

The Multidimensional Burden of COPD in China: A Propensity Score-Matched Comparison with Other Prevalent Non-Communicable Diseases

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Purpose: Chronic obstructive pulmonary disease (COPD) is a leading cause of mortality in China, yet its multifaceted burden relative to other major non-communicable diseases (NCDs) is not well-characterized. This study comprehensively assessed the multidimensional burden of COPD compared to hypertension, diabetes, hypercholesterolemia, and osteoporosis in China.

Patients and Methods: A cross-sectional analysis was performed using data from the 2020 China National Health and Wellness Survey (NHWS). The study included 589 self-reported COPD patients and comparison cohorts with other NCDs. Propensity score matching (1:1) was used to balance demographic and clinical characteristics. Outcomes included health-related quality of life (HRQoL), work productivity and activity impairment (WPAI), and healthcare resource utilization (HCRU).

Results: After matching, COPD patients exhibited a significantly greater overall disease burden compared to those with hypertension, diabetes, or hypercholesterolemia. The burden was severity-dependent, with patients in GOLD stages B and D experiencing the most severe impairments. COPD was associated with significantly lower HRQoL and higher activity impairment than hypertension and hypercholesterolemia. Compared to diabetes, severe COPD (Stage D) showed greater work productivity loss and higher hospitalization rates. The burden relative to osteoporosis was more variable, with the advantage of mild COPD (Stage A) diminishing in advanced stages.

Conclusion: COPD imposes a substantial and distinct multidimensional burden in China, often exceeding that of other common NCDs and escalating with severity. These findings underscore the need for severity-based management and integrated care to mitigate the significant health and socioeconomic impact of COPD.

Keywords: chronic obstructive pulmonary disease, disease burden, propensity score matching, urban China, comparative study

Introduction

Chronic obstructive pulmonary disease (COPD) is a common and debilitating chronic respiratory condition characterized by persistent airflow limitation resulting from airway and/or alveolar abnormalities. It is clinically manifested by chronic respiratory symptoms such as dyspnoea, cough, and sputum production, and is often progressive in nature. Patients with COPD experience an accelerated decline in lung function over time, with smoking and the presence of comorbidities being major contributors to disease progression.^{1,2} As the disease advances, functional impairment increasingly affects daily activities and overall well-being.

Beyond respiratory symptoms, COPD imposes a substantial humanistic burden. Patients commonly experience reduced health-related quality of life (HRQoL), limitations in physical functioning, impaired sleep quality, and mental health challenges.³⁻⁵ Acute exacerbations further exacerbate this burden and represent a major driver of healthcare utilization and mortality, particularly among patients with moderate-to-severe disease.^{6,7} Evidence from

China indicates that COPD prognosis remains poor, with high exacerbation rates and substantial short-term mortality observed during follow-up.⁸ Disease severity has been shown to correlate strongly with worsening HRQoL, reduced physical activity, and increased psychological distress, highlighting the multidimensional nature of COPD burden.⁹

Compared with the general population, individuals with COPD consistently report poorer HRQoL across multiple domains.⁸ Previous cross-sectional studies in China have demonstrated high prevalence of mobility limitations, pain or discomfort, anxiety or depression, and difficulties with usual activities and self-care among patients with COPD, with disease severity being a key determinant of declining utility and health status.¹⁰ Despite this evidence, most existing studies have focused on COPD in isolation, and comparative assessments of disease burden between COPD and other prevalent non-communicable diseases (NCDs) remain limited.

In China, COPD represents a major public health challenge, ranking among the most prevalent NCDs alongside hypertension and type 2 diabetes and affecting an estimated 99.9 million individuals.¹¹ The progressive and symptomatic nature of COPD may result in a more profound impact on daily functioning and quality of life than other common NCDs such as hypertension, diabetes, hypercholesterolemia, and osteoporosis. However, real-world evidence comparing the multidimensional burden of COPD with that of other NCDs in China remains scarce.¹²

Policy attention to COPD in China has evolved over the past decade through a series of initiatives, including its inclusion in national chronic disease prevention plans, the expansion of COPD surveillance systems, promotion of spirometry in adults aged ≥ 40 years, and the establishment of tiered diagnosis and treatment pathways between 2012 and 2020. More recent policy developments, such as the formal inclusion of COPD management within the National Basic Public Health Services (NBPHS) in 2024, reflect a continued shift toward strengthening primary-care-based prevention and management.^{12,13} These recent initiatives are discussed here to illustrate the evolving policy landscape and future direction of COPD control, rather than to interpret findings derived from earlier data.

Within this context, robust real-world assessments of the multidimensional burden of COPD are essential to inform health system planning, resource prioritization, and future policy evaluation. Therefore, the present study aimed to characterize patient characteristics and disease burden among individuals with COPD in China and to compare the burden of COPD with that of other common NCDs, including hypertension, diabetes, hypercholesterolemia, and osteoporosis, using data from the National Health and Wellness Survey (NHWS), a large population-based survey of self-reported health outcomes.

Materials and Methods

Data Source and Analysis Sample

This cross-sectional study utilized data from the NHWS conducted from July to September 2020.¹⁴ The NHWS employs age- and sex-stratified random sampling to recruit adults aged ≥ 18 years from urban areas in China, with post-stratification weighting based on national census data to enhance representativeness. Data were collected through a combination of online questionnaires and centralized offline surveys.¹⁵ The study protocol was exempted by the Pearl Institutional Review Board (IRB Approval No.: Pearl-2020-CHN). As the analysis relied exclusively on anonymized, publicly available data, it was also exempt from ethics review under Article 32, Item 1 of the Measures for Ethical Review of Life Sciences and Medical Research Involving Humans issued in China.¹⁶

COPD cases were identified using a combination of self-reported disease status, physician-diagnosis information, and symptom-based validation. Specifically, respondents reporting COPD or related chronic respiratory conditions were further screened using the COPD Screening Questionnaire (COPD-SQ), and only those with a positive score (≥ 16) were classified as having COPD. This approach aimed to improve case specificity while allowing inclusion of individuals with clinically relevant symptoms who may not yet have received a formal diagnosis.

Comparator cohorts included respondents with hypertension, diabetes, hypercholesterolemia, or osteoporosis. Individuals reporting two or more of these target conditions were excluded to minimize disease overlap.

