Spirometry Changes in Normal or Early ILO Pneumoconiosis Radiographs of Sandstone-Dust Exposed Workers: A Preliminary Result

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Objective: *To estimate forced expiratory volume in first second (FEV_1) decline after one-year follow-up among sandstone workers with normal or early abnormal International Labour Organization (ILO) classification chest radiographs.*

Material and Method: *Fifty-two sandstone workers with an ILO classification chest radiographs profusion CAG ≤1/1, FEV_1 and forced vital capacity (FVC) that decline as measured using follow-up FVC maneuver spirometry testing were interviewed. Work exposure, personal protective equipment, and symptoms (if any) obtained through questionnaire was also included.*

Results: *The 52 participants mostly were female, average age 48±8.9 years, and mostly non-smokers. Mean of FEV_1 decline at one-year follow-up was 105.4±131.7 mL (95% CI 68.7, 142.0) with increasing of FEV_1 decline among high exposure, smokers and exposed for 10 years or more. The mean FEV_1 decline among workers with all those factors was 272.0±155.5 mL. Subgroup analysis with independent t-test and multiple linear regression models revealed only FEV_1 decline was found in high exposure group. FVC decline trended similar to FEV_1 decline. Mean of FVC loss was 119.4±181.1 mL (95% CI 69.0, 169.9), while mean FVC loss among those classified as high exposure smoking workers with 10 years or more of exposure was 376.0±216.2 mL. However, the FEV_1 and FVC declined among sandstone workers were at least three times greater than Thai physiological decline.*

Conclusion: *Although ILO chest radiographs were normal or near normal, the FEV_1 and FVC declined among silica dust exposed workers. Therefore, FEV_1 deterioration should be monitored in order to comply with the UK RCS Dust Exposed Surveillance Guideline, especially among high exposure.*

Keywords: *Spirometry, FEV_1, FVC, Silica dust, Occupational, Medical surveillance, ILO chest radiograph*

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Silicosis among sandstone workers in Thailand is increasing(1) due to uncontrolled working environments. There is no concerted attempt to reduce respirable crystalline silica (RCS) or to require proper respirators be used among workers in cottage industry. The cottage industry is the main area of occupational silica dust exposed industries construction, stone quarrying, sandstone sculpturing, sandstone brick production, and tile industry are common occupational silica dust exposure trades. Several developed countries such as the USA[2] and the UK[3] control silica dust exposure and perform health surveillance guidelines for RSC exposed workers in a systematized and actionable protocols[4-7].

Testing frequency of each test varied country to country. In Germany, the requirement for all surveillance parameter is every three years[7]; while in Australia, it is every five years[6]. In the UK, chest radiographs are required every three years but only after at least 15 years of RCS exposure while the other parameters are documented annually[5]. Thai law requires medical surveillance of workers exposed to silica dust. Surveillance tools include physical examination, respiratory symptoms questionnaires, chest radiographs, and spirometry. However, only chest radiographs, physical examination, and history taking are usually performed[8].

Chest radiographs played an important role for both diagnosis and screening of silicosis. The

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National Institute for Occupational Safety and Health (NIOSH) B reader requires chest radiographs be interpreted according to International Labour Organization (ILO) regulations, but the number of qualified NIOSH B reader in Thailand is limited[9]. In the northeast region, there is only one qualified NIOSH B reader[9]. Some studies have demonstrated changes to respiratory function even in normal or early abnormal ILO classification chest radiographs[10,11], so spirometry helps detect some respiratory tract abnormalities in RCS exposed worker[4,5]. Several studies showed that RCS not only affected lung parenchyma but also affected airways[11-14]; therefore, an obstructive abnormality and forced expiratory volume in first second (FEV_1) deterioration among workers exposed to RCS can be found even among those with normal or early abnormal ILO classification chest radiograph[15-17].

Recently, the UK[5] also recommended using the deterioration of FEV_1 among workers exposed to RCS as a medical surveillance tool, and that spirometry be performed annually. A decline in FEV_1 of 500 mL or more in one year or 500 mL over five consecutive years (average 100 mL/year) is serious. The interim action point is at 200 mL or more in one year or 200 mL over two consecutive years. Using these thresholds, spirometry can be used for detecting an early stage of respiratory disorders among workers exposed to RCS. There has been no report regarding deterioration of FEV_1 among workers exposed to RCS in Thailand or Southeast Asia. The present study aimed to estimate FEV_1 decline among sandstone workers who have a normal or early abnormal ILO classification chest radiograph in one year.

Material and Method

Study design

A descriptive study was conducted among the sandstone workers at Nong Nam Sai, Sikhio, Nakhon Ratchasima, northeastern Thailand.

