest income group). This finding indicates an association between socioeconomic disadvantage and fatigue, although the cross-sectional design does not establish the mechanisms underlying this relationship. The persistence of associations after controlling for lung function suggests that fatigue cannot be explained solely by physiological airflow limitation and likely reflects broader biopsychosocial influences. For example, smoking status was significantly associated with fatigue overall. Compared with never smokers, both former smokers and current smokers had lower adjusted odds of fatigue. Given the cross-sectional design, these findings should be interpreted cautiously and do not establish a protective effect of smoking. Race/ethnicity was significantly associated with fatigue overall after adjustment for age, lung function, socioeconomic position, smoking status, and multimorbidity ($p = .001$). However, none of the individual racial/ethnic comparisons with the Mexican American reference group reached statistical significance. These findings suggest that race/ethnicity may be relevant to understanding variation in fatigue among men with COPD, although they do not establish specific between-group disparities or explain the mechanisms underlying these associations. Previous research has highlighted the potential importance of structural inequalities, healthcare access, and socioeconomic disadvantage in COPD outcomes [16,17]. Further research incorporating more detailed measures of social and structural factors is needed to investigate these relationships [43]. Identifying sleep disturbance and fatigue as potential indicators of psychological distress may support pulmonary rehabilitation programmes that integrate psychological assessment and support alongside physical training. Previous research has demonstrated benefits of pulmonary rehabilitation for exercise capacity, dyspnoea, quality of life, and psychological outcomes [44,45,46]. However, psychological barriers, including anxiety, low self-efficacy, and depressive symptoms, alongside practical challenges such as transport difficulties and competing time commands, may limit participation [47,48,49]. Flexible delivery models, including tele-rehabilitation and integrated psychological support, may help address some of these barriers, although their effectiveness for men experiencing sleep disturbance and fatigue requires further investigation. In primary care and respiratory clinics, depression screening is often conducted using brief tools such as the PHQ-2 or PHQ-9. However, men may deny core affective symptoms (low mood, anhedonia) while endorsing sleep or fatigue complaints. Clinicians may therefore benefit from exploring the functional meaning of these symptoms by asking follow-up questions about motivation, anhedonia, coping, and daily impact, rather than relying solely on mood-based entry questions. This approach may improve identification of depression that presents through somatic channels. Psychological interventions such as cognitive behavioural therapy (CBT), behavioural activation or compassion-focused approaches may warrant further investigation among men with COPD, that help to reduce sleep disturbance, fatigue, insomnia and to improve quality of life, for those that have a chronic illness [35]. Several limitations should nevertheless be acknowledged. COPD was defined using pre-bronchodilator spirometry rather than clinical diagnosis (within the NHANES dataset), which may not fully reflect physician-diagnosed disease or treatment patterns. The cross-sectional design precludes causal inference, and longitudinal research is needed to determine whether sleep disturbance and fatigue contribute to COPD progression, arise as consequences of disease, or develop alongside it. Dichotomisation of individual PHQ-9 items may reduce sensitivity to symptom frequency and severity. Furthermore, sleep disturbance and fatigue are non-specific symptoms that may arise from COPD itself, comorbid conditions, medication effects, or psychological distress not directly attributable to COPD. Consequently, endorsement of sleep disturbance and fatigue symptomology cannot independently establish a diagnosis of clinical depression, and the findings should be interpreted as associations with individual symptoms rather than evidence of depressive disorder [33]. In addition, the broad racial and ethnic categories available in NHANES limit more nuanced examination of psychosocial and cultural influences on COPD outcomes, highlighting the need for future studies incorporating more granular ethnicity data. Longitudinal research is also needed to clarify whether somatic symptoms such as sleep disturbance and fatigue predict later depressive disorders or suicidal behaviour, which could inform screening and intervention efforts [9,40]. The focus on men in this study is a strength, providing sex-disaggregated insight into depressive symptom patterns in COPD [50,51]. Nevertheless, this focus limits the generalisability of findings to women and mixed-gender populations. Future research should adopt an intersectional approach to explore how sex and gender interact with race/ethnicity and socioeconomic position in shaping symptom expression. Finally, many pharmacological treatments used in COPD, including inhaled corticosteroids, long-acting bronchodilators, and phosphodiesterase-4 inhibitors such as roflumilast, have been associated with sleep disturbances and related adverse events [52], which may have contributed to the fatigue and sleep outcomes observed. Detailed medication data were not available in NHANES, highlighting the need for future research incorporating comprehensive pharmacotherapy information.