Outcome Measures and Statistical Analysis

Disease burden was assessed using a multidimensional framework encompassing health-related quality of life (HRQoL), work productivity, and healthcare utilization. HRQoL was measured using the 12-item Short Form Health Survey Version 2 (SF-12v2) Physical and Mental Component Summary scores (range: 0–100) and the 5-level EuroQol Five Dimensions Questionnaire (EQ-5D-5L) utility index, which summarizes self-reported health status across five dimensions into a single preference-based score by applying population-specific value weights. In this study, EQ-5D-5L utility values (range: 0–1, with higher values indicating better health) were calculated using the Chinese value set.^{17–19} Work productivity and activity impairment were evaluated using the Work Productivity and Activity Impairment (WPAI) questionnaire, capturing absenteeism, presenteeism, overall work impairment, and activity impairment.²⁰ Healthcare utilization was evaluated based on self-reported outpatient visits, emergency department visits, and hospitalizations during the preceding six months.²¹

Among COPD patients, disease severity was classified according to Global Initiative for Chronic Obstructive Lung Disease (GOLD) criteria using symptom burden (CAT score ≥ 10) and exacerbation risk (≥ 1 hospitalization for exacerbation in the past 12 months), resulting in classification into GOLD groups A–D.²²

Statistical Analysis

Baseline characteristics and outcome measures were summarized using descriptive statistics. To reduce baseline differences between COPD patients and comparator groups, 1:1 propensity score matching was performed using demographic, socioeconomic, lifestyle, and clinical covariates. Covariate balance after matching was assessed using standardized mean differences (SMD), with values < 0.1 indicating adequate balance.^{23,24} Matched comparisons were conducted using paired statistical tests as appropriate, with Bonferroni correction applied for multiple comparisons ($\alpha = 0.05$).^{25,26} All analyses were performed using SAS software (version 9.4) (Figure 1).

Results

Baseline Characteristics

A total of 20,051 respondents from the NHWS were included in the analysis. After excluding individuals reporting two or more of the target chronic conditions, patients with self-reported COPD and comparator cohorts with hypertension, diabetes, hypercholesterolemia, or osteoporosis were identified for baseline comparisons.

Before matching, self-reported COPD patients (N=589, including 274 cases of diagnosed COPD) differed significantly from individuals with hypertension (N=1635), diabetes (N=262), hypercholesterolemia (N=371), and osteoporosis (N=602) across multiple sociodemographic characteristics (Table S1).

Demographically, COPD patients were significantly younger, with 49.92% aged 18–39 years compared to 13.64% of hypertension, 11.45% of diabetes, 25.91% of osteoporosis, and 32.61% of hypercholesterolemia patients (all $p < 0.01$; SMD range: 0.41–0.76). A higher proportion of males was observed among COPD patients (53.48%) relative to osteoporosis patients (40.86%, $p < 0.01$, SMD=0.25), with no significant difference compared to diabetes and hypercholesterolemia patients.

Notable socioeconomic disparities were present. COPD patients were less frequently married or cohabiting (76.40%) than patients with hypertension (91.30%), diabetes (88.17%), hypercholesterolemia (86.79%), and osteoporosis (85.14%) (all $p < 0.01$; SMD range: -0.40 to -0.22). The proportion with a university degree or above was higher among COPD patients (68.76%) than among hypertension (51.19%, SMD=0.36), diabetes (39.69%, SMD=0.58), and osteoporosis patients (54.91%, SMD=0.29), but lower than among hypercholesterolemia patients (78.17%, SMD= -0.21). Current employment was lower in the COPD cohort (30.39%) compared to hypertension (48.69%, SMD= -0.37), diabetes (60.31%, SMD= -0.60), and osteoporosis groups (48.51%, SMD= -0.37). COPD patients were also less likely to have urban employee basic medical insurance and more likely to report having no insurance. Statistically significant differences in annual household income distribution were also observed, particularly versus hypercholesterolemia patients ($p < 0.01$).