Study population and sample

The study population included Thai sandstone workers who were exposed to RCS for six months or more, between 25 and 70 years of age, with an ILO classification chest radiograph profusion category 1/1 or less as per the ILO pneumoconiosis classification 2000 (revised 2011)[17]. A profusion category 1/1 or more is one of the diagnostic criteria for silicosis in Thailand[18], so the lesser categories are for early detection.

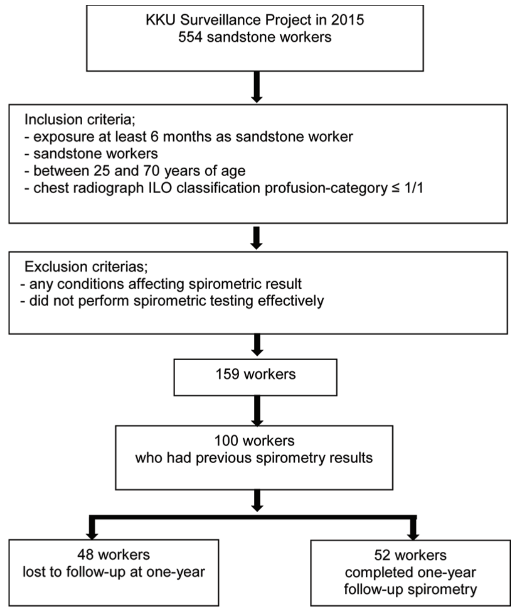

Fig. 1 Sample recruitment procedure.

Workers with an underlying disease that affected their spirometric result or with the conditions interfered with effective performance of spirometry were excluded. There were 554 sandstone workers registered with the Khon Kaen University (KKU) Development of Disease Surveillance System for Silicosis and Respiratory Disorder Related to Inorganic Dust (KKU Surveillance Project in 2015). One hundred fifty nine workers met the inclusion criteria, but only 100 workers had previous spirometry results (March 2015). The sample size was calculated using an estimated standard deviation (SD) based on FEV_1 decline (57.0±75.0 mL) among gold miners who showed ILO chest radiographs profusion category 1[19]; thus, the sample was set at 83 workers. All workers who had previous spirometry results were recruited to the study, but at the one-year follow-up, only 52 workers completed the study (Fig. 1).

Because of the lack of precise RCS occupational exposure levels, the classification of RCS levels was determined subjectively according to tasks and jobs into three groups, (a) high exposure comprising current stone-cutters (Fig. 2A, B); (b) medium exposure including the former stone-cutters and current hand chiseling workers, and (c) low exposure including former hand chiseling workers (Fig. 2C).

Tools

The interview questionnaire included general personal biodata, work history, duration of

Fig. 2 Tasks of sandstone worker. (A) Stone cutting worker at site with a grass cutter like stone cutter. (B) Stone cutting at home with a stone cutter. (C) Stone cut and decorated with hand chisel.

silica dust exposure, the use of protective respirators, and respiratory symptoms was developed by KKU Surveillance Project and modified by the authors. The portable KOKO® spirometer with nSpire Health Inc. flow-sensing pneumotachometer and 3-liter calibrator that complied with the American Thoracic Society/European Respiratory Society (ATS/ERS) 2005[20] standard were used to measure FEV_1 and other spirometry parameters. The secondary data of studied workers included previous spirometry results, personal biodata, work histories, duration of silica dust exposure, the use of protective respirators, and the respiratory symptoms from KKU Surveillance Project in 2015.

Data collection

At the beginning of the study (time = 0), personal biodata, work history, duration of silica dust exposure, use of protective respirators and the respiratory symptoms, initial FEV_1, initial forced vital capacity (FVC) and other spirometry parameters of the studied workers in 2015 were obtained from the existing data of KKU Surveillance Project. At one-year follow-up (13.3 to 13.4 months), the interview questionnaire was completed one-on-one to obtain information regarding personal biodata, work history, duration of silica dust exposure, the use of protective respirators, respiratory symptoms, and contraindications for spirometry testing. The portable KOKO® spirometer with flow-sensing pneumotachometer that complied with ATS/ERS 2005[20] standard were also used to measure FEV_1, FVC, FEV_1/FVC, and forced expiratory flow at 25 to 75% ($FEF_{25-75\%}$). The spirometries (using the FVC maneuver technique) were operated by certified nurses or technicians. The results of the spirometry were interpreted per the criteria of Thoracic Society of Thailand[21].

Data analysis

Data were analyzed by STATA 10.0 and demographic data were analyzed by descriptive statistics. The results were presented as means ± SD or medians (P_{25} to P_{75}) and 95% CI for only FEV_1 decline and FVC decline as they reflected the effects of RCS[14,19]. The independent t-test and multiple linear regression were used to compare FEV_1 decline between the exposure groups. A p-value <0.05 was regarded as statistically significant.

