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REVIEW

Disease burden of COPD in China: a systematic review

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Abstract: Chronic obstructive pulmonary disease (COPD) is one of the main contributors to the global burden of disease. The aim of this systematic review was to quantify the disease burden of COPD in China and to determine the risk factors of the disease. The number of studies included in the review was 47 with an average quality assessment score of 7.70 out of 10. Reported COPD prevalence varied between 1.20% and 8.87% in different provinces/cities across China. The prevalence rate of COPD was higher among men (7.76%) than women (4.07%). The disease was more prevalent in rural areas (7.62%) than in urban areas (6.09%). The diagnostic rate of COPD patients in China varied from 23.61% to 30.00%. The percentage of COPD patients receiving outpatient treatment was around 50%, while the admission rate ranged between 8.78% and 35.60%. Tobacco exposure and biomass fuel/solid fuel usage were documented as two important risk factors of COPD. COPD ranked among the top three leading causes of death in China. The direct medical cost of COPD ranged from 72 to 3,565 USD per capita per year, accounting for 33.33% to 118.09% of local average annual income. The most commonly used scales for the assessment of quality of life (QoL) included Saint George Respiratory Questionnaire, Airways Questionnaire 20, SF-36, and their revised versions. The status of QoL was worse among COPD patients than in non-COPD patients, and COPD patients were at higher risks of depression. The COPD burden in China was high in terms of economic burden and QoL. In view of the high smoking rate and considerable concerns related to air pollution and smog in China, countermeasures need to be taken to improve disease prevention and management to reduce disease burdens raised by COPD.

Keywords: COPD, burden of disease, systematic review

Introduction

Chronic obstructive pulmonary disease (COPD) refers to a progressive deterioration of lung function and a series of mental and physical comorbidities.[1] It is one of the main contributors to the global burden of disease. COPD has caused significant morbidity and mortality especially in developing countries. There are also excessive health resource consumption and health expenditures attributed to COPD worldwide. Researchers have found greater burden of COPD in China than in developed countries. In 2008, COPD was known as the fourth and third leading cause of death in urban and rural areas in China, respectively.[2] There is big variation in the reported prevalence of COPD among different geographic areas in China, which is partly due to different levels of exposure to risk factors and disparities in socioeconomic development among different areas.[3] Despite the abundant information on the epidemiological impact of COPD, there is limited evidence on its economic influence.[4] Hence, in-depth study on the disease burden of COPD is still an urgent need.

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The aim of this systematic review was to quantify the disease burden of COPD in China and to determine the risk factors of the disease. Data on prevalence, consultation rate, risk factors, mortality, disease burden, cost of illness, and quality of life (QoL) are extracted from available studies and analyzed to improve public awareness of COPD.

Methods

Literature search

A systematic review was conducted to identify articles regarding disease burden of COPD in mainland China in both Chinese and English published before October 2015. The literature search was carried out in electronic databases such as CNKI, Wanfang Data, VIP, PubMed, Embase, and Cochrane. The search terms were as follows: "COPD", "cost", and "health care costs". With CNKI and PubMed as examples, the retrieval strategies are shown in Box 1. Duplicate studies were identified and removed by using NoteExpress.

Study selection

Publications identified from the first round of search were reviewed by title and abstract independently by two investigators (BZ and YW). The inclusion and exclusion criteria used for study selection are listed in Table 1.

Methodological quality assessment

The quality of the studies was assessed by using a self-established scale based on Agency for Healthcare Research and Quality Assessment Form,[5] the Newcastle–Ottawa Scale,[6] and Drummond Criteria[7] (Table 2). The studies were assessed independently by two reviewers (BZ and JM). The assessment scores were then confirmed and pooled together. Quality score was in the range of 0–10 points, and the articles were categorized into three classes. Articles with ≥8 points were listed under category A, 4–7 points under category B, and <4 points under category C. This study excluded studies with poor quality, that is, those in category C.

Box 1 Examples of retrieval strategy

CNKI retrieval strategy
#1 "Chronic Obstructive Lung" OR "Chronic Obstructive Pulmonary Disease" OR "COPD"
#2 "disease burden" OR "epidemic" OR "prevalence" OR "mortality" OR "incidence" OR "hospitalization rate" OR "economic burden" OR "cost" OR "expense" OR "disability adjusted life years" OR "disability adjusted living years" OR "DALY" OR "years lost due to disability" OR "years of life lost" OR "YLD" OR "YLL"
#3 #1 AND #2

PubMed retrieval strategy
#1 "China"[Mesh]
#2 "Pulmonary Disease, Chronic Obstructive"[Mesh] OR "COPD, Severe Early-Onset" [Supplementary Concept]
"COPD/economics"[Mesh] OR "COPD/epidemiology"[Mesh] OR "COPD/mortality"[Mesh]
#3 "Cost of Illness"[Mesh]
#4 #1 AND #2 AND #3

Table 1 Inclusion and exclusion criteria

Inclusion criteria	Exclusion criteria
• Chinese or English language • Full-text available • Studies that consider the disease burden or quality of life of COPD	• Conference abstracts, case reports, letters, comments, editorials, and review papers • Economic evaluation studies on therapies • Epidemiological studies on pathogenesis or etiology • Intervention studies • Clinical studies • Effect studies • Animal or in vitro studies

Data extraction

A standardized data extraction form was used to obtain data from research studies included in the final review, including article name, journal of publication, authors, institution of study, year of publication, study design, region of study, study duration, data source, sample characteristics (population and age), prevalence, incidence, influencing factors, consultation rate, mortality, disability-adjusted living years (DALY), years of life lost (YLL), years lost due to disability (YLD), QoL, the scale used for QoL assessment, direct medical cost (yuan per capita, per year), direct medical cost (per capita, per year) #% of income per year, direct non-medical cost (yuan per capita, per year), direct non-medical cost (per capita, per year) #% of income per year, indirect cost (yuan per capita, per year), indirect cost (per capita, per year) #% of income per year, total disease cost

Table 2 Quality assessment scale

1. Was the objective clear?
2. Was the data source official?
3. Was the study population-based?
4. Was the sampling randomized?
5. Was the study region nationwide?
6. Were the diagnostic criteria clear?
7. Were the results comparatively analyzed?
8. Did outcome indicators include DALY/YLL/YLD?
9. Can the results be externalized?

Notes: All items have two possible answers except number 9: yes (+) and no (–). Item 9 has three possible responses: yes (++), likely (+), and no (–).
Abbreviations: DALY, disability-adjusted living year; YLL, years of life lost; YLD, years lost due to disability.

(yuan per capita, per year), outpatient expenditure (yuan per capita, per time), hospitalization expenses (yuan per capita, per time), total disease cost of #% total health expenditure, and main reason for cost/influence factors.

