

Association between chronic obstructive pulmonary disease and activity of daily living among oldest-old in China: based on Chinese Longitudinal Health Longevity Survey

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Aims: This study was designed to investigate the association between COPD and activity of daily living among oldest-old in People's Republic of China.

Patients and methods: The data of Chinese Longitudinal and Health Longevity Study in 2014 was used, and those who were aged more than 80 years old were included. Both basic activity of daily living (BADL) and instrumental activity of daily living (IADL) were measured.

Results: A total of 4621 oldest-old (≥ 80 years old) were included. 32.1% (1482) of the oldest-old had BADL disability and 79.0% (3129) had IADL disability. The BADL disability and IADL disability rates were higher for participants with COPD than those without, and this difference was more robust among male (31.8% vs 25.6%, $p=0.018$). The IADL disability rate showed similar trends. Multivariate logistic regression analysis showed that the odds ratios of COPD on BADL disability and IADL disability were 1.261 (95% CI: 1.044–1.525) and 2.014 (95% CI: 1.561–2.598), respectively. The odds ratios of COPD on moderate to severe BADL disability and IADL disability were 1.007 (95% CI: 0.790–1.284) and 1.713 (95% CI: 1.397–2.100), respectively.

Conclusion: There were independent associations between COPD and disability among oldest-old in People's Republic of China, and the associations were greater among male population. Besides, COPD had a profound influence on the mild disability of BADL, while had a greater impact on the moderate and severe disability of IADL.

Keywords: chronic obstructive pulmonary disease, activity of daily living, oldest-old

Background

COPD is one of the most important public health problems in People's Republic of China. Data show that the prevalence of COPD among middle-aged and elderly people in People's Republic of China is 8.6%.^{1,2} Moreover, people in our country have insufficient knowledge of COPD, with seriously low awareness rate and treatment rate.³ The disease burden caused by COPD shows an increasing trend in those years.^{4,5}

COPD not only affects the respiratory system, but also leads to a series of serious physical and mental problems. The activity of daily living (ADL) of COPD patients has been greatly affected. Nonetheless, up to now, there were few studies on this aspect, and most of them focused on hospitalized population or middle-aged

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people. There was only a few studies on the oldest-old aged 80 years and over, which was different from the younger elderly. In addition, previous studies about ADL disability mainly focused on basic activity of daily living (BADL), there were little data on instrumental activity of daily living (IADL) of the oldest-old, which can affect the life quality directly.^{6,7} On the other hand, with the acceleration of People's Republic of China's aging process, the number of oldest-old is increasing, and the consumption of health resources and social burden of this group far exceeds those of adults and elderly aged <80 years old.⁸ Therefore, it is urgent to carry out research about the association between COPD and ADL status among oldest-old. In this study, we analyzed the correlation between COPD prevalence and ADL disability (both BADL) in more than 4000 oldest-old in People's Republic of China by using the national survey data consisted of a large sample of community-based oldest-old which were from more than half of provinces in People's Republic of China, so as to provide basic data and also scientific evidence for targeted prevention and treatment of COPD.

Methods

Study population

All the data in this study are from Chinese Longitudinal and Health Longevity Study in 2014. The sampling framework and research methods are shown in previous studies.⁹ In this study, the oldest-old who were aged 80 years and over were included in the analysis. Those individuals with incomplete COPD or ADL information were deleted. Finally, 4621 oldest-old were included in the analysis.