Ethical considerations

The ethical concerns included complication from the spirometry testing and the confidentiality of personal data. Contraindications for spirometry were checked so as to exclude at risk participants. The present study was approved by the KKU Human Ethics Committee number HE581208.

Results

Characteristic of participants

On April 2016, 52 participant workers were eligible for the analyses with a 62% response to one-year follow-up spirometry. Most of the participants were female (65.4%). The 52 workers were between 27 and 65 years of age (48±8.9 years) with a mean height of 156.5±8.0 cm. The majority (69.2%) were non-smokers but 26.9% had some underlying diseases (diabetes affecting six persons).

Most were current sandstone workers with median exposure time of 6.5 years (IQR = 4.8 to 10.3). The tasks of the majority included cutting and decorating with a hand chisel (Fig. 2C), classified as medium to low exposure. Only 30.8% of workers were classified as high exposure as they were cutting sandstone using machine. Medium exposure workers had formerly cut sandstone by machine or were currently using hand chisels. Low exposure included only former cut and decorated using hand chisels.

None of these workers used a proper respirator. They mainly used a piece of cloth to protect themselves against dust. Only six workers wore an N80 respirator, the best specific respirator available. Most workers had chest radiographs of 0/0 as per the ILO classification profusion category (96.2%).

Result of spirometry

The initial and one-year follow-up spirometry was mainly within the normal threshold (Table 2, 3). Only 8 and 12 workers presented an abnormal at the initial and one-year follow-up respectively. All abnormal spirometries were interpreted as obstruction or small airway disease. Among the abnormal spirometries, only six workers reported some respiratory symptoms at one-year follow-up (Table 1). Comparing the one-year follow-up with the initial, there were five new symptomatic workers but only one with ongoing cough and wheezing symptom since 2015. Nine workers relieved the symptoms at one-year follow-up.

FEV_1 deterioration

The mean deterioration of FEV_1 at the one-year follow-up was 105.4±131.7 mL (95% CI 68.7, 142.0) and a further decline of FEV_1 among workers in the high exposure group (184.4±160.4 mL), smokers (151.9±185.3 mL), males (148.3±176.5 mL), and those exposed to RCS of 10 years or more (161.5±152.6 mL). The mean decrease FEV_1 of high exposure workers who were smokers and exposed to RCS for 10 years or more was 272.0±155.5 mL (n = 5). The mean decrease FEV_1 was greater among male workers than female workers. In this cohort, male workers were more often smokers and in the high exposure group (Table 4). In addition, the mean decline in FEV_1 was greater among six symptomatic workers (213.3±148.5 mL).

However, the average of FEV_1 decline per year for Thai was 30.1 mL for male and 18.0 mL for female; calculated from decreasing of predicted value among Thais who were height of 160 cm and aged between 25 and 70 years (Thoracic Society of Thailand)[21]. Therefore, the mean of FEV_1 decline among sandstone workers were at least three times greater than normal physiological decline.

Further analyses using an independent t-test were performed to explore the relationship between smoking, exposure group, and duration of exposure to RCS. The results revealed that the workers who were classified as high exposure group had a statistically significant decline in FEV_1 ($p = 0.0030$) (Table 5). This

Table 1. Demographic data of the studied sandstone workers (n = 52)

	n (%)		n (%)
Gender		Exposure levels	
Male	18 (34.6)	High	16 (30.8)
Female	34 (65.4)	Medium	26 (50.0)
Age (years)[b]	48.0±8.9	Low	10 (19.2)
25 to 34	4 (7.7)	Exposure duration (years)[a]	6.5 (4.8 to 10.3)
35 to 44	11 (21.2)	<2	5 (9.6)
45 to 54	23 (44.2)	2 to 4	15 (28.9)
55 to 64	13 (25.0)	5 to 9	19 (36.5)
≥65	1 (1.9)	≥10	13 (25.0)
Height (cm)[b]	156.5±8.0	Protective respirator	
Body weight (kg)[b]	61.7±8.7	Non-users	7 (13.5)
BMI (kg/m^2)[a]	24.2 (22.0 to 28.0)	Proper users	0 (0)
		Non-proper users	45 (86.5)
Smoking status		Respiratory symptoms	6 (11.5)
Non-smokers	36 (69.2)	Cough	2
Smokers	16 (30.8)	Wheezing	4
Underlying diseases	14 (29.6)		
Chest radiograph ILO classification			
0/0	50 (96.2)		
0/1	1 (1.9)		
1/1	1 (1.9)		

BMI = body mass index; ILO = International Labour Organization

[a] Median (P_{25} to P_{75}), [b] Mean ± standard deviation

phenomenon was confirmed using a linear regression analysis where only workers in the high exposure group had a statistically significant relationship with declined FEV_1 ($p = 0.014$) (Table 6).