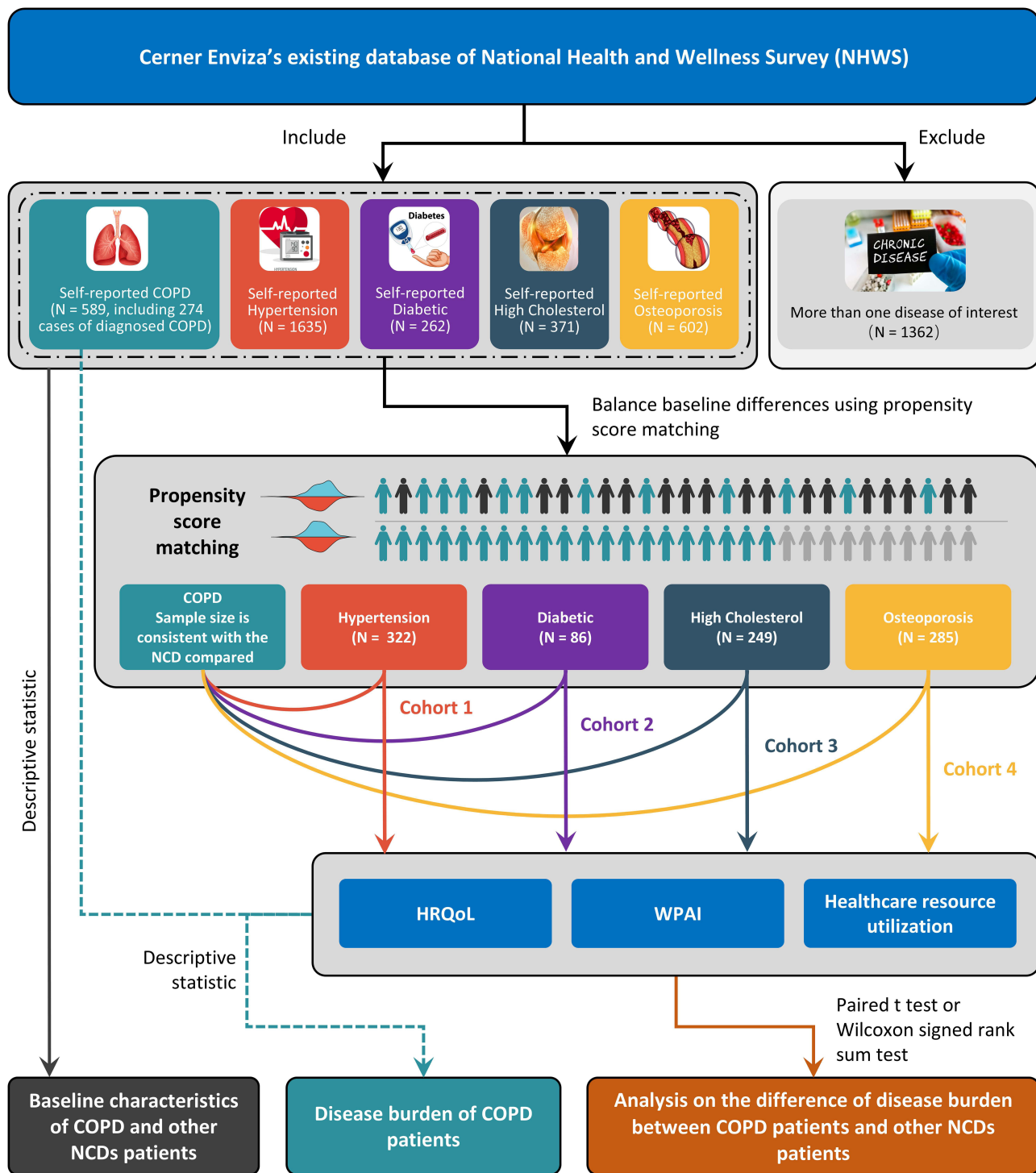


Figure 1 Research roadmap.

Regarding clinical and lifestyle characteristics, the proportion of underweight individuals (BMI < 18.5) was higher among COPD patients (12.73%) compared to all other groups. Both past and current smoking prevalence were significantly higher in COPD patients than in all comparator groups, most notably versus osteoporosis (SMD=0.30 for current smoking). Alcohol consumption and physical activity levels also varied across groups. For comorbidity burden, diabetic patients exhibited a higher proportion with a Charlson Comorbidity Index (CCI) score ≥ 2 than COPD patients (SMD=1.29).

Given these systematic baseline imbalances across demographic and socioeconomic factors, propensity score matching was applied to create balanced cohorts for subsequent comparisons of disease burden outcomes, as detailed in Table 1.

Analysis of Disease Burden in COPD Patients

Both clinically confirmed and self-reported COPD patients experienced substantial disease burden across multiple domains (Table 2). HRQoL was impaired, with SF-12v2 Physical and Mental Component Summary scores consistently below population norms. EQ-5D-5L utility values further reflected reduced overall health status, while CAT scores indicated a moderate symptom burden.

Work productivity and daily functioning were also affected. WPAI results demonstrated measurable absenteeism and presenteeism, resulting in considerable overall work productivity loss and activity impairment. Healthcare utilization was frequent, with COPD patients reporting multiple outpatient visits, emergency department encounters, and hospitalizations over the preceding six months. Both direct medical costs and indirect costs related to productivity loss contributed to a substantial economic burden.

Comparative Analysis of Disease Burden Between COPD and Hypertensive Patients

After propensity score matching, patients with COPD in China were found to experience a more pronounced multidimensional disease burden compared to hypertensive patients, with a clear gradient related to disease severity. In terms of HRQoL, COPD patients had significantly lower MCS, PCS, and EQ-5D index scores than hypertensive patients. Analysis by GOLD stages showed distinct profiles: Stage A patients had significantly lower MCS but slightly higher EQ-5D scores than hypertensive patients; Stage B patients showed significantly lower scores across all three HRQoL dimensions; Stage C patients did not differ significantly from hypertensive patients; and Stage D patients displayed the largest deficits in PCS and EQ-5D, underscoring the strong influence of disease severity on quality of life (Figure 2i–iii).

In WPAI, COPD patients also exhibited greater limitations. Overall, presenteeism, overall work productivity loss, and activity impairment were significantly higher in COPD patients than in hypertensive patients. Stratification by GOLD stage revealed a graded pattern: Stage A and C patients showed minimal differences across WPAI domains, whereas Stage B and D patients had significantly higher presenteeism, overall work loss, and activity impairment. Stage D patients also had the highest absenteeism rate, indicating pronounced work capacity reduction with disease progression (Figure 2iv–vii).

Healthcare utilization patterns differed between the two groups. Outpatient visit rates did not differ significantly overall or by disease stage. Emergency department visits were elevated only in Stage D COPD patients. Hospitalization rates over six months were significantly lower in the overall COPD cohort and in most GOLD stages compared to hypertensive patients, except for Stage C patients, who showed comparable hospitalization rates—possibly reflecting increased acute exacerbation risk in this subgroup (Figure 2viii–x).

These findings confirm the substantial burden of COPD relative to hypertension in China and highlight its severity-dependent nature. A graded management approach is warranted: Stage A patients may benefit from early pulmonary preservation and lifestyle support; Stage B patients require focused attention on maintaining work capacity; and Stage C/D patients would benefit from integrated strategies encompassing exacerbation prevention, psychological support, and occupational rehabilitation to reduce multidimensional burden and socioeconomic impact.

Comparative Analysis of Disease Burden Between COPD and Diabetic Patients

Propensity score matching-based comparisons revealed distinct multidimensional burden profiles between COPD and diabetic patients. In HRQoL measures, COPD patients overall showed significantly lower scores in both MCS and PCS domains compared to diabetic patients. While the EQ-5D health utility index was numerically lower in COPD patients, this difference did not reach statistical significance. However, stratification by disease severity revealed important patterns: patients with GOLD stage D COPD had significantly lower EQ-5D scores than diabetic patients, and stage

Table 1 Comparisons of Sociodemographic and General Health Characteristics Between Self-Reported COPD Patients and Other NCD Patients in China Post-PSM

