Dai Weirong, Li Xin, Liu Wenfeng

Analysis of screening questionnaire on chronic obstructive pulmonary disease and pulmonary function test on dust-exposed migrant workers

Hunan Prevention and Treatment Institute for Occupational Diseases, 162, Xinjianxi Road, Changsha, People's Republic of China, 410007

Objective. To analyze the application of screening questionnaire on chronic obstructive pulmonary disease (COPD) and pulmonary function test on dust-exposed migrant workers.
Methods. According to 149 eligible objects of study selected in medical outreach, the real situation on them threaten by COPD and influential elements are analyzed in depth.
Results. 73 workers are suspected to be suffered COPD by pulmonary function test. The detection rate (62.6%) of suspected COPD in the population with total score of more than 5 is significantly higher than that of the population with total score of less than 5 (14.3%). The result has the statistical significance (X^2=28.19, p<0.000). Age, working years, stage of pneumoconiosis, smoking or not, smoking index are all the factors influencing the positive results of pulmonary function tests, and pneumoconiosis stage is the biggest influencing one.
Conclusion. *By using questionnaires and pulmonary function tests, the early diagnosis and intervention of COPD are available.*
Keywords: *dust-exposed; migrant workers; COPD; screening questionnaire; lung function*

Дай Вейронг, Ли Синь, Лю Вэньфэн

Анализ скрининговой анкеты-опросника по хронической обструктивной болезни легких и функционального исследования легких у рабочих-мигрантов, подвергшихся воздействию пыли

Хунаньский институт профилактики и лечения профессиональных заболеваний Китай, шоссе Синьджаньси, г. Чанша, Китайская Народная Республика, 410007

Цель исследования — проанализировать применение скрининговой анкеты-опросника по хронической обструктивной болезни легких (ХОБЛ) и функционального исследования легких у работников-мигрантов, подвергшихся воздействию пыли.
Методы. По 149 подходящим объектам исследования, отобранным во время выезда медицинских групп, проведен углубленный анализ реальной ситуации угрозы развития у них ХОБЛ и влияющих на нее факторов.
Результаты. Функциональное исследование легких выявило подозрение на наличие ХОБЛ у 73 работников. Частота выявления подозрений на ХОБЛ в популяции с общей суммой баллов более 5 (62,6%) была статистически достоверно выше, чем в популяции с общей суммой баллов менее 5 (14,3%) (X^2=28.19, p<0,000). Возраст, трудовой стаж, стадия пневмокониоза, курение или отсутствие привычки курения, индекс курения — это факторы, влияющие на положительные результаты функционального исследования легких, где наибольшее влияние имеет стадия пневмокониоза.
Заключение. *Использование анкеты-опросника и функционального исследования легких являются приемлемыми для ранней диагностики и мер профилактики ХОБЛ.*
Ключевые слова: *воздействие пыли; рабочие-мигранты; ХОБЛ; скрининговый опросник; легочная функция*

Introduction. Chronic obstructive pulmonary disease, or COPD, refers to a group of diseases that cause airflow blockage and breathing-related problems. It includes emphysema and chronic bronchitis. Because of high rate of death and heavy burden on socialty and economy, it has gained global attention [1]. COPD is prevent and cured completely. Therefore, it is very important to make early screening and early intervention treatment on high risk group. Occupational dust (Silica, coal dust, cotton dust and cane dust, etc) is one of the environmental factors leading to COPD [2]. However, the study on this is far more less [3]. And the population of dust-exposed migrant workers is small. The two reasons mentioned lead to the lack of early diagnosis. According to the survey result on the medical outreach and questionnaire and free pulmonary function test, the details are allowed on high risk group suffering COPD.

Objects and Methods.

Object of study the dust-exposed migrant farmers from 4 villages in the medical outreach by Hunan Prevention and Treatment Center for Occupational Diseases in April, 2019.

1.1. *Inclusion criteria* (1) >18 years old (2) one more year contacting with dust.

1.2. *Exclusion criteria:* (1) uncompleted questionnaire due to hard communication (2) the one who has contraindication for pulmonary function test (3) the one who is incoordinate with diagnosis (4) the quality of research is not reach the standards (5) no ID card.