Results

Literature search

The process and results of literature screening are shown in Figure 1. Of all the articles assessed by the quality assessment scale, six were recognized as low quality and excluded from the research (Table S1). The number of articles included in the review is 47: 14 in English and 33 in Chinese, with an average quality assessment score of 7.70 out of 10. The years of publication of the included studies range from 2002 to 2015. About half of the papers (24 out of 47) were published in 2011 or later. Of the 47 studies identified in the literature review, 15 are about prevalence, 14 about QoL, nine about DALY/YLL/YLD, and 18 about economic burden (Table 3).

Burden of disease

Prevalence

A total number of 13 studies are engaged in quantitative analysis of prevalence (Table 4). The overall prevalence of COPD in China ranges from 1.20% to 8.87%, with an average of 5.87%. The prevalence rate of COPD is significantly lower in research studies including population aged <35 years, in consistent with the finding that the prevalence rate of COPD rises with the age of certain population segmentation.[44,53] An overall trend is that the prevalence rate of COPD is higher among men (7.76%) in comparison with women (4.07%) and that the disease is more prevalent in rural areas (7.62%) than in urban areas (6.09%).

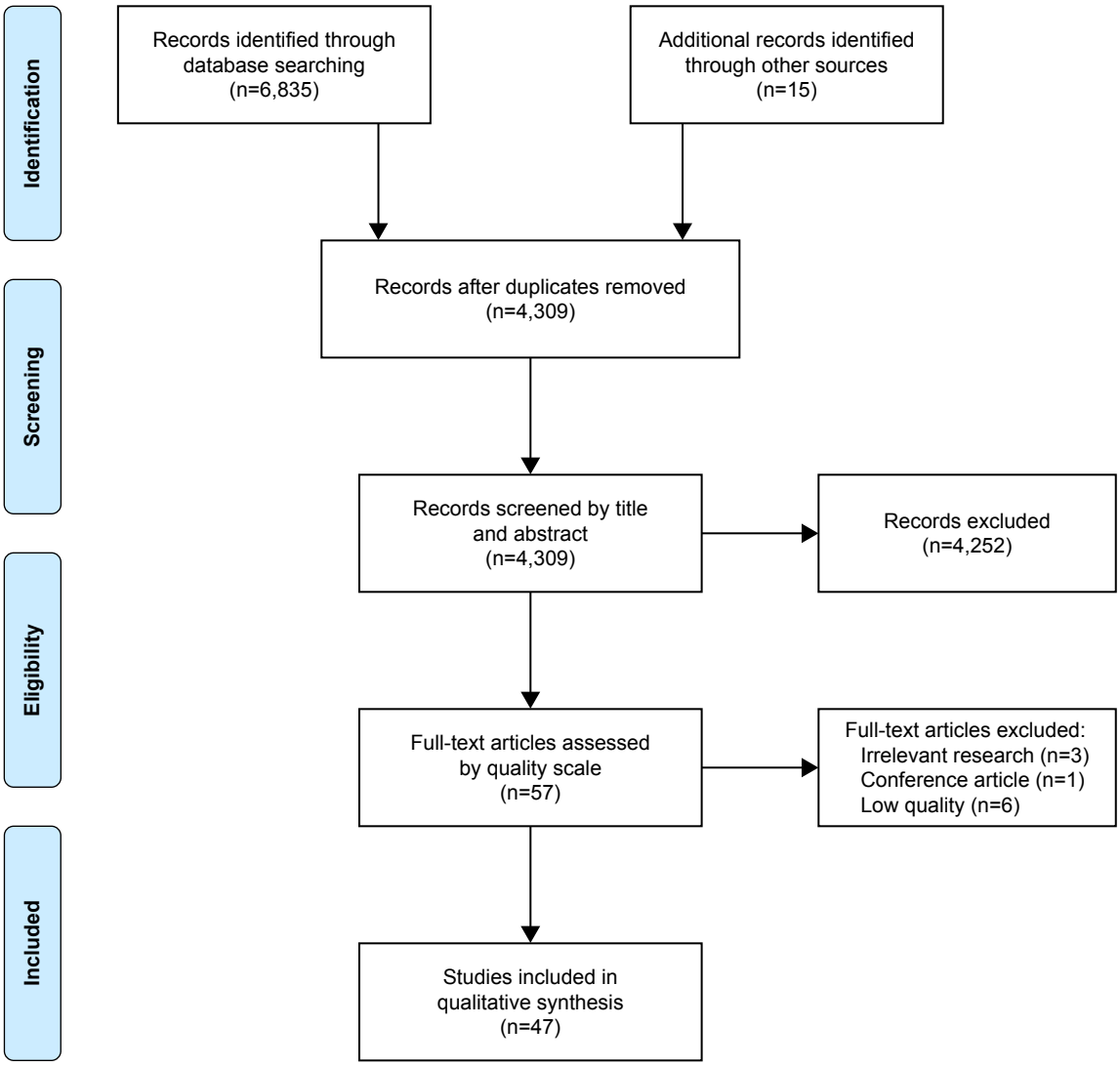


Figure 1 The process and results of literature screening.

Table 3 Characteristics of included studies (n=47)