Sociodemographic and General Health Characteristics		Self-Reported COPD Patients	Self-Reported Hypertension Patients	p-value	SMD	Self-Reported COPD Patients	Self-Reported Diabetic Patients	p-value	SMD	Self-Reported COPD Patients	Self-Reported High Cholesterol Patients	p-value	SMD	Self-Reported COPD Patients	Self-Reported Osteoporosis Patients	p-value	SMD
		(N = 322)	(N = 322)			(N = 86)	(N = 86)			(N = 249)	(N = 249)			(N = 285)	(N = 285)		
		N (%)	N (%)			N (%)	N (%)			N (%)	N (%)			N (%)	N (%)		
Age group	18-39	106 (32.92%)	105 (32.61%)	0.97	0.02	22 (25.58%)	23 (26.74%)	0.98	0.03	102 (40.96%)	108 (43.37%)	0.73	0.06	114 (40.00%)	114 (40.00%)	0.99	0.01
	40-59	111 (34.47%)	114 (35.40%)			30 (34.88%)	29 (33.72%)			104 (41.77%)	104 (41.77%)			84 (29.47%)	85 (29.82%)		
	≥60	105 (32.61%)	103 (31.99%)			34 (39.53%)	34 (39.53%)			43 (17.27%)	37 (14.86%)			87 (30.53%)	86 (30.18%)		
Gender	Male	190 (59.01%)	187 (58.07%)	0.81	0.02	46 (53.49%)	44 (51.16%)	0.76	0.05	147 (59.04%)	137 (55.02%)	0.37	0.08	133 (46.67%)	133 (46.67%)	1.00	0.00
	Female	132 (40.99%)	135 (41.93%)			40 (46.51%)	42 (48.84%)			102 (40.96%)	112 (44.98%)			152 (53.33%)	152 (53.33%)		
Marital status	Married/living with partner	304 (94.41%)	307 (95.34%)	0.59	-0.04	77 (89.53%)	75 (87.21%)	0.63	0.07	218 (87.55%)	217 (87.15%)	0.89	0.01	255 (89.47%)	254 (89.12%)	0.89	0.01
	Single, never married/divorced/separated/widowed	18 (5.59%)	15 (4.66%)			9 (10.47%)	11 (12.79%)			31 (12.45%)	32 (12.85%)			30 (10.53%)	31 (10.88%)		
Level of education	University degree or above	203 (63.04%)	207 (64.29%)	0.74	-0.03	44 (51.16%)	48 (55.81%)	0.54	-0.09	188 (75.50%)	189 (75.90%)	0.92	-0.01	193 (67.72%)	192 (67.37%)	0.93	0.01
	High school degree or below	119 (36.96%)	115 (35.71%)			42 (48.84%)	38 (44.19%)			61 (24.50%)	60 (24.10%)			92 (32.28%)	93 (32.63%)		
Employment status	Currently employed	109 (33.85%)	113 (35.09%)	0.74	-0.03	38 (44.19%)	37 (43.02%)	0.88	0.02	55 (22.09%)	55 (22.09%)	1.00	0.00	99 (34.74%)	103 (36.14%)	0.73	-0.03
	Not employed	213 (66.15%)	209 (64.91%)			48 (55.81%)	49 (56.98%)			194 (77.91%)	194 (77.91%)			186 (65.26%)	182 (63.86%)		
Household income	RMB < 8000	55 (17.24%)	53 (16.61%)	0.77	0.05	25 (29.07%)	18 (21.18%)	0.46	0.02	38 (15.26%)	30 (12.05%)	0.57	0.08	61 (21.63%)	56 (19.65%)	0.77	0.05
	RMB 8000 to 15,999	143 (44.83%)	136 (42.63%)			26 (30.23%)	31 (36.47%)			107 (42.97%)	109 (43.78%)			120 (42.55%)	119 (41.75%)		
	RMB 16,000 or more	121 (37.93%)	130 (40.75%)			35 (40.70%)	36 (42.35%)			104 (41.77%)	110 (44.18%)			101 (35.82%)	109 (38.25%)		
Insurance type	Urban resident basic medical insurance/new rural cooperation medical insurance	145 (45.03%)	148 (45.96%)	0.68	0.07	36 (41.86%)	44 (51.16%)	0.24	0.04	98 (39.36%)	90 (36.14%)	0.82	0.08	132 (46.32%)	140 (49.12%)	0.82	0.08
	Urban employee basic medical insurance	171 (53.11%)	171 (53.11%)			46 (53.49%)	41 (47.67%)			147 (59.04%)	156 (62.65%)			135 (47.37%)	129 (45.26%)		
	Other	1 (0.31%)	0 (0.00%)			0 (0.00%)	0 (0.00%)			2 (0.80%)	2 (0.80%)			4 (1.40%)	6 (2.11%)		
	No insurance	5 (1.55%)	3 (0.93%)			4 (4.65%)	1 (1.16%)			2 (0.80%)	1 (0.40%)			14 (4.91%)	10 (3.51%)		

Body mass index	Underweight (BMI < 18.5)	15 (4.66%)	15 (4.66%)	0.87	0.05	4 (4.65%)	4 (4.65%)	0.86	0.02	11 (4.42%)	16 (6.43%)	0.76	0.07	29 (10.18%)	36 (12.63%)	0.76	0.07
	Normal (BMI 18.5–23.9)	185 (57.45%)	186 (57.76%)			48 (55.81%)	51 (59.30%)			141 (56.63%)	141 (56.63%)			162 (56.84%)	154 (54.04%)		
	Overweight or obese (BMI ≥24)	114 (35.40%)	116 (36.02%)			30 (34.88%)	29 (33.72%)			93 (37.35%)	89 (35.74%)			85 (29.82%)	86 (30.18%)		
	Unknown	8 (2.48%)	5 (1.55%)			4 (4.65%)	2 (2.33%)			4 (1.61%)	3 (1.20%)			9 (3.16%)	9 (3.16%)		
Smoking status	Non-smoker	191 (59.32%)	205 (63.66%)	0.52	0.08	37 (43.02%)	41 (47.67%)	0.74	0.09	150 (60.24%)	164 (65.86%)	0.41	0.08	197 (69.12%)	199 (69.82%)	0.98	0.02
	Former smoker	35 (10.87%)	30 (9.32%)			13 (15.12%)	10 (11.63%)			26 (10.44%)	24 (9.64%)			20 (7.02%)	20 (7.02%)		
	Current smoker	96 (29.81%)	87 (27.02%)			36 (41.86%)	35 (40.70%)			73 (29.32%)	61 (24.50%)			68 (23.86%)	66 (23.16%)		
Alcohol use	Drinker	107 (33.23%)	113 (35.09%)	0.62	-0.04	25 (29.07%)	25 (29.07%)	1.00	0.00	68 (27.31%)	68 (27.31%)	1.00	0.00	113 (39.65%)	115 (40.35%)	0.86	-0.01
	Non-drinker	215 (66.77%)	209 (64.91%)			61 (70.93%)	61 (70.93%)			181 (72.69%)	181 (72.69%)			172 (60.35%)	170 (59.65%)		
Vigorous exercise in the past 30 days	None	119 (36.96%)	124 (38.51%)	0.90	0.03	31 (36.05%)	38 (44.19%)	0.55	0.03	77 (30.92%)	75 (30.12%)	0.51	0.09	102 (35.79%)	104 (36.49%)	0.98	0.02
	1-11 times	126 (39.13%)	125 (38.82%)			26 (30.23%)	23 (26.74%)			114 (45.78%)	105 (42.17%)			107 (37.54%)	107 (37.54%)		
	≥12 times	77 (23.91%)	73 (22.67%)			29 (33.72%)	25 (29.07%)			58 (23.29%)	69 (27.71%)			76 (26.67%)	74 (25.96%)		
Charlson Comorbidity Index	0	284 (88.02%)	287 (89.13%)	0.90	0.04	29 (33.72%)	25 (29.07%)	0.66	0.09	223 (89.56%)	225 (90.36%)	0.52	0.08	251 (88.07%)	247 (86.67%)	0.63	0.07
	1	34 (10.56%)	32 (9.94%)			42 (48.84%)	48 (55.81%)			21 (8.43%)	22 (8.84%)			26 (9.12%)	32 (11.23%)		
	≥2	4 (1.24%)	3 (0.93%)			15 (17.44%)	13 (15.12%)			5 (2.01%)	2 (0.80%)			8 (2.81%)	6 (2.11%)		