2. *Method*

2.1. *Questionnaire:* by using the questionnaire in Guideline for Primary Diagnosis and Treatment Of COPD [4], two local medical workers with Center for Disease Control and Prevention diagnosed the migrant farmers one by one after checking their identities. The one who get the scores equal to or higher than 5(≥5) is the high risk group suffering COPD. The result is positive.

2.2 *Pulmonary function test:* by using portable lung function detector, the technician check the identity of migrant worker, who was diagnosed with $FEV_1/FVC<70\%$, was the high group suffering COPD . Therefore, the pulmonary function was positive. The classification of lung functional impairment is evaluated by identification of occupational injury and disability levels [5].

2.3. *The diagnosis of pneumoconiosis:* The chest X-ray examination was carried out by the on-board medical DR imaging system for physical examination, and the same professional technician checked the ID card for operation. The experts of pneumoconiosis diagnosis group read the tablets collectively, and performed the clinical diagnosis stages of pneumoconiosis according to GBZ70–2015 "diagnosis of occupational pneumoconiosis" standard [6].

2.4. *Data statistics:* all datas were statistically analyzed by SPSS18.0 statistical software, and the significance level was set as a=0.05. Qualitative materials were described by composition ratio. Quantitative datas were evaluated by X̄±S. χ^2 test was used in each group. The analysis of influencing factors was performed by Logistic regression analysis.

Results.

1. In general, 149 migrant workers who were eligible for dust-posed operations, were all exposed to coal dust, aged 42–80 (57.6±9.0) years with working age from 1 to 50 (26.8±11.8) years. There were 107 (71.8%) patients with positive results of questionnaire screening and 73 (49.0%) patients with positive results of lung function examination. Twenty-three patients were diagnosed with pneumoconiosis in the first stage, 26 in the second stage, 26 in the third stage, and 74 without pneumoconiosis.

2. *Screening questionnaire results*

2.1. *General results* among the 149 dust-exposed migrant workers, 125 had symptoms of shortness of breath (83.89%), 79 had symptoms of cough and sputum (53.02%), 123 had decreased activity tolerance (82.56%), 117 smoked (78.52%), and 128 were ≥50 years old (85.91%).

2.2. *The evaluation index* when the evaluation index is divided into cut-off points by the total score of 5, the sensitivity of the questionnaire is 91.78%, the specificity is 47.37%, the positive prediction rate is 62.62%, the negative prediction rate is 85.71%, the false positive rate is 52.63%, the false negative rate is 8.22%, the coincidence rate is 69.13%, the Youden index is 0.39, the positive likelihood ratio is 1.74, and the negative likelihood ratio is 0.17.

2.3. *ROC analysis* (1) ROC AUG was 0.771 (*p*=0.000) and 95% confidence interval was (0.696,0.846). (2) the optimal cut-off point was 6.5 points, and the sensitivity and specificity were 63.0% and 78.9% respectively.

2.4. *Correlative analysis* of lung function among 107 (71.8%) patients with positive lung function test results, there are 67 (62.6%) patients with positive lung function test results; Among the 42 patients (28.2%) with negative results of the screening questionnaire, there are 6 patients (14.3%) with positive results of the lung function test. The statistical differences between the two groups indicates that patients with lung function FEV1 / FVC< 70% could be better screened by screening questionnaire (≥5 points) (table 1).

3. *Lung function test results.*

3.1. *General results* show that a total of 101 (67.79%) in 149 dust-exposed migrant workers had impaired lung function, among which 53 (52.48%) had mild lung function impairment, 32 (31.68%) had moderate lung function impairment, and 16 (15.84%) had severe lung function impairment.

3.2. *Lung function* conformity with questionnaire screening a total of 73 patients (49.0%) with FEV1 / FVC< 70% were detected, among which 67 patients (91.8%) had positive questionnaire screening results, showing good compliance.