Study	Publication year	Region of study	Data source	Sample size	Sample age (years)	Indicator of disease burden	Language
Yin et al[10]	2015	China	Official statistics		>15	Prevalence, mortality, DALY, YLL, YLD	Chinese
Han et al[11]	2015	Heilongjiang	Survey	4,478	>40	Prevalence, influencing factors	Chinese
Shi et al[12]	2015	Ningbo, Zhejiang	Institutional data	803	>60	Direct cost	Chinese
Huang[13]	2015	Beijing	Institutional data	1,638	73.4±9.07	Direct cost	Chinese
Chen and Bian[14]	2015	Zhuji, Zhejiang	Survey	82	36–81	QoL	Chinese
Zhu et al[15]	2014	Xinjiang	Survey	2,874	>35	Prevalence, influencing factors	Chinese
Cai et al[16]	2014	Yunnan Province	Survey	17,158	>18	Prevalence, influencing factors, direct & indirect cost	English
Xu et al[17]	2013	Chengdu, Sichuan	Survey	83	54–86	Direct & indirect cost	Chinese
Zhu et al[18]	2013	Jinshan, Shanghai	Institutional data			Mortality, YLL	Chinese
An et al[19]	2013	Beijing	Survey	97		QoL	Chinese
Fang et al[20]	2013	Shanghai	Survey	101	76.15	QoL	Chinese
Jiang[21]	2013	Guangzhou, Guangdong	Survey	278	67.6±8.0	QoL	Chinese
Yang et al[22]	2013	China	GBD2010			Mortality, DALY, YLL, YLD	English
Qiu[23]	2012	Ningxia	Survey	4,626	>40	Prevalence, influencing factors, consultation rate	Chinese
Mao et al[24]	2012	Yunnan (rural)	Survey	9,396	≥18	Prevalence, mortality, DALY, direct & indirect cost	Chinese
Li[25]	2008	Guangzhou, Guangdong	Survey	102	38–83	QoL	Chinese
He et al[26]	2012	Huaian, Jiangsu	Survey	185	≥60	QoL	Chinese
Lou et al[27]	2012	Xuzhou, Jiangsu	Survey	5,900	40–75	Influencing factors, YLL, QoL, direct & indirect cost	English
Lou et al[28]	2012	Xuzhou, Jiangsu	Survey	8,217	36–84	Consultation rate, YLL, direct & indirect cost	English
Xu et al[29]	2011	China	Survey	1,859	>18	Prevalence, direct & indirect cost	Chinese
Liu et al[30]	2011	Meizhou, Guangdong	Survey	134	58–85	QoL	Chinese
Wang et al[31]	2011	China	Official statistics		≥40	Prevalence, mortality	English
Fletcher et al[32]	2011	Brazil, China, Germany, Turkey, UK, US	Survey	2,426	45–67	QoL, direct & indirect cost	English
Yin et al[33]	2011	China	Official statistics	49,363	15–69	Prevalence, influencing factors	English
Guo[34]	2010	Guangzhou, Guangdong	Institutional data	669		Direct & indirect cost	Chinese
Lou et al[35]	2010	Xuzhou, Jiangsu	Survey	383	34–84	YLL, direct & indirect cost	Chinese
Lu and Li[36]	2010	Beijing	Survey	61		QoL	Chinese
Zhou et al[37]	2009	China (rural)	Survey	11,290	≥40	Prevalence, influencing factors, consultation rate, QoL	Chinese
Zhou et al[38]	2009	China	Survey	20,245	≥40	QoL	Chinese
Chen[39]	2009	Shanghai	Institutional data	83	>40	Direct cost	Chinese
An et al[40]	2009	Xuzhou, Jiangsu	Survey	383	62	Direct cost	Chinese
He et al[41]	2009	China	Survey	723	67±10	QoL, direct & indirect cost	Chinese
Zhu and Cai[42]	2009	Beijing	Institutional data	416		Direct cost	Chinese
Hosgood et al[43]	2009	Xuan Wei, Yunnan	Survey	160		Influencing factors	English
Jiang et al[44]	2008	Hubei	Survey	1,883	>40	Prevalence, consultation rate	Chinese
Cai et al[45]	2008	Kunming, Yunnan (Suburban)	Official statistics	335,622	>0	Influencing factors, mortality, YLL	English
Shen et al[46]	2008	Xuan Wei, Yunnan	Survey	178		Influencing factors	English
Zhang[47]	2007	Shandong	Survey			Direct & indirect cost	Chinese
Jiang et al[48]	2007	Hubei	Survey	1,883	>40	Prevalence, influencing factors	Chinese
Zhang et al[49]	2007	Chengdu, Sichuan	Survey	446		Direct cost	Chinese
Zhang et al[50]	2007	Chengdu, Sichuan	Survey	446	38–94	Consultation rate	Chinese
Xu et al[51]	2007	Nanjing	Survey	29,319	≥35	Prevalence, influencing factors	English
Liu et al[52]	2007	Guangdong	Survey	3,286	≥40	Prevalence, influencing factors	English
Zhong et al[53]	2007	China	Survey	20,245	40–99	Prevalence, influencing factors	English
Yang et al[54]	2006	Beijing	Survey	110	68–90	QoL	Chinese
Cai and Chongsuvivatwong[55]	2006	Kunming, Yunnan	Official statistics	894,253	>0	Mortality, YLL	English
Ren et al[56]	2002	Chengdu, Sichuan	Survey	205		Consultation rate, direct cost	Chinese

Abbreviations: DALY, disability-adjusted living years; YLL, years of life lost; YLD, years lost due to disability; QoL, quality of life.

Table 4 Prevalence of COPD in China

Publication year	Study region	Sample size	Age (years)	Prevalence (%)				
				Overall	Female	Male	Urban	Rural
2015	China[10]		>15	3.90				
2015	Heilongjiang[11]	4,478	≥40	7.30	6.50	8.60	6.00	8.80
2014	Xinjiang[15]	2,874	≥35					7.50
2014	Yunnan[16]	17,158	>18	1.20	1.00	1.40		
2012	Ningxia[23]	4,626	≥40	8.87	5.35	13.01	7.97	9.78
2012	Yunnan[24]	9,396	≥18					1.41
2011	China[29]	1,859	≥18				1.92	
2011	China[33]	49,363	15–69	2.20	2.40	3.40	2.50	3.10
2009	China[37]	11,290	≥40					8.80
2007	Hubei[48]	1,883	≥40					9.88
2007	Nanjing[51]	29,319	≥35	5.90				
2007	Guangdong[52]	3,286	>40	9.40				
2007	China[53]	20,245	40–99	8.20	5.10	12.40	7.80	8.80

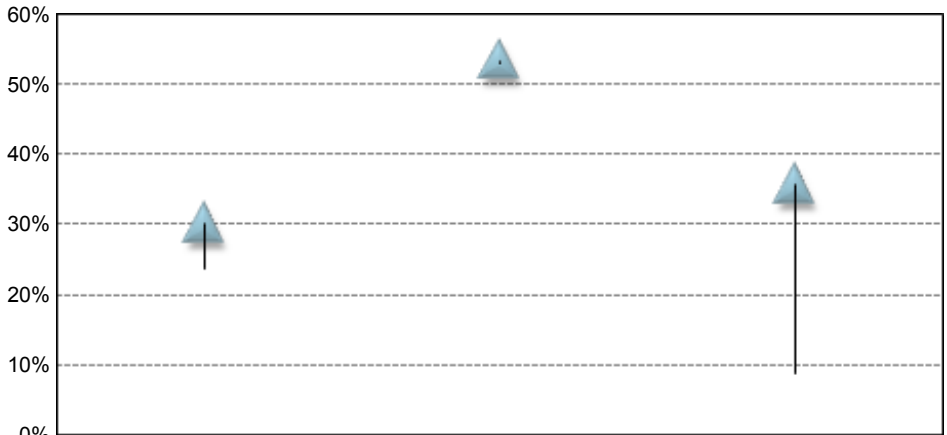
Another research conducted by the World Bank estimated that the number of projected cases of COPD in China would be 25,658,483 in 2010, 42,527,240 in 2020 and 55,174,104 in 2030.[31]

Consultation rate

The diagnostic rate of COPD (number of patients diagnosed with COPD divided by the number of COPD cases found through epidemiology research) in China varies from 23.61% to 30.00%.[23,37,44] The percentage of COPD patients receiving outpatient treatment is around 50%,[50,56] while the admission rate ranges between 8.78% and 35.60%[28,50,56] (Figure 2). A national survey across seven provinces[37] found that the regular medical treatment rate of COPD patients was only 7.9% which calls for the improvement of the prevention and management of COPD. There is still a large amount of unmet needs in health services among COPD patients in China.