Abbreviations: COPD, Chronic Obstructive Pulmonary Disease; SMD, Standardized Mean Differences.

Table 2 Disease Burden Among Diagnosed and Self-Reported COPD Patients in China

Disease burden		Diagnosed COPD Patients (N = 274)			Self-Reported COPD Patients (N = 589)		
		N	Mean	SD	N	Mean	SD
HRQoL	MCS (Chinese norm)	274	48.44	7.88	589	45.76	8.15
	PCS (Chinese norm)	274	47.89	7.51	589	47.99	7.21
	EQ-5D index	274	0.91	0.13	589	0.88	0.17
	CAT score	274	16.66	7.75	589	17.11	8.46
WPAI	Absenteeism (%)	151	5.89	11.75	396	9.11	14.82
	Presenteeism (%)	153	26.93	24.95	408	34.66	28.74
	Overall work impairment (%)	151	29.27	26.10	396	37.88	30.27
	Activity impairment (%)	274	27.01	23.26	589	32.70	26.46
Healthcare resource utilization	No. of outpatient visits in the past 6 months	195	3.09	3.23	413	3.52	3.80
	No. of ER visits in the past 6 months	63	2.05	2.28	184	2.34	2.34
	No. of hospitalizations in the past 6 months	32	1.81	2.12	109	2.08	1.92
Indirect cost (in thousand Chinese Yuan)		151	23.34	22.76	396	31.92	30.28
Direct cost (in thousand Chinese Yuan)		195	12.51	38.96	413	21.53	48.82

Abbreviations: CAT, COPD Assessment Test; COPD, Chronic Obstructive Pulmonary Disease; EQ-5D, EuroQol Five Dimensions Questionnaire; HRQoL, Health-Related Quality of Life; MCS, Mental Component Summary; PCS, Physical Component Summary; SD, Standard Deviation; WPAI, Work Productivity and Activity Impairment questionnaire.

B patients showed markedly reduced MCS scores, demonstrating a severity-dependent gradient in HRQoL impairment (Figure 3i–iii).

Work productivity assessments revealed a bipolar pattern across COPD severity stages. Patients with mild (stage A) COPD exhibited better presenteeism and overall work productivity outcomes than diabetic patients, whereas severe (stage D) COPD patients showed significantly greater impairment across all work productivity metrics. The most pronounced difference was observed in daily activity impairment, which was substantially higher in stage D COPD patients, reflecting the profound functional impact of advanced disease (Figure 3iv–vii).

Healthcare utilization patterns showed both similarities and differences between the groups. Outpatient and emergency department visit frequencies were comparable between COPD and diabetic patients. However, COPD patients overall had significantly higher hospitalization rates over six months (2.35 ± 2.03) compared to diabetic patients, highlighting their greater reliance on inpatient care, likely driven by acute exacerbations characteristic of advanced disease stages (Figure 3viii–x).

These findings demonstrate divergent burden trajectories between COPD and diabetes. While diabetic patients exhibit a relatively stable burden profile across disease stages, COPD shows a severity-dependent progression, with stage D patients experiencing particularly pronounced deterioration in quality of life, work productivity, and healthcare needs. The bipolar pattern in work productivity outcomes—with mild COPD patients faring better but severe patients significantly worse than their diabetic counterparts—underscores the need for disease-stage-specific management approaches. For advanced COPD patients, integrated strategies addressing exacerbation prevention, functional maintenance, and psychological support are essential to mitigate the multidimensional disease burden.

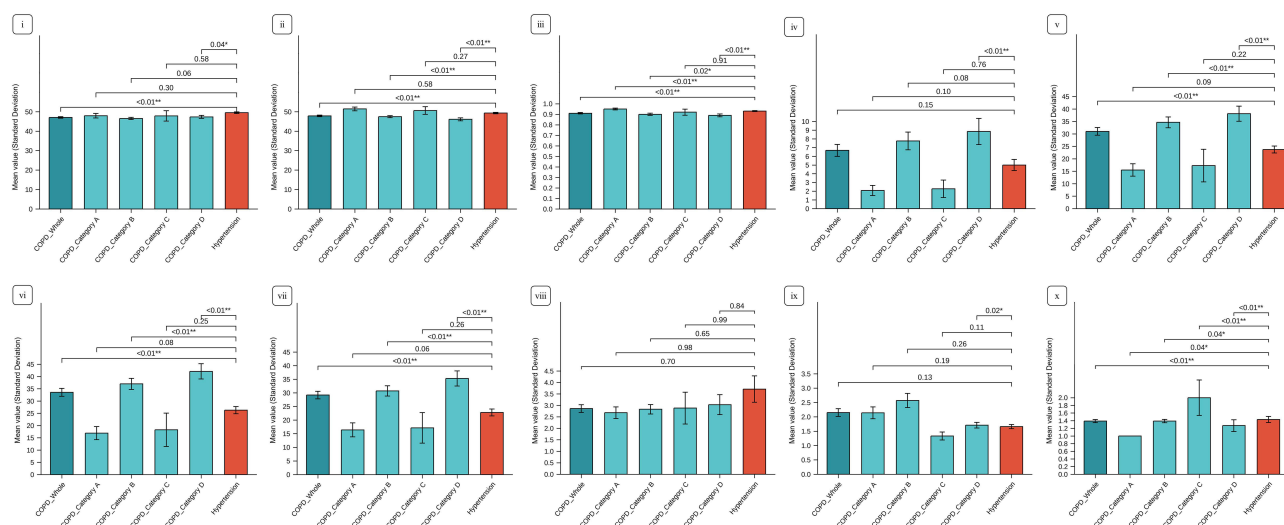


Figure 2 Differences between Chinese Chronic Obstructive Pulmonary Disease patients and hypertension patients in health-related quality of life (Mental Component Summary (i), Physical Component Summary (ii), and EuroQol Five Dimensions Questionnaire (iii)), Work Productivity and Activity Impairment (absenteeism rate (iv), presenteeism rate (v), overall work productivity loss (vi), and daily activity impairment rate (vii), and Healthcare Resource Utilization (number of outpatient visits (viii), emergency department visits (ix), and hospital admissions within six months (x)). ** $p < 0.01$, * $p < 0.05$.