Assessments

The BADL status was assessed by Katz scale according to the score of six items. Any item that answers "independence" was scored 1 point. Any item that answers "dependence" was scored 0 point. According to the number of items of independence, BADL disability can be divided into four categories: complete normal (0 items of dependence), mild disability (1–2 items of dependence), moderate disability (3–4 items of dependence), and severe disability (5–6 items of dependence).¹⁰ The IADL status was assessed by Lawton scale according to the score of eight items. Any item that answers "independence" was scored 1 point. According to the number of items of IADL disability, IADL disability can be divided into four categories: complete normal (0 items of dependence), mild

disability (1–2 items of dependence), moderate disability (3–5 items of dependence), and severe disability (6–8 items of dependence).¹¹ BADL moderate to severe disability were identified as those who were classified as either BADL moderate disability or BADL severe disability. IADL moderate to severe disability were identified as those who were classified as either IADL moderate disability or IADL severe disability. The prevalence of COPD is categorized according to the question "Have you ever been diagnosed as COPD before by doctors" in the questionnaire, and the answer "Yes" was defined as having COPD before, and the answer "No" or "unknown" as defined as not having "COPD" before.

Statistical analysis

N(%) was used for categorical variables and mean±SD was used for continuous variables. Chi-square test and Kruskal–Wallis test were used to compare categorical variables. Logistic regression was used to analyze the correlation between COPD prevalence and ADL. BADL disability, IADL disability, BADL moderate to severe disability, IADL moderate to severe disability were used as dependent variables separately. SPSS 23.0 was used for the analysis. $P<0.05$ was considered as statistically significant.

Results

A total of 4621 oldest-old were enrolled, with an average age of 91.29±7.77 years old, and 41.5% were males (n=1916). It can be seen that the prevalence of COPD was higher among those who were male, 80–89 years old, urban, higher education, current/past smoking, present/past drinking, and poor self-rated health. Those who were BADL disability or IADL disability had a higher COPD prevalence (Table 1).

Prevalence of ADL disability according to COPD status

A total of 32.1% (n=1482) of the oldest-old had BADL disability. Among them, those with COPD had a relatively higher prevalence of BADL disability rate than that without COPD (35.6% vs 31.5%, $p=0.038$). The difference was more robust among male than female (male: 31.8% vs 25.6%, $p=0.018$; female: 39.7% vs 35.4%, $p=0.128$). A total of 79.0% (n=3129) of the oldest-old had IADL disability. Among them, those with COPD had a relatively higher prevalence of IADL disability rate than that without COPD (86.5% vs 79.0%, $p<0.001$). The difference was more robust among male than female (male: 87.1% vs 68.0%, $p<0.001$;

Table 1 General characteristics of participants

Characteristics		N	COPD prevalence n (%)	χ^2	p
Gender	Male	1916	349 (18.2)	40.838	<0.001
	Female	2705	312 (11.5)		
Age group (years)	80–89	2159	352 (16.3)	21.771	<0.001
	90–99	1608	226 (14.1)		
	≥100	854	83 (9.7)		
Residence	Urban	2059	329 (16.0)	8.494	0.004
	Rural	2562	332 (13.0)		
Ethnic	Han	4294	625 (14.6)	3.117	0.077
	Minorities	327	36 (11.0)		
Education level	Illiterate	3129	383 (12.2)	34.147	<0.001
	Primary school	1182	224 (19.0)		
	Secondary school and above	310	54 (17.4)		
Marriage	Married	1187	217 (18.3)	20.906	<0.001
	Widow	3347	431 (12.9)		
	Divorce/unmarried	87	13 (14.9)		
Smoking	Current/past	1213	237 (19.5)	36.758	<0.001
	Never	3408	424 (12.4)		
Alcohol drinking	Current/past	1033	174 (16.8)	7.001	0.008
	Never	3588	487 (13.6)		
Physical exercise≥0.5 h/day	Yes	994	156 (15.7)	1.996	0.158
	No	3627	505 (13.9)		
Self-rated good health	Yes	1809	176 (9.7)	50.762	<0.001
	No	2812	485 (17.2)		
BADL disability	Yes	1482	235 (15.9)	4.291	0.038
	No	3139	426 (13.6)		
IADL disability	Yes	3664	572 (15.6)	4.275	0.039
	No	957	126 (13.2)		

Abbreviations: BADL, activity of daily living; IADL, instrumental activity of daily living.

female: 85.9% vs 86.2%, $p=0.851$). A total of 79.0% (3129) of the oldest-old had IADL disability.