Risk factors of COPD

A total of 13 studies analyzed the risk factors of COPD. Figure 3 shows the major factors and the number of studies that define them as risk factors of COPD in China. Tobacco exposure and biomass fuel/solid fuel usage are documented as two important risk factors of COPD, mentioned in



	Diagnostic rate*	Outpatient treatment rate	Admission rate
1	23.61%	53.04%	8.78%
2	28.50%		18.22%
3	30.00%	53.20%	35.60%

Figure 2 Consultation rate of COPD in China.
Note: *Diagnostic rate is defined by the number of patients who have been diagnosed with COPD in the past divided by the number of subjects recognized as COPD cases through epidemiology research.

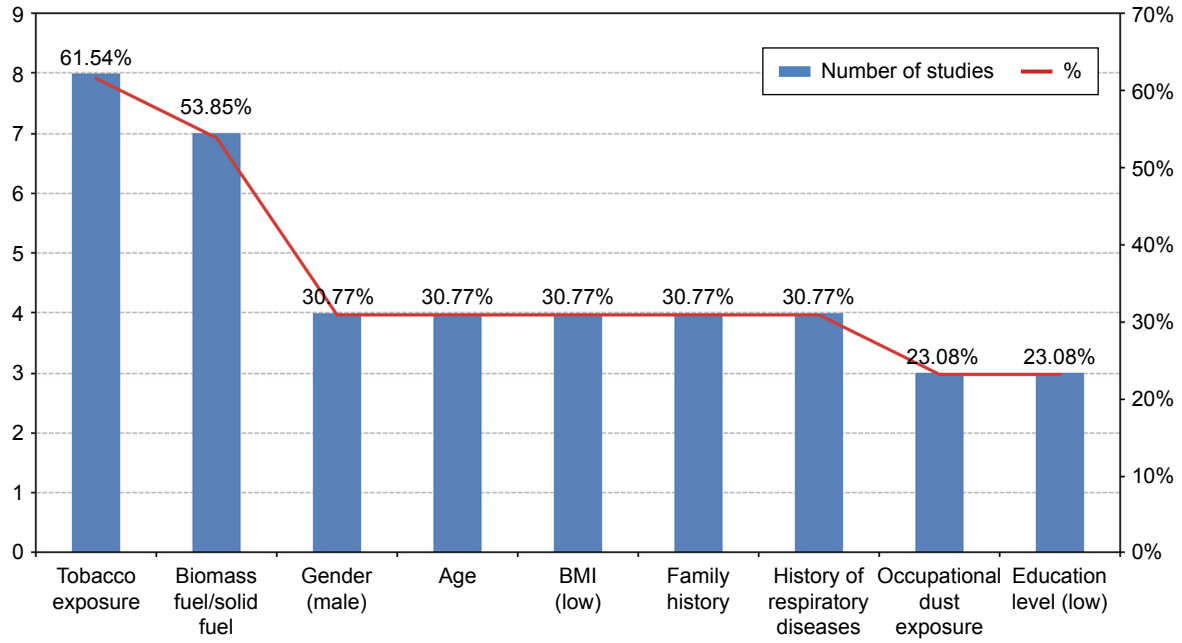


Figure 3 Risk factors of COPD in China.

eight (61.54%) studies[16,23,27,33,37,48,51,53] and seven (53.85%) studies,[11,27,37,45,48,52,53] respectively. Other major risk factors include gender,[11,23,48,53] age,[11,23,48,53] low BMI,[15,23,48,53] family history,[23,27,48,53] history of respiratory disease,[11,23,48,53] occupational dust exposure,[23,27,53] and low education level.[11,33,53]

Other risk factors include cardiovascular disease,[11] lack of exercise and social support,[27] low level of household income,[33] frequency of cooking,[48] having house remodelling in the past 5 years,[48] and poor ventilation in the kitchen,[53] which are not listed in the figure because of their low level of evidence strength; that is, they are mentioned by only one study.

Another case–control study[46] conducted in Xuanwei, a region with high exposure to indoor smoky coal emissions, tested the association between single-nucleotide polymorphisms and COPD risk and concluded that polymorphisms in CSF2, IL8, and PTEN may have an effect on the pathogenesis of COPD.

Mortality

According to the Global Burden of Disease Study 2010,[8] COPD ranked among the top three leading causes of death in China, causing 934,000 deaths (534,000 men and 400,000 women) in 2010.

The age-standardized mortality rate of COPD declined from 235.2/100,000 in 1990 to 90.5/100,000 in 2010.[8] Another regional study reported a similar trend:[18] the age-standardized mortality rate of COPD in Jinshan District, Shanghai (located in eastern China) declined from 219.43/100,000 in 1985 to 45.66/100,000 in 2011, yet the level of premature mortality of COPD in China is still worse than the average outcomes of the member coutries of Group of Twenty (G20).[22]

Another two studies reported the level of COPD mortality in Kunming, Yunnan Province which is located in the southwest of China: the age-standardized mortality rate of COPD in 2003 was the highest in rural areas (184.4/100,000), followed by suburban (129.5/100,000), and then urban areas (51.2/100,000),[55] while the crude mortality rate in rural Kunming was 65.67/100,000 in 2010.[24]

Lin et al[9] suggested that ~65 million people may die from COPD from 2003 to 2033, accounting for 19% of all deaths over this period, unless the smoking rate and solid-fuel usage are controlled.