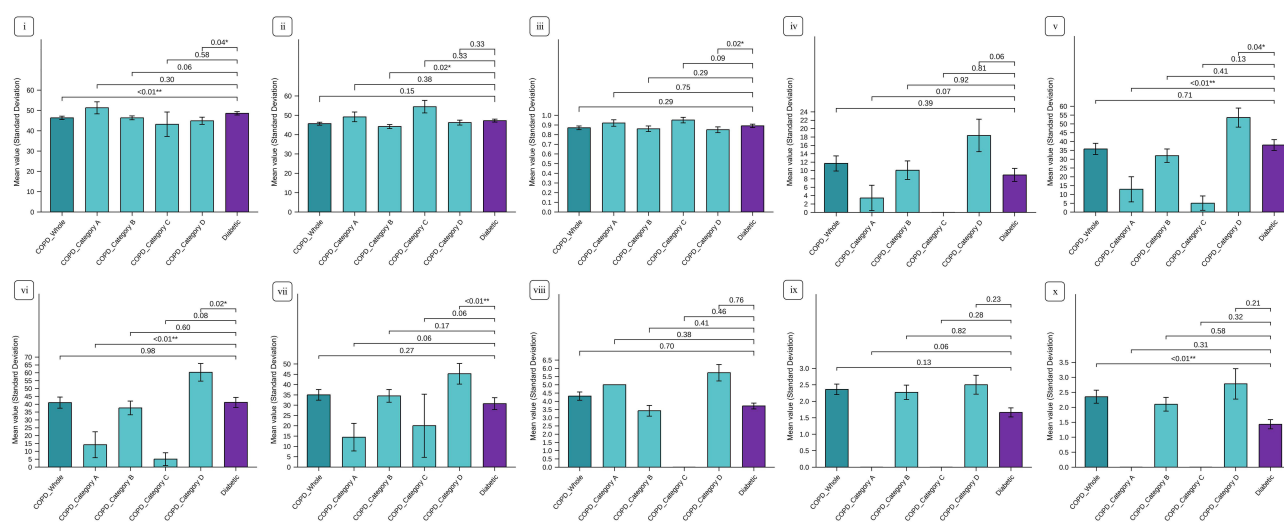


Figure 3 Differences between Chinese Chronic Obstructive Pulmonary Disease patients and type 2 diabetes patients in health-related quality of life (Mental Component Summary (i), Physical Component Summary (ii), and EuroQol Five Dimensions Questionnaire (iii)), Work Productivity and Activity Impairment (absenteeism rate (iv), presenteeism rate (v), overall work productivity loss (vi), and daily activity impairment rate (vii), and Healthcare Resource Utilization (number of outpatient visits (viii), emergency department visits (ix), and hospital admissions within six months (x)). ** $p < 0.01$, * $p < 0.05$.

Comparative Analysis of Disease Burden Between COPD and Hypercholesterolemia Patients

Propensity score matching analysis demonstrated significantly greater disease burden in COPD patients compared to those with hypercholesterolemia, with variations following a severity-dependent pattern. In health-related quality of life measures, COPD patients overall showed significantly lower scores than hypercholesterolemia patients across all HRQoL domains, including Mental Component Summary, Physical Component Summary, and EQ-5D utility index. Stratification by GOLD stages revealed that while stages A and C COPD patients maintained comparable HRQoL to hypercholesterolemia patients, stages B and D exhibited substantially impaired scores across all three dimensions (Figure 4i-iii).

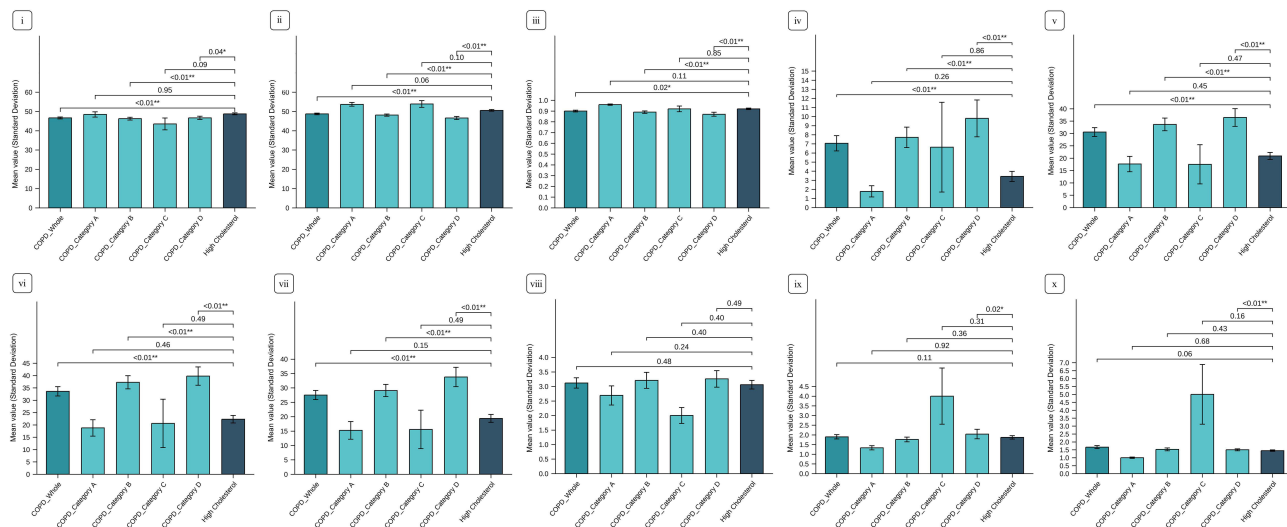


Figure 4 Differences between Chinese Chronic Obstructive Pulmonary Disease patients and hypercholesterolemia patients in health-related quality of life (Mental Component Summary (i), Physical Component Summary (ii), and EuroQol Five Dimensions Questionnaire (iii)), Work Productivity and Activity Impairment (absenteeism rate (iv), presenteeism rate (v)), overall work productivity loss (vi), and daily activity impairment rate (vii), and Healthcare Resource Utilization (number of outpatient visits (viii), emergency department visits (ix), and hospital admissions within six months (x)). ** $p < 0.01$, * $p < 0.05$.