According to the severity of disability status, ADL disability and IADL disability can be divided into four categories (complete normal, mild disability, moderate disability, and severe disability). It can be seen along with the distribution of COPD was unbalanced along with the severity of ADL disability ($p<0.05$) (Table 2).

Association of both ADL disability and IADL disability with COPD status

Multivariate logistic regression was used to explore the correlation between COPD prevalence and disability. As can be seen from Table 3, the ORs of COPD on BADL

disability and IADL disability were 1.261 (95% CI: 1.044–1.525) and 2.014 (95% CI: 1.561–2.598), respectively after adjusting related variables. When using moderate to severe disability as dependent variable, it can be seen that there is little influence of COPD on moderate to severe BADL disability (OR: 1.007, 95% CI: 0.790–1.284), while there was a greater impact on moderate to severe IADL disability (OR: 1.713, 95% CI: 1.397–2.100). Compared with different genders, the association was weak among female. The corresponding ORs of BADL disability and IADL disability were 1.047 (95% CI: 0.759–1.446) and 1.301 (95% CI: 0.960–1.703), respectively. On the other hand, the association between COPD and ADL disability among male was more robust, the corresponding ORs of

Table 2 Distribution of COPD and ADL disability among participants

	Male		<i>p</i>	Female		<i>p</i>	Total		<i>p</i>
	With COPD	Without COPD		With COPD	Without COPD		With COPD	Without COPD	
BADL disability (dichotomy)			0.018			0.128			0.038
No	238 (68.2)	1166 (74.4)		188 (60.3)	1547 (64.6)		426 (64.4)	2713 (68.5)	
Yes	111 (31.8)	401 (25.6)		124 (39.7)	846 (35.4)		235 (35.6)	1247 (31.5)	
BADL disability (four categories)			0.017			0.252			0.039
Complete normal	238 (68.2)	1166 (74.4)		188 (60.3)	1547 (64.6)		426 (64.4)	2713 (68.5)	
Mild disability	66 (18.9)	209 (13.3)		62 (19.9)	385 (16.1)		128 (19.4)	594 (15.0)	
Moderate disability	14 (4.0)	84 (5.4)		28 (9.0)	181 (7.6)		42 (6.4)	265 (6.7)	
Severe disability	31 (8.9)	108 (6.9)		34 (10.9)	280 (11.7)		65 (9.8)	388 (9.8)	
IADL disability (dichotomy)			<0.001			0.851			<0.001
No	45 (12.9)	501 (32.0)		44 (14.1)	330 (13.8)		89 (13.5)	831 (21.0)	
Yes	304 (87.1)	1066 (68.0)		268 (85.9)	2063 (86.2)		572 (86.5)	3129 (79.0)	
IADL disability (four categories)			<0.001			0.189			<0.001
Complete normal	45 (12.9)	501 (32.0)		44 (14.1)	330 (13.8)		89 (13.5)	831 (21.0)	
Mild disability	71 (20.3)	280 (17.9)		30 (9.6)	327 (13.7)		101 (15.3)	607 (15.3)	
Moderate disability	84 (24.1)	289 (18.4)		82 (26.3)	549 (22.9)		168 (25.1)	838 (21.2)	
Severe disability	149 (42.7)	497 (31.7)		156 (50.0)	1187 (49.6)		305 (46.1)	1684 (42.5)	

Abbreviations: ADL, activity of daily living; BADL, activity of daily living; IADL, instrumental activity of daily living.

BADL disability and IADL disability were and IADL disability in male oldest-old with COPD were 1.283 (95% CI: 1.027–1.566) and 3.417 (95% CI: 2.412–4.841), respectively. Sensitivity analysis based on participants without cardiovascular disease or osteoarthritis showed similar results (Table S1).