DALY

Combining premature mortality (YLL) and disability (YLD) together in terms of DALYs provides an overall picture of the disease burden of COPD in China. According to the Global Burden of Disease Study 2010, a total number of 16,723,800 DALYs were caused by COPD, ranking among the top 10.[22] The age-standardized rate of DALY declined from 4,120.1/100,000 in 1990 to 1,575.9/100,000 in 2010.[10] Another regional study reported that the rate of DALY in rural Kunming, Yunnan Province, was 602/100,000 (673/100,000 among men and 526/100,000 among women).[24]

COPD also remained one of the leading causes of YLL,[10] causing 12,946,000 YLL. Age-standardized YLL rates of COPD decreased from 3,756.9/100,000 in 1990 to 1,235.6/100,000 in 2010, ranked 18 in 2010 among the member countries of G20, worse than the average outcome.[22]

Table 5 Total disease cost of COPD in China*

Publication year	Study region	Sample size	Direct cost (per capita per year, USD)	Direct medical cost (per capita per year, USD)	Direct non-medical cost (per capita per year, USD)	Indirect cost (per capita per year, USD)	Total disease cost (per capita per year, USD)
2015	Ningbo[12]	803					685
2013	Chengdu[17]	83	1,930			396	
2012	Rural Yunnan[24]	9,396	884			20	
2011	China[29]	1,859	726			306	1,033
2010	Xuzhou[28]	383		298			
2009	Shanghai[39]	83		1,323			
2009	China[41]	723		3,565	477		
2007	Shandong[47]	150		358	136	783	1,277
2007	Chengdu[49]	446	499				
2002	Chengdu[56]	205		729			
2014	Yunnan[16]	17,158		1,657	109	22	1,787
2011	Shanghai[32]	398		72		77	

Notes: *All Chinese currency in the tables of this section are adjusted to comparable prices to 2013, according to the Residence Consumption Index (http://data.stats.gov.cn/easyquery.htm?cn C01) and converted to USD according to the exchange rate in 2013 (6.1932 RMB=1 USD).

In Kunming, Yunnan Province, COPD was ranked second among the causes of YLL in urban and suburban areas and ranked top in rural areas in 2003.[55]

In Xuzhou, Jiangsu Province, COPD caused 1.76 years of potential life lost per patient among men and 1.18 among women in 2007.[27] In Shanghai Jinshan District, over 27 years, from 1985 to 2011, the standardized rate of years of potential life lost decreased from 1,543/100,000 to 140/100,000.[18]

Cost of illness

Total disease cost

A total of 12 studies analyzed the disease cost (Table 5). The direct cost of COPD ranges from 499 to 1,930 USD per capita per year. The direct medical cost of COPD ranges from 72 to 3,565 USD per capita per year, accounting for 33.33%–118.09% of local average annual income.[28,47] The indirect cost ranges from 20 to 783 USD per capita per year, with the total disease cost being around 700–1,800 USD. The study conducted in Chengdu suggested that the direct cost of COPD accounted for 22.98% of patients' annual income, while indirect cost accounted for 4.72%.[17]

A human capital approach is usually adopted in calculating the indirect cost, while there is disagreement concerning the loss of working time due to COPD. A study in rural Yunnan found that COPD patients were incapable of working for about 150 days each year, while their family members were unable to work for 59 days each year;[28] hence, the lifetime indirect cost of COPD was 3,414 USD per capita when the method of YPLL was applied. Two other research studies brought forth similar conclusions that COPD patients were prevented from work for an average time of 17 days[41] and 15 days per year,[29] indicating high economic impact of COPD caused by loss in productivity.

In terms of lifetime indirect loss due to COPD, a multinational evaluation claimed the average losses in China to be the lowest (678 USD[32]) among five countries. Another research conducted in Guangzhou concluded that the lifetime loss was 7,256 USD per capita.[34]

Only one study reported the intangible cost of COPD: 1,168 USD per capita per year in rural Yunnan.[24]

Outpatient and inpatient expenditure

The results of hospitalization costs of COPD vary largely among different studies. Hospital-based studies usually lead to higher hospitalization expenses, as shown in Table 6. Nonetheless, researchers consistently report that inpatient services account for a larger proportion of total disease

Table 6 Outpatient and hospitalization expenditure of COPD in China

Publication year	Study region	Sample size	Outpatient expenditure (per capita per year) (USD)	Hospitalization expenses (per capita per year) (USD)	Features
2015	Beijing[13]	1,638		4,220	Hospital based
2010	Guangzhou[34]	669		5,611	Hospital based
2009	Beijing[42]	416		20,295	Hospital based
2002	Chengdu[56]	205	202	338	Community based
2014	Rural Yunnan[16]	17,158	74	1,332	Community based

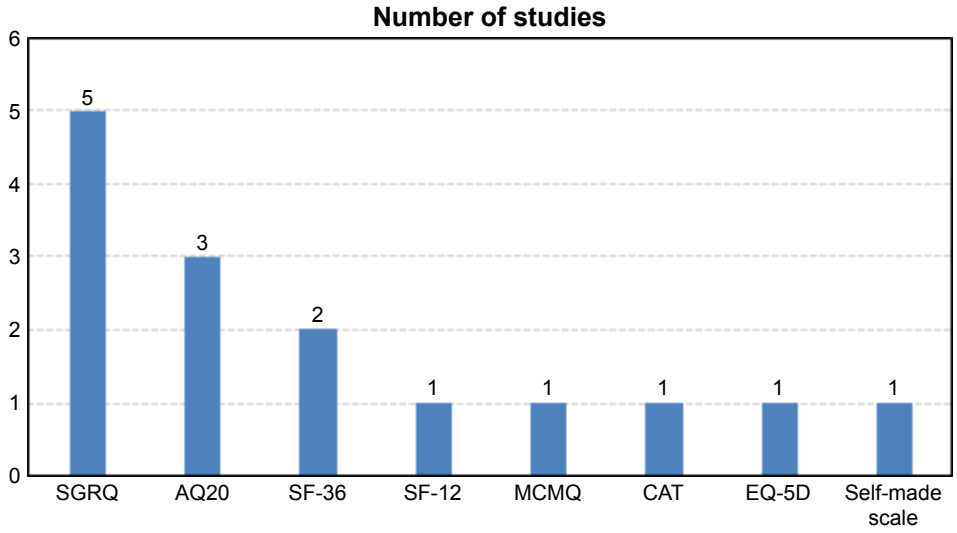


Figure 4 Major scales used for QoL assessment of COPD patients.
Abbreviations: SGRQ, Saint George Respiratory Questionnaire; AQ20, Airways Questionnaire 20; SF-12, 12-item short-form health survey questionnaire; MCMQ, Medical Coping Modes Questionnaire; CAT, COPD Assessment Test; SF-36, 36-item Short Form Survey Instrument; EQ-5D, EuroQol Five-Dimensional Questionnaire.

cost. The research conducted in Ningbo, Zhejiang Province, suggested that costs of inpatient services accounted for 77% of COPD-related medical costs.[12]

Main reason for cost

In terms of the influence factors of cost, the most frequently mentioned factors are number of visits/admissions[13,17,47,49,56] and severity of the disease.[13,39,49,56]

Researchers found that patients with high-income levels usually generate higher medical costs and that those unemployed often bear lower economic burden. In terms of insurance type, patients with free medical services (a type of insurance for public servants where most of their medical expenditures are paid by the state) usually have higher medical costs.[56]