Table 1 / Таблица 1

Screening Questionnaire and Pulmonary Function Examination
Скрининговый опросник и исследование легочной функции

Scores of screening questionnaires	Pulmonary function examination		
	FEV1/FVC<70%	FEV1/FVC≥70%	Total
≥5 points	67	40	107[*]
<5 points	6	36	42
Total	73	76	149

Note: * — X^2=28.19, *p*<0.000

Примечание: * — X^2=28,19, *p*<0,000

Table 2 / Таблица 2

Positive Possible Risk Factors of Pulmonary Function Examination
Положительные возможные факторов риска исследования функции легких

Relevant factors	Grouping	Pulmonary function test results		X2	p
		FEV1/FVC<70%	FEV1/FVC≥70%		
Age (year)	40–49	4	21	26.15	0.00
	50–59	25	38	–	–
	60–69	34	13	–	–
	70–80	10	4	–	–
Working years	≤10	7	10	32.16	0.00
	11–20	4	33	–	–
	21–30	26	15	–	–
	>30	36	18	–	–
Pneumoconiosis stage	No	26	48	19.15	0.00
	I	11	12	–	–
	II	14	12	–	–
	III	22	4	–	–
Smoking	No	10	30	12.59	0.00
	Yes	63	46	–	–
Smoking index (Bag/day)	≤10	14	29	18.83	0.00
	10–20	19	8	–	–
	>20	30	9	–	–

Table 3 / Таблица 3

Unconditional Logistic Regression Analysis of Influencing Factors of Positive Pulmonary Function Examination Results (Multivariate)
Безусловный логистический регрессионный анализ влияющих факторов положительных результатов исследования функции легких (многофакторный)

Relevant factors	B	S.E	Wals	df	Sig.	Exp (B)	EXP(B) 95% C.I.	
							min.	max.
Age	0.764	0.272	7.890	1	0.005	2.147	1.260	3.659
Working years	0.406	0.211	3.694	1	0.055	1.501	0.992	2.272
Pneumoconiosis stage	0.639	0.182	12.331	1	0.000	1.894	1.326	2.705
Smoking	1.537	0.499	9.474	1	0.002	4.649	1.747	12.366

3.3. *Influential factors.* By single factor chi-square analysis, there were statistical significance on differences occurring on positive lung function test results, varying with age, working years, pneumoconiosis stage, smoking or not, and smoking index ($p<0.05$) (table 2).

3.4. *Multiple factors regression analysis.* The possible risk factors leading to positive result in pulmonary function test, which are age, working years, pneumoconiosis period, smoking, are introduced to the unconditioned LogisticL multi-factor regression analysis. It indicates that those factors lead to positive pulmonary function test results. Especially, pneumoconiosis is the biggest one (table 3).

Discussion. The global high incidence and mortality of COPD is rising [1], the epidemiological studies have shown that people aged 40 or more suffering COPD rate from 8.2% in 2002–2004 [7], rose to 13.7% from 2012 to 2015 [8]. According to the calculation, the crowd of nearly 100 million suffering COPD have become a major slow disease, posing a great burden of disease on country [9]. The number of deaths reached 0.9 million in 2013 [10], which had become the major cause of death second only to ischemic heart disease and stroke. Al-though the prevalence rate and mortality rate of COPD are both high, there is generally insufficient understanding and diagnosis on COPD in the world [1]. Epidemiological studies show that more than 75% of patients with COPD are missed [11], and less than 25% of patients have taken the initiative medical treatment [12]. The situation id far more serious in countryside. The lack of understanding of COPD, being reluctant to seek medical care and a serious shortage of grassroots medical institutions, lung function often has declined obviously, thus lost the optimal timing of diagnosis and treatment. COPD has been seen as the top disease consisting of chronic respiratory diseases resulting in death in rural country [13]. In this thesis, only 13 of the 149 residents in 4 villages received free diagnosis, and only 3 had been hospitalized in provincial hospitals for pulmonary function examination, one was diagnosed with COPD. The other 146 had no pulmonary function examination, and no one was informed of COPD. The active consultation rate of this population is only 8.7%, and the pulmonary function examination rate is only 2.0%. The first reason is self-related: they did not know and paid little attention to the disease, and seldom took the initiative to seek medical

treatment; the second is the condition reason: rural country-side is remote, and hard to go out to see a doctor; the third is short of basic consciousness: the cognition of COPD is not enough, the related knowledge cannot be popularized in time and the patient screening is not equipped with the relevant equipment to check the lung function.