Work productivity assessment demonstrated consistently higher impairment in COPD patients relative to hypercholesterolemia controls, with significantly elevated rates of absenteeism, presenteeism, overall work productivity loss, and daily activity impairment in the overall COPD cohort. This pattern was particularly evident in GOLD stages B and D, which showed marked deficits across all WPAI domains, while stages A and C patients maintained comparable function to the hypercholesterolemia group (Figure 4iv–vii).

Healthcare utilization patterns differed notably between the groups. Although outpatient visit frequencies were similar overall, stage D COPD patients required significantly more emergency department visits and hospitalizations over six months compared to hypercholesterolemia patients, indicating heightened acute care needs in advanced disease stages (Figure 4viii–x).

The results establish that COPD patients experience substantially greater multidimensional burden than hypercholesterolemia patients, with disparities widening with disease progression. The severity-dependent nature of these differences underscores the importance of individualized management approaches, particularly for stages B and D where targeted interventions focusing on occupational capacity preservation and optimized healthcare resource allocation are most needed.

Comparative Analysis of Disease Burden Between COPD and Osteoporosis Patients

Propensity score matching analysis revealed distinct severity-dependent patterns in the multidimensional disease burden between COPD and osteoporosis patients. In terms of health-related quality of life, the overall COPD cohort demonstrated a significantly higher EQ-5D health utility index than osteoporosis patients. Stratification by GOLD stages showed a more nuanced pattern: patients with stage A COPD had significantly better physical component summary scores and EQ-5D indices, while stage B patients also exhibited higher EQ-5D scores. However, no significant differences in any HRQoL dimensions were observed between stage C or D COPD patients and osteoporosis patients. Notably, mental health domain scores showed no significant differences between groups across all severity strata (Figure 5i–iii).

Work productivity assessments demonstrated relative advantages for COPD patients overall, with lower absenteeism, presenteeism, and overall work productivity loss compared to osteoporosis patients. Stage-specific analysis revealed that stage A COPD patients performed significantly better across all WPAI metrics, while stage C patients also showed superior outcomes except for daily activity impairment. In contrast, stage B and D COPD patients exhibited comparable impairment levels to osteoporosis patients across all productivity measures (Figure 5iv–vii).

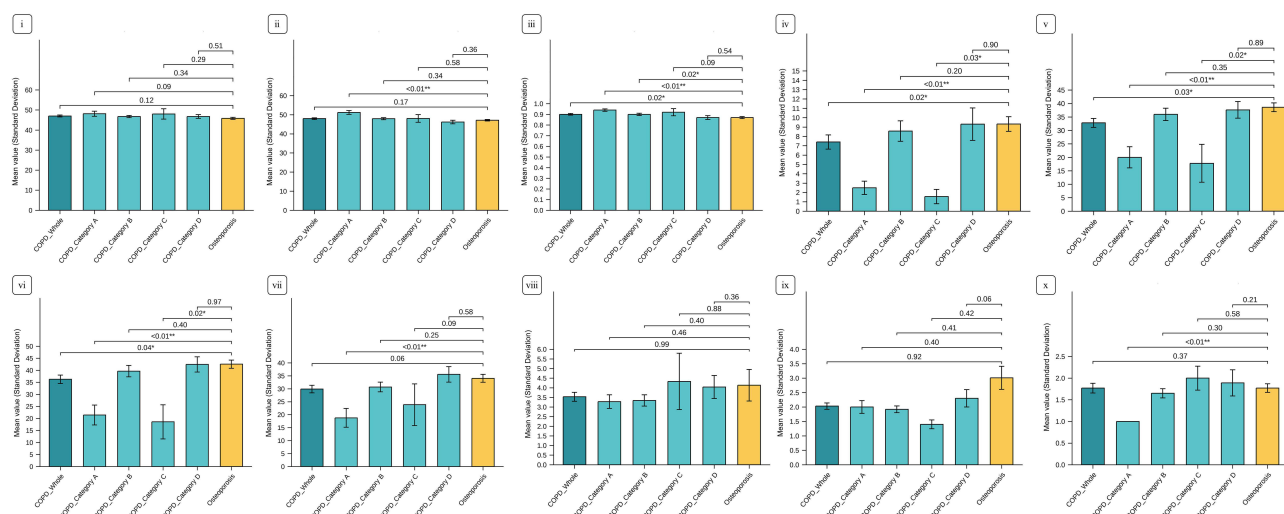


Figure 5 Differences between Chinese Chronic Obstructive Pulmonary Disease patients and osteoporosis patients in health-related quality of life (Mental Component Summary (i), Physical Component Summary (ii), and EuroQol Five Dimensions Questionnaire (iii)), Work Productivity and Activity Impairment (absenteeism rate (iv), presenteeism rate (v)), overall work productivity loss (vi), and daily activity impairment rate (vii), and Healthcare Resource Utilization (number of outpatient visits (viii), emergency department visits (ix), and hospital admissions within six months (x)). ** $p < 0.01$, * $p < 0.05$.

Healthcare utilization patterns showed limited differences between the groups. While outpatient and emergency department visit frequencies were similar, stage A COPD patients had significantly fewer hospitalizations over six months compared to osteoporosis patients. No significant differences in hospitalization rates were observed for other GOLD stages (Figure 5viii–x).

These findings indicate distinct burden profiles between COPD and osteoporosis patients, with mild COPD (stage A) associated with better quality of life and work productivity outcomes. However, this advantage diminishes with disease progression, as moderate-to-severe COPD patients (stages B and D) experience burden levels comparable to osteoporosis patients. The results highlight the importance of severity-stratified management approaches, emphasizing proactive health maintenance for early-stage COPD patients and integrated cardiorespiratory-bone health interventions for advanced-stage patients to address cumulative disease burden.