Discussion

This study showed that COPD status was inversely and independently related with disability, based on the large sample from 23 provinces in People's Republic of China. And the associations were greater among male population. Besides, COPD had a great influence on the mild disability of BADL, while had a greater impact on the moderate and severe disability of IADL.

The main symptoms of COPD patients included cough, dyspnea, dyspnea, fatigue, functional activity limitation, then leading to disability. According to Belgium's 2008 National Health Survey, COPD is one of the main causes of moderate to severe disability.^{12,13} Finnish research also showed that COPD was the second cause of disability.¹⁴ Data analysis based on China Health and Retirement

Longitudinal Study showed that rural elderly with COPD were 1.3 times more likely to be disabled than those without COPD.¹⁵ The ADL score of the elderly with COPD was lower than that of the uninfected.¹⁶ The results of this study also showed that COPD had an independent effect on both BADL disability and IADL disability in the oldest-old. It also suggests that in addition to focusing on the diseases of oldest-old, we need to pay attention to the accompanying disability problems.

The results of this study showed that COPD had a great influence on the mild disability of BADL, while had a greater impact on the moderate and severe disability of IADL. Most previous studies only discussed the effect of COPD on BADL disability, but did not analyze the other one-IADL disability.^{17,18} Part of the research evidence indicated that the impacts of COPD on disability are mainly due to dyspnea, the limitation was mainly in the comparatively laborious ability.^{19,20} Therefore, the impacts of COPD status on BADL's basic daily activities such as eating and dressing were relatively small. On the other hand, IADL's evaluation items included long-term and complex activities such as transportation, shopping, cooking, etc., which had certain

Table 3 Logistic regression of COPD with ADL disability

	BADL			IADL		
	OR	95% CI	p	OR	95% CI	p
Male						
Disability						
Model 1	1.356	1.054–1.745	0.018	3.175	2.281–4.419	<0.001
Model 2	1.447	1.111–1.884	0.006	3.749	2.667–5.268	<0.001
Model 3	1.283	1.027–1.566	0.037	3.417	2.412–4.841	<0.001
Moderate to severe disability						
Model 1	1.060	0.749–1.501	0.742	1.996	1.564–2.547	<0.001
Model 2	1.110	0.779–1.583	0.563	2.331	1.802–3.014	<0.001
Model 3	0.945	0.653–1.368	0.765	2.120	1.621–2.773	<0.001
Female						
Disability						
Model 1	1.206	0.947–1.536	0.129	0.974	0.694–1.368	0.881
Model 2	1.331	0.977–1.625	0.131	0.975	0.790–1.404	0.613
Model 3	1.231	0.946–1.203	0.123	0.922	0.640–1.327	0.662
Moderate to severe disability						
Model 1	1.039	0.773–1.397	0.798	1.217	0.924–1.604	0.163
Model 2	1.156	0.847–1.577	0.362	1.474	1.098–1.979	0.010
Model 3	1.047	0.759–1.446	0.779	1.301	0.960–1.703	0.090
Total						
Disability						
Model 1	1.200	1.010–1.427	0.038	1.707	1.346–2.161	<0.001
Model 2	1.384	1.150–1.666	0.001	1.990	1.542–2.567	<0.001
Model 3	1.261	1.044–1.525	0.016	2.014	1.561–2.598	<0.001
Moderate to severe disability						
Model 1	0.978	0.782–1.223	0.846	1.413	1.180–1.693	<0.001
Model 2	1.131	0.895–1.429	0.303	1.920	1.578–2.336	<0.001
Model 3	1.007	0.790–1.284	0.956	1.713	1.397–2.100	<0.001

Notes: Model 1: adjusted by age; Model 2: adjusted ethic, residence, marriage, education, besides those adjusted in Model 1; Model 3: adjusted smoking, alcohol drinking, physical exercise, self-rated good health, besides those adjusted in Model 2.