Conclusion

The present study examined sleep disturbance and fatigue as individual PHQ-9 symptoms among men with spirometry-defined COPD. The findings identified partially overlapping patterns of association with demographic, socioeconomic, and clinical factors, highlighting the potential value of examining these symptoms individually rather than relying exclusively on total depressive symptom scores. Race/ethnicity was associated with fatigue overall after adjustment for socioeconomic and clinical factors, although no individual racial/ethnic comparison reached statistical significance. Further research is needed to investigate the potential contribution of social, structural, and cultural factors to fatigue among men with COPD. The observed

symptom-specific associations complement previous research by Grimwood et al. [2, 35] and reinforce the relevance of examining sleep disturbance and fatigue individually. Longitudinal and intervention studies are also needed to determine how these symptoms change over time and whether targeted support improves psychological and clinical outcomes. These results highlight the potential value of assessing sleep disturbance and fatigue individually in men with COPD, while considering their wider clinical and socioeconomic context. Further research is needed to determine how symptom-specific assessment might inform psychological and respiratory care.

Abbreviation

ANOVA – Analysis of Variance
CDC – Centers for Disease Control and Prevention
CI – Confidence Interval
COPD – Chronic Obstructive Pulmonary Disease
DSM-5 – Diagnostic And Statistical Manual of Mental Disorders, Fifth Edition
FAS – Fatigue Assessment Scale
FEV_1 – Forced Expiratory Volume in One Second
FEV_1/FVC – Ratio of Forced Expiratory Volume in One Second to Forced Vital Capacity
FVC – Forced Vital Capacity
GOLD – Global Initiative for Chronic Obstructive Lung Disease
GORD – Gastro-Oesophageal Reflux Disease
MANOVA – Multivariate Analysis of Variance
MRC – Medical Research Council
NHANES – National Health and Nutrition Examination Survey
OR – Odds Ratio
PHQ-2 – Patient Health Questionnaire-2
PHQ-9 – Patient Health Questionnaire-9
PIR – Poverty–Income Ratio
PR – Pulmonary Rehabilitation
SD – Standard Deviation
SEQN – Unique Participant Sequence Number (NHANES)
SPSS – Statistical Package for the Social Sciences.

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Availability of data and materials

The data can be accessed on the NHANES website: ttps://wwwn.cdc.gov/nchs/nhanes/continuousnhanes/default.aspx?BeginYear=2007.

Authors' contributions

Samuel Grimwood (SG) – Conceptualisation, Methodology, Data curation, Formal analysis, Investigation, Visualization, Writing – original draft, Writing – review & editing, Project administration. Joanna Dilks (JD) – Conceptualisation, Methodology, Writing – review & editing. Kisane Prutton (KP) – Conceptualisation, Methodology, Writing – review & editing. All authors read and approved the final manuscript.

Ethics approval and consent to participate

We conducted the research in accordance with the Declaration of Helsinki. Not Applicable, as the data has come from NHANES which is publicly available and ethics has been obtained.

Consent for publication

Not applicable

Competing interest

The authors declare that they have no competing interests.

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Author Details

[1]Indepemndent researcher, United Kingdom.
[2]Department The University of Nottingham and Lincolnshire Partnership NHS FT, United Kingdom.

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