Discussion

This nationwide comparative study demonstrates that COPD imposes a substantially greater multidimensional burden compared to other prevalent NCDs in China, with a distinct severity-dependent progression pattern. Our findings reveal that COPD patients experience more pronounced impairments in HRQoL, work productivity, and healthcare utilization than those with hypertension, diabetes, or hypercholesterolemia, while showing a more variable profile when compared to osteoporosis patients depending on disease stage.²⁷

Notably, the gradient of burden escalation across GOLD stages was particularly evident in quality of life measures. The significantly reduced EQ-5D utility values in stage D patients underscore a clear dose-response relationship between disease severity and quality of life impairment. This pattern aligns with established literature documenting the progressive nature of COPD-related quality of life decline, particularly in physical functioning domains where airflow limitation directly impacts daily activities.^{28–30}

The work productivity findings reveal a notable divergence from patterns observed in other chronic conditions. While mild COPD patients (stage A) maintained comparable or even superior work capacity relative to some comparator groups, advanced disease stages (particularly D) demonstrated profound productivity losses exceeding those observed in other NCDs. This bifurcated pattern suggests that early-stage COPD may preserve functional capacity better than conditions like diabetes, but disease progression leads to disproportionately greater functional decline.

Healthcare utilization patterns provide important insights for resource planning. The elevated hospitalization rates among COPD patients, especially in stages C and D, highlight the critical role of acute exacerbations in driving

healthcare burden. This distinguishes COPD from more stable chronic conditions like hypertension and underscores the importance of exacerbation prevention as a key management strategy.

Methodologically, our use of PSM addresses important limitations in previous burden comparisons by minimizing confounding from baseline characteristics.³¹ The systematic comparison across multiple disease cohorts provides a more nuanced understanding of COPD's relative position within the chronic disease spectrum than previously available from single-disease studies.^{32–38}

The mechanisms underlying COPD's substantial burden profile are multifactorial. The irreversible airflow limitation characteristic of COPD directly impairs physical function, while systemic inflammation contributes to both respiratory and non-respiratory manifestations.³⁹ Furthermore, common risk factors such as smoking and environmental exposures may compound disease burden through multiple pathways.⁴⁰ Additionally, COPD is highly associated with adverse environmental factors. COPD is frequently accompanied by multiple comorbidities, which interact with COPD, forming a vicious cycle that further deteriorates patients' functional status and quality of life.⁴¹ In contrast, although hypertension and hypercholesterolemia are also chronic progressive diseases, they often present with no obvious symptoms in the early stages, resulting in a smaller direct impact on patients' daily lives, which partly explains the differences observed.⁴²

From a policy perspective, these findings argue for stratified management approaches that account for the severity-dependent nature of COPD burden. For early-stage patients, interventions should focus on preserving function and preventing progression, while advanced-stage patients require comprehensive support addressing both respiratory and systemic manifestations. The significant productivity losses observed highlight the economic imperative for workplace accommodations and vocational rehabilitation programs.

Several limitations of this study should be acknowledged. First, the cross-sectional design precludes assessment of temporal changes in disease burden and limits causal inference regarding the observed associations. Second, COPD status was identified based on self-reported information, which, although commonly used in large population-based surveys and valuable for capturing patient-perceived disease burden, may be subject to misclassification and reporting bias, particularly in the absence of spirometry confirmation. Such misclassification could lead to an underestimation or overestimation of the true burden of COPD relative to other non-communicable diseases. Third, while propensity score matching was applied to balance observed baseline characteristics across disease groups, the relatively small sample sizes in some matched comparisons may have reduced statistical power and limited the generalizability of certain comparative estimates. In addition, although we adjusted for a broad range of sociodemographic and health-related covariates, residual confounding from unmeasured factors—such as disease duration, clinical severity indicators, healthcare access, and health-seeking behaviors—cannot be fully excluded. Finally, although both direct and indirect costs were reported, the economic burden assessment did not comprehensively capture broader societal costs, including informal caregiving, productivity losses beyond paid employment, and other intangible impacts. Consequently, the total societal burden of COPD in China may be underestimated.

Conclusions

This study establishes COPD as a leading contributor to chronic disease burden in China, with a distinct severity-dependent pattern that distinguishes it from other prevalent NCDs. Patients with advanced COPD (particularly GOLD stage D) experience disproportionate impairments in quality of life, work productivity, and healthcare utilization compared to those with other chronic conditions. These findings compel a reorientation of COPD management strategies toward severity-stratified approaches that prioritize early intervention for preserving function in mild disease and comprehensive support for managing complex needs in advanced disease. At the systems level, optimal COPD care requires integration of medical management, vocational support, and community-based services to address the multi-dimensional nature of COPD-related burden. Future policies should incorporate respiratory health considerations across all relevant sectors to mitigate the substantial health and economic impact of COPD in China.

Abbreviations

BMI, Body Mass Index; COPD, Chronic Obstructive Pulmonary Disease; CAT, COPD Assessment Test; CNY, Chinese Yuan, Chronic Obstructive Lung Disease, EQ-5D, EuroQol Five Dimensions Questionnaire; GOLD, Chronic Obstructive Lung Disease; HRQoL, Health-Related Quality of Life; HSU, Health State Utility; MCS, Mental Component Summary; NCDs, Non-Communicable Diseases; NHWS, National Health and Wellness Survey; PCS, Physical Component Summary; PSM, Propensity Score Matching; SMD, Standardized Mean Differences; WPAI, Work Productivity and Activity Impairment questionnaire.

Data Sharing Statement

The data that support the findings of this study are available from Cerner Enviza but restrictions apply to the availability of these data, which were used under license for the current study, and so are not publicly available. Data are however available from the authors upon reasonable request and with permission of Cerner Enviza.

Ethics Approval and Informed Consent

The NHWS received Pearl Institutional Review Board (Indianapolis, IN, USA) approval (No. Protocol #20-KANT-228), and all respondents were informed about confidentiality in the statement of informed consent. Respondents provided written consent to participate.

Author Contributions

Quan Sun and Bixiang Lu share first authorship. BL, QS and ZZ conceptualized the rationale and design of the study. BL and QS draws the original manuscript. QS and QC performed data analysis. All authors made a significant contribution to the work reported, whether that is in the conception, study design, execution, acquisition of data, analysis and interpretation, or in all these areas; took part in drafting, revising or critically reviewing the article; gave final approval of the version to be published; have agreed on the journal to which the article has been submitted; and agree to be accountable for all aspects of the work.

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Disclosure

The authors declare that they have no competing interests in this work.

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