Yet contradictory perspectives on the influence of patient sources on medical costs exist. Some believe that local patients bear higher medical costs because of the relatively higher income level and sound insurance system,[13] while others hold the opposite view that patients from nonlocal areas have undergone heavier economic burden due to the severity of their diseases when they need to go to a major city for treatment.[34]

Other influencing factors include length of stay,[13,34] age,[40,47] status of smoking,[47] whether undertaking surgery,[34] marital state,[34] attitude toward the disease,[49] and physical exercise.[17]

QoL

A total of 13 studies are included in the analysis of scales used for QoL assessment (Figure 4). The most commonly used scales include Saint George Respiratory Questionnaire,[20,21,27,36,41] Airways Questionnaire 20 (AQ20),[14,25,30] 12-item short-form health survey questionnaire,[38] Medical Coping Modes Questionnaire,[25] COPD Assessment Test,[26] EuroQol Five-Dimensional Questionnaire,[32] and their revised versions. One of the studies established a self-made scale to assess the QoL of COPD patients.[54]

An overall conclusion is that the quality assessment scores are lower among COPD patients, and four studies report significant results when compared with non-COPD patients. In two studies applying AQ20, the QoL of 56.1%–61.9% of COPD patients are in the lower and poorer level. Another two studies reported higher likelihood of COPD patients to have depression.[14,26] The status of QoL is worse among COPD patients than in non-COPD patients, and they are at higher risk of having depression.

Conclusion

The prevalence of COPD shows a wide range of variation throughout the nation. An overall trend is that the prevalence rate is higher among men and in rural areas. The diagnostic rate, outpatient treatment rate, and admission rate of COPD are relatively low, indicating considerable under-treatment and unmet medical needs of COPD in China. Tobacco exposure and biomass fuel/solid fuel usage are documented as two important risk factors of COPD. The results of economic burden of COPD vary largely due to differences in study designs and heterogeneity of sample characteristics. While various studies reported different degrees of productivity loss in both COPD patients and their relatives, there is still an urgent need to understand the overall cost of COPD in China through well-designed research on disease burden.

In view of the high smoking rate and considerable concerns related to air pollution and smog in China, as well as the large gap of unmet medical needs, countermeasures need to be taken to improve disease prevention and management to reduce disease burdens raised by COPD.

Acknowledgment

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Disclosure

The authors report no conflicts of interest in this work.

References

1. Rabe KF, Hurd S, Anzueto A, et al. Global Initiative for Chronic Obstructive Lung Disease. Global strategy for the diagnosis, management, and prevention of chronic obstructive pulmonary disease: GOLD executive summary. *Am J Respir Crit Care Med*. 2007;176(6):532–555.
2. Mathers CD, Loncar D. Projections of global mortality and burden of disease from 2002 to 2030. *PLoS Med*. 2006;3(11):e442.
3. Halbert RJ, Natoli JL, Gano A, Badamgarav E, Buist AS, Mannino DM. Global burden of COPD: systematic review and meta-analysis. *Eur Respir J*. 2006;28(3):523–532.
4. Fang X, Wang X, Bai C. COPD in China: the burden and importance of proper management. *Chest*. 2011;139(4):920–929.
5. Rostom A, Dube C, Cranney A, et al. Appendix D. Quality Assessment Forms. Celiac disease. *Evidence Reports/Technology Assessments, No. 104*. Rockville, MD: Agency for Healthcare Research and Quality (US); 2004. Available from: https://www.ncbi.nlm.nih.gov/books/NBK35156/. Accessed April 8, 2018.
6. Stang A. Critical evaluation of the Newcastle-Ottawa scale for the assessment of the quality of nonrandomized studies in meta-analysis. *Eur J Epidemiol*. 2010;25(9):603–605.
7. Drummond MF, Sculpher MJ, Torrance GW, O'Brien BJ, Stoddart GL. *Methods for the Economic Evaluation of Health Care Programmes*. Third edition. Beijing: People's Medical Publishing House; 2008. Chinese.
8. Xu G, Zhang Z, Lv Q, et al. NSFC health research funding and burden of disease in China. *PLoS One*. 2014;9:e111458.
9. Lin HH, Murray M, Cohen T, Colijn C, Ezzati M. Effects of smoking and solid-fuel use on COPD, lung cancer, and tuberculosis in China: a time-based, multiple risk factor, modelling study. *Lancet*. 2008;372(9648):1473–1483.
10. Yin P, Wang LJ, Liu SW, et al. The disease burden of chronic obstructive pulmonary disease among people aged over 15 years in 1990 and 2010 in China. *Zhonghua Yu Fang Yi Xue Za Zhi*. 2015;49(4):334–338. Chinese.
11. Han R, Zou JH, Shen X, et al. The risk factors of chronic obstructive pulmonary disease in Heilongjiang province. *Zhonghua Yu Fang Yi Xue Za Zhi*. 2015;38(2):93–98. Chinese.
12. Shi BJ, Zhang T, Cui J, Wang Y, Li H. Direct economic burden of 803 patients with chronic obstructive pulmonary disease and influencing factors in Ningbo. *Dis Surveill*. 2015;30(4):300–304. Chinese.
13. Huang J. Analysis on direct economic burden of hospitalized patients with COPD and its influencing factors in a three-level hospital in Beijing. *Med Soc*. 2015;28(7):19–22. Chinese.
14. Chen HJ, Bian HY. Analysis on quality of life and its influencing factors in patients with stable chronic obstructive pulmonary disease. *Pract Prev Med*. 2015;22(4):470–471. Chinese.
15. Zhu LL, Fang MQ, Zhu J, et al. Correlation study of body mass index with morbidity rate of chronic obstructive pulmonary disease in parts of Xinjiang. *Clin Med*. 2014;34(8):1–4. Chinese.
16. Cai L, Cui W, He J, Wu X. The economic burden of smoking and secondhand smoke exposure in rural South-West China. *J Asthma*. 2014;51(5):515–521.
17. Xu M, He CP, Luo Y, et al. Economic burden and influence factors of chronic obstructive pulmonary disease patients in Chenghua District. *J Prev Med Inf*. 2013;29(10):889–892. Chinese.
18. Zhu XY, Gao X, Qiao GL. Mortality and the trend of YPLL of COPD in Jinshan District of Shanghai City from 1985–2011. *Occup Health*. 2013;29(11):1292–1294. Chinese.
19. An XJ, Nie QR, Deng GF. The correlational study of severity and life quality of stable phase chronic obstructive pulmonary disease patients. *Chin J Soc Med*. 2013;30(5):339–341. Chinese.
20. Fang Y, Zhang M, Wang L. Analysis on quality of life of patients with chronic obstructive pulmonary disease and its influencing factors. *Chin Nurs Res*. 2013;27(23):2450–2452. Chinese.
21. Jiang M. Application of COPD-specific version of the St George's Respiratory Questionnaire in evaluating quality of life among COPD patients in Guangzhou. *Chin J Health Stat*. 2013;30(6):808–811. Chinese.
22. Yang G, Wang Y, Zeng Y, et al. Rapid health transition in China, 1990–2010: findings from the Global Burden of Disease study 2010. *Lancet*. 2013;381(9882):1987–2015.
23. Qiu J. Prevalence of chronic obstructive pulmonary disease in Ningxia Province of China. Ningxia Medical University; 2012. Chinese. Available from: http://www.wanfangdata.com.cn/details/detail.do?_type=degree&id=D225251. Accessed April 8, 2018.
24. Mao HY, Cai L, Shu ZK, et al. Analysis of prevalence and economic burden of chronic obstructive pulmonary disease in rural residents of Yunnan Province. *Chin J Prev Control Chronic Noncommun Dis*. 2012;20(3):244–246. Chinese.
25. Li RH. Quality of life and coping style in patients with chronic obstructive pulmonary disease. Zhongshan University; 2008:71–74. Chinese. Available from: http://www.wanfangdata.com.cn/details/detail.do?_type=degree&id=D124487. Accessed April 8, 2018.
26. He YQ, Xu CQ, Zheng YL, et al. Quality of life and its related factors in patients of stable chronic obstructive pulmonary disease. *Chin J Gen Pract*. 2012;11(11):860–862. Chinese.
27. Lou P, Zhu Y, Chen P, et al. Vulnerability of patients with chronic obstructive pulmonary disease according to gender in China. *Int J Chron Obstruct Pulmon Dis*. 2012;7:825–832.
28. Lou P, Zhu Y, Chen P, et al. Vulnerability, beliefs, treatments and economic burden of chronic obstructive pulmonary disease in rural areas in China: a cross-sectional study. *BMC Public Health*. 2012;12:287.
29. Xu DB, Li HC, Ma AX. Study on the costs of chronic obstructive pulmonary disease. *Chin J Pharm Econ*. 2011;6(1):18–26. Chinese.
30. Liu YW, Cai DX, Zhong W, et al. Evaluation and analysis on quality of life and influencing factors of patients with chronic obstructive pulmonary disease. *Chin Med Herald*. 2011;8(10):146–147. Chinese.
31. Wang S, Marquez P, Langenbrunner J, et al. Toward a healthy and harmonious life in China: stemming the rising tide of non-communicable diseases. Washington, DC: World Bank. 2011:1–48.
32. Fletcher MJ, Upton J, Taylor-Fishwick J, et al. COPD uncovered: an international survey on the impact of chronic obstructive pulmonary disease [COPD] on a working age population. *BMC Public Health*. 2011;11:612.
33. Yin P, Zhang M, Li Y, et al. Prevalence of COPD and its association with socioeconomic status in China: findings from China Chronic Disease Risk Factor Surveillance 2007. *BMC Public Health*. 2011;11:586.
34. Guo ZQ. A study on economic burden for hospitalized patients with COPD. Guangzhou Medical College; 2010. Chinese. Available from: http://www.wanfangdata.com.cn/details/detail.do?_type=degree&id=D124487. Accessed April 8, 2018.
35. Lou PA, Yu JX, Zhang L, et al. Analysis on economic burden of COPD patients in Tongshan County. *Chin J Dis Control Prev*. 2010;14(11):1129–1131. Chinese.
36. Lu DM, Li L. Survey of the quality of life and social supports of patients with chronic obstructive pulmonary disease in community. *J Nurs Adm*. 2010;10(12):850–851. Chinese.