Abbreviations: ADL, activity of daily living; BADL, activity of daily living; IADL, instrumental activity of daily living.

requirements for physical fitness.^{21,22} Besides, these activities required certain cognitive function, while there were clear evidence showed that COPD patients had lower cognitive ability due to long-term dyspnea.^{23,24}

This study has several advantages. Chinese Longitudinal Healthy Longevity Survey (CLHLS) is a representative study with large sample size selected from the whole country. In addition, this study provided data based on the oldest-old, which made up for the gap in previous studies that focus mainly on adults or younger elderly. Third, unlike most previous studies, this study not only provided data on BADL disability, but also data on IADL disability. This would give a more comprehensive description of ability assessment among the oldest-old. Also, there were several shortcomings as follows. First,

the ADL scale used were Katz and Lawton scale, which were inconsistent with some of the previous studies (mainly used Barther index), and may have certain influence on the comparisons among different results. Second, the prevalence of COPD was based on the self-reporting from the questionnaires, there may be recall bias. And some of the potential patients may not be diagnosed because of any economic or other reasons. This would cause an underestimate of COPD status, and then underestimate the ORs. Third, there was lack of data about the detailed stage or duration of COPD since data about pulmonary function test was not available in the CLHLS. Fourth, the data analyzed were based on a cross-sectional survey, and had limitation in causal inference since the time sequence was unclear.

Conclusion

In summary, the results of this study showed that COPD status was closely related to disability especially IADL disability among oldest-old, and this association was more robust among male population. Besides, COPD status had impact on the mild disability of BADL, while a greater impact on the moderate to severe IADL disability.

Availability of data and materials

All data used in this study were available upon request.

Abbreviations

ADL, activity of daily living; BADL, basic activity of daily living; BMI, body mass index; CLHLS, Chinese Longitudinal Healthy Longevity Survey; DBP, diastolic blood pressure; IADL, instrumental activity of daily living.

Ethics approval

The study was approved by the Biomedical Ethics Committee of Peking University.

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Author contributions

All authors contributed to data analysis, drafting and revising the article, gave final approval of the version to be published, and agree to be accountable for all aspects of the work.

Disclosure

The authors report no conflicts of interest in this work.

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Supplementary material

Table S1 Logistic regression of COPD with ADL disability among those without cardiovascular diseases or osteoarthritis

	BADL			IADL		
	OR	95% CI	p	OR	95% CI	p
Those without heart disease						
Male						
Disability	1.341	1.014–1.868	0.034	4.212	1.231–5.410	<0.001
Moderate to severe disability	1.184	0.693–2.025	0.537	3.534	2.462–5.072	<0.001
Female						
Disability	1.205	0.833–1.742	0.322	0.863	0.538–1.383	0.662
Moderate to severe disability	1.136	0.720–1.791	0.584	1.224	0.816–1.836	0.328
Total						
Disability	1.266	1.070–1.551	0.032	2.571	1.836–3.601	<0.001
Moderate to severe disability	1.139	0.805–1.612	0.461	2.254	1.716–2.961	<0.001
Those without osteoarthritis						
Male						
Disability	1.550	1.098–2.189	0.013	4.745	3.063–7.351	<0.001
Moderate to severe disability	1.190	0.731–1.937	0.484	3.121	2.233–4.363	<0.001
Female						
Disability	1.388	0.980–1.966	0.065	1.120	0.715–1.753	0.621
Moderate to severe disability	1.356	0.883–2.084	0.164	1.351	0.924–1.976	0.121
Total						
Disability	1.455	1.139–1.858	0.003	2.653	1.937–3.634	<0.001
Moderate to severe disability	1.252	0.908–1.728	0.171	2.181	1.693–2.810	<0.001

Notes: Model 1: adjusted by age; Model 2: adjusted ethnic, residence, marriage, education, besides those adjusted in Model 1; Model 3: adjusted smoking, alcohol drinking, physical exercise, self-rated good health, besides those adjusted in Model 2.

Abbreviations: ADL, activity of daily living; BADL, activity of daily living; IADL, instrumental activity of daily living.

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