Lung function is the most accurate and authorized standard in the diagnosis of COPD [2]. Currently, grassroots doctors should be asked to measure lung function like blood pressure. Our country basic guidelines of the chronic obstructive pulmonary diseases (2018) [4] point out that when the basic-level hospitals lack of lung function testing equipment can screen the high-risk groups by questionnaire screening. Questionnaire based on 5 questions recommended by the basic guidelines for COPD, 0–2 points for each question with a total score of 10 points. If the total score is greater than or equal to 5 points, it indicates that the patient has got chronic obstructive pulmonary disease (COPD) and need further diagnosis. In this thesis, according to the screening questionnaire recommended by the basic guidelines, patients who get score of ≥5 are with high risk of COPD. A total of 107 patients with high risk of COPD were screened, and 67 patients with abnormal pulmonary function (FEV1 / FVC<70%). And in 42 migrant workers getting score of <5 points, only 6 were the lung function abnormal. The anomaly detection rate (62.6%) of the crowd (≥5 points) was significantly higher than that (14,3%) with the score (<5). It is of statistical significance. Screening questionnaire can improve the detection rate of patients with abnormal lung function, so as to improving the detection rate of COPD, which is consistent with other studies [14–16]. To be sure, although the results of comparing the portable instrument with general international jaeger lung function instrument have good consistency, and also can meet the demand of clinical diagnosis of COPD [17], but because of the limit of free clinic condition, people with abnormal lung function(FEV1/FVC<70%) who had no inhale of bronchodilator before test could not be diagnosed with COPD, but had the possibility of COPD. This population screening questionnaire results ROC curve analysis shows that the optimum truncation points are 6.5 points, the score moves up. The analysis indicates pneumoconiosis disease itself can cause symptoms such as cough, sputum, shortness of breath. Those symptoms can also cause higher false positive rate in questionnaire, which results in a decline in the specific degree of the diagnosis. However, cut-off point 5 is appropriate on the perspective of reducing of rate of missed diagnosis.

Occupational exposure is a commonly underestimated risk factor for COPD [1]. It is rarely studied in China. Zhou Yumin has reported that occupational dust smoke exposure is a risk factor for COPD and is related to respiratory symptoms [18]. In this study, 137 (91.95%) migrant workers with any respiratory symptoms of cough, sputum or shortness of breath were studied, and 101 (67.79%) patients with lung function impairment. Among them, 73 (49%) patients with lung function examination FEV1 / FVC< 70% were diagnosed with COPD . The rate of COPD is higher than ordinary people by predicating after inhale of bronchodilators. Through analysis, age, working age, pneumoconiosis stage and smoking index are all influencing factors of COPD positive results, among which pneumoconiosis stage is the biggest influencing factor. The result is consistent with Li Xin [19] . According to the study, there were statistically significant differences in the positive rate ofCOPD in the dust exposed group in different age groups, smoking and

non-smoking groups, and different smoking index groups, which was consistent with the study on other general population[20,21]. As the growth of the length of working, COPD positive rate increases, due to contacting with coal mine dust concentration is similar for this group of people in the villages and towns and more quantity of induct breathed with the increase of length of working. The result is consistent with the DIJKSTRA [22] reports about exposure on the dust can increase the risk of COPD, and the results of the study on relation between dose-reaction are consistent. By Logistic multi-factor regression analysis, smoking is not the biggest influential factor leading to COPD but the pneumoconiosis stage. With pneumoconiosis stage increasing, pulmonary fibrosis increasing , areas of small airway twisted block being aggravating, at the same time a large release of inflammatory factor, airway damage is so aggravating that irreversible obstructive ventilation dysfunction is caused.

Conclusion. *In conclusion, dust-exposed migrant workers have higher risk of COPD, the low rate of diagnosis will lead to delayed diagnosis and treatment of COPD, and even worse disease. The COPD screening questionnaire is simple, economical, convenient to operate, and has a high positive rate of screening high-risk groups of COPD, which is conducive to promotion in primary hospitals. Smoking is recognized as a high risk factor for COPD, and can also accelerate the progress of pulmonary fibrosis in pneumoconiosis [23]. Dust exposed workers are more encouraged to quit smoking to slow down the progression of the disease, and strengthen personal protection and reduce dust inhalation, all of which can reduce the risk of COPD. In addition, the popularization of COPD knowledge should be strengthen and the ability of diagnosis and treatment of COPD at the basic level should be promoted to realize the strategy of early detection, early diagnosis and early prevention of COPD.*

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