37. Zhou YM, Wang C, Yao WZ, et al. Current status of prevention and management of chronic obstructive pulmonary disease in rural area in China. *Chin J Intern Med*. 2009;48(5):358–361. Chinese.
38. Zhou YM, Wang C, Yao WZ, et al. The quality of life of patients with chronic obstructive pulmonary disease and correlated factors. *Zhonghua Jie He He Hu Xi Za Zhi*. 2009;32(4):248–252. Chinese.
39. Chen SJ. The economic burden of chronic obstructive pulmonary disease (COPD) in Shanghai and the feasibility of 3D reconstruction using low-dose CT scan in diagnosis and classification of COPD. Fudan University; 2009. Chinese. Available from: http://www.wanfangdata.com.cn/details/detail.do?_type=degree&id=Y1967586. Accessed April 8, 2018.
40. An XH, Lou PA, Yu JX, et al. Research on direct economic burden of chronic obstructive pulmonary disease in community of Xuzhou City. *Chin J School Doctor*. 2009;23:505. Chinese.
41. He QY, Zhou X, Xie CM, et al. Impact of chronic obstructive pulmonary disease on quality of life and economic burden in Chinese urban areas. *Zhonghua Jie He He Hu Xi Za Zhi*. 2009;32(4):253–257. Chinese.
42. Zhu ML, Cai BQ. Costs of the last hospitalization for patients with acute exacerbation of chronic obstructive pulmonary disease and patients with lung cancer. *Zhonghua Jie He He Hu Xi Za Zhi*. 2009;32(4):258–261. Chinese.
43. Hosgood HR, Menashe I, He X, et al. PTEN identified as important risk factor of chronic obstructive pulmonary disease. *Respir Med*. 2009;103(12):1866–1870.
44. Jiang RG, Luo DS, Huang CP, et al. Analysis on status of chronic obstructive pulmonary disease in rural population. *Mod Prev Med*. 2008;35(3):561–562, 565. Chinese.
45. Cai L, Chongsuvivatwong V, Geater A. Changing pattern of premature mortality burden over 6 years of rapid growth of the economy in suburban south-west China: 1998–2003. *Public Health*. 2008;122(5):478–486.
46. Shen M, Vermeulen R, Chapman RS, et al. A report of cytokine polymorphisms and COPD risk in Xuan Wei, China. *Int J Hyg Environ Health*. 2008;211(3–4):352–356.
47. Zhang CY. The study of the economic burden on Chinese rural COPD patients. Shandong University; 2007. Chinese. Available from: http://www.wanfangdata.com.cn/details/detail.do?_type=degree&id=Y1066432. Accessed April 8, 2018.
48. Jiang RG, Luo DS, Huang CP, et al. Study on the prevalence rate and risk factors of chronic obstructive pulmonary disease in rural community population in Hubei province. *Chin J Epidemiol*. 2007;28(10):976–979. Chinese.
49. Zhang B, Zhang Y, Yang JY, et al. Analysis on direct economic burden of community COPD patients and its influence factors in Chengdu. *J Hyg Res*. 2007;36(6):706–710. Chinese.
50. Zhang B, Zhang Y, Liu HC, et al. Factors influencing the use of health care services from patients with COPD in Chengdu. *J Sichuan Univ*. 2007;38(2):316–320. Chinese.
51. Xu F, Yin X, Shen H, et al. Better understanding the influence of cigarette smoking and indoor air pollution on chronic obstructive pulmonary disease: a case-control study in Mainland China. *Respirology*. 2007;12(6):891–897.
52. Liu S, Zhou Y, Wang X, et al. Biomass fuels are the probable risk factor for chronic obstructive pulmonary disease in rural South China. *Thorax*. 2007;62(10):889–897.
53. Zhong N, Wang C, Yao W, et al. Prevalence of chronic obstructive pulmonary disease in China: a large, population-based survey. *Am J Respir Crit Care Med*. 2007;176(8):753–760.
54. Yang J, Hou HR, Gao Y. Investigation and analysis on the quality of life and influence factors in patients with COPD. *J Nurs Adm*. 2006;6(3):1–2. Chinese.
55. Cai L, Chongsuvivatwong V. Rural-urban differentials of premature mortality burden in south-west China. *Int J Equity Health*. 2006;5:13.
56. Ren JP, Li H, Mao ZZ, et al. The economic burden of the COPD and its factor analysis. *Health Econ Res*. 2002;9(10):16–17. Chinese.

Supplementary material

Table S1 Quality assessment results of included studies

No	Article title	Quality scale
1	Changing pattern of premature mortality burden over 6 years of rapid growth of the economy in suburban south-west China: 1998–2003	B
2	Rural-urban differentials of premature mortality burden in south-west China	B
3	Rapid health transition in China, 1990–2010: findings from the Global Burden of Disease study 2010	A
4	NSFC health research funding and burden of disease in China	B
5	Toward a healthy and harmonious life in China: stemming the rising tide of non-communicable diseases	B
6	Vulnerability of patients with chronic obstructive pulmonary disease according to gender in China	B
7	Vulnerability, beliefs, treatments and economic burden of chronic obstructive pulmonary disease in rural areas in China: a cross-sectional study	B
8	The economic burden of smoking and secondhand smoke exposure in rural South-West China	B
9	COPD uncovered: an international survey on the impact of chronic obstructive pulmonary disease [COPD] on a working age population	B
10	Better understanding the influence of cigarette smoking and indoor air pollution on chronic obstructive pulmonary disease: a case-control study in Mainland China	A
11	Biomass fuels are the probable risk factor for chronic obstructive pulmonary disease in rural South China	A
12	A report of cytokine polymorphisms and COPD risk in Xuan Wei, China	B
13	PTEN identified as important risk factor of chronic obstructive pulmonary disease	B
14	Effects of smoking and solid-fuel use on COPD, lung cancer, and tuberculosis in China: a time-based, multiple risk factor, modelling study	A
15	Prevalence of chronic obstructive pulmonary disease in Ningxia Province of China (in Chinese)	B
16	The economic burden of chronic obstructive pulmonary disease (COPD) in Shanghai and the feasibility of 3D reconstruction using low-dose CT scan in diagnosis and classification of COPD (in Chinese)	B
17	The study of the economic burden on Chinese rural COPD patients (in Chinese)	B
18	A study on economic burden for hospitalized patients with COPD (in Chinese)	B
19	The risk factors of chronic obstructive pulmonary disease in Heilongjiang province (in Chinese)	B
20	Study on the prevalence rate and risk factors of chronic obstructive pulmonary disease in rural community population in Hubei province (in Chinese)	B
21	Correlation study of body mass index with morbidity rate of chronic obstructive pulmonary disease in parts of Xinjiang (in Chinese)	B
22	Analysis on status of chronic obstructive pulmonary disease in rural population (in Chinese)	B
23	Analysis on economic burden of COPD patients in Tongshan County (in Chinese)	B
24	Direct economic burden of 803 patients with chronic obstructive pulmonary disease and influencing factors in Ningbo (in Chinese)	B
25	The disease burden of chronic obstructive pulmonary disease among people aged over 15 years in 1990 and 2010 in China (in Chinese)	A
26	Analysis on direct economic burden of hospitalized patients with COPD and its influencing factors in a three-level hospital in Beijing (in Chinese)	B
27	Analysis on direct economic burden of community COPD patients and its influence factors in Chengdu (in Chinese)	B
28	Research on direct economic burden of chronic obstructive pulmonary disease in community of Xuzhou City (in Chinese)	B
29	Current status of prevention and management of chronic obstructive pulmonary disease in rural area in China (in Chinese)	A
30	Impact of chronic obstructive pulmonary disease on quality of life and economic burden in Chinese urban areas (in Chinese)	B
31	Costs of the last hospitalization for patients with acute exacerbation of chronic obstructive pulmonary disease and patients with lung cancer (in Chinese)	B
32	The economic burden of the COPD and its factor analysis (in Chinese)	B
33	Analysis of prevalence and economic burden of chronic obstructive pulmonary disease in rural residents of Yunnan Province (in Chinese)	B
34	Economic burden and influence factors of chronic obstructive pulmonary disease patients in Chenghua District (in Chinese)	B
35	Mortality and the trend of YPLL of COPD in Jinshan District of Shanghai City from 1985–2011 (in Chinese)	B
36	Factors influencing the use of health care services from patients with COPD in Chengdu (in Chinese)	B
37	Study on the costs of chronic obstructive pulmonary disease (in Chinese)	B
38	The correlational study of severity and QoL of stable phase chronic obstructive pulmonary disease patients (in Chinese)	B
39	Analysis on quality of life and its influencing factors in patients with stable chronic obstructive pulmonary disease (in Chinese)	B
40	Analysis on quality of life of patients with chronic obstructive pulmonary disease and its influencing factors (in Chinese)	B

(*Continued*)

Table S1 (*Continued*)

No	Article title	Quality scale
41	Investigation and analysis on the quality of life and influence factors in patients with COPD (in Chinese)	B
42	Quality of life and coping style in patients with chronic obstructive pulmonary disease (in Chinese)	B
43	Evaluation and analysis on quality of life and influencing factors of patients with chronic obstructive pulmonary disease (in Chinese)	B
44	Quality of life and its related factors in patients of stable chronic obstructive pulmonary disease (in Chinese)	B
45	Survey of the quality of life and social supports of patients with chronic obstructive pulmonary disease in community (in Chinese)	B
46	Application of COPD-specific version of the St George's Respiratory Questionnaire in evaluating quality of life among COPD patients in Guangzhou (in Chinese)	B
47	The quality of life of patients with chronic obstructive pulmonary disease and correlated factors (in Chinese)	A