FVC deterioration

The mean decline in FVC at the one-year follow-up was 119.4±181.1 mL (95% CI 69.0, 169.9), with greater decline among the high exposure group (203.1±207.7 mL), smokers (183.1±220.7 mL), males (181.7±215.4 mL), and workers exposed to RCS for 10 years or more (185.4±261.0 mL). However, the mean of FVC decline among the non-smokers classified as high exposure group (253.3±80.8 mL) decreased more than smokers although there were only three workers. Similar to FEV_1 deterioration, the mean decreasing of FVC was 376.0±216.2 mL among the high exposure workers who were smokers and being exposed to RCS for 10 years or more, albeit there were only five workers. In the present study, almost all male workers were smokers and classified in the high exposure group. Therefore, the greater decline in FVC among the male workers may be a consequence of high exposure and smoking (Table 7). Similar to FEV_1

Table 2. Spirometry parameters of initial and one-year follow-up (n = 52)

	Initial[a]	95% CI	One-year follow-up[a]	95% CI
FEV_1 (L)	2.37 (2.15 to 2.82)	2.27, 2.57	2.26 (2.10 to 2.64)	2.17, 2.40
% predict FEV_1	105.0±12.1	101.7, 108.4	101.6±14.0	97.8, 105.5
FVC (L)	2.94 (2.64 to 3.62)	2.80, 3.24	2.81 (2.60 to 3.37)	2.71, 3.07
% predict FVC	109.2±11.5	106.0, 112.4	105.9±12.0	102.5, 109.2
FEV_1/FVC	0.81±0.06	0.79, 0.82	0.80±0.07	0.78, 0.82
$FEF_{25-75\%}$ (L/second)	2.43 (1.97 to 3.27)	2.23, 2.77	2.44 (1.86 to 2.80)	2.16, 2.63
% predict $FEF_{25-75\%}$	91.8±29.0	83.8, 99.9	87.5±29.0	79.4, 95.6

FEV_1 = forced expiratory volume in first second; FVC = forced vital capacity; $FEF_{25-75\%}$ = forced expiratory flow at 25 to 75%
[a] Median (P_{25} to P_{75}) or mean ± standard deviation

Table 3. Spirometry findings of workers at initial and one-year follow-up interpreted per Thoracic Society of Thailand

	Initial		One-year follow-up	
	Non-smoker (%) (n = 36)	Smoker (%) (n = 16)	Non-smoker (%) (n = 36)	Smoker (%) (n = 16)
Normal	34 (94.4)	10 (62.5)	31 (86.1)	9 (56.3)
Abnormal	2 (5.6)	6 (37.5)	5 (13.9)	7 (43.7)
Obstruction	1	6	1	5
Restriction	-	-	-	-
Mixed type	-	-	-	-
Small airway disease	1	-	4	2

Table 4. FEV_1 deterioration at one-year follow-up

	Δ FEV_1 (mL)								
	Non-smokers			Smokers			Total		
	n	Mean ± SD	95% CI	n	Mean ± SD	95% CI	n	Mean ± SD	95% CI
Gender									
Male	2	120.0±113.1	-	16	151.9±185.3	53.1, 250.6	18	148.3±176.5	60.5, 236.1
Female	34	82.6±96.0	49.2, 116.1	0	-	-	34	82.6±96.0	49.2, 116.1
Exposure level									
High	3	163.3±47.3	-	13	189.2±177.9	81.7, 296.8	16	184.4±160.4	98.9, 270.0
Medium	23	70.9±101.9	26.8, 114.9	3	-10.0±138.9	-	26	61.5±106.7	18.4, 104.6
Low	10	93.0±83.5	33.2, 152.8	0	-	-	10	93.0±83.5	33.3, 152.7
Exposure duration									
<10 years	28	82.5±93.4	46.3, 118.7	11	97.3±177.1	-21.7, 216.2	39	86.7±120.4	47.6, 125.7
≥10 years	8	92.5±109.3	-	5	272.0±155.5	-	13	161.5±152.6	69.3, 253.7
High exposure & ≥10 years exposed	1	180	-	5	272.0±155.5	-	6	256.7±144.0	-
Total	36	84.7±95.4	52.4, 117.0	16	151.9±185.3	53.1, 250.6	52	105.4±131.7	68.7, 142.0

deterioration, the mean FVC decline was greater (221.7±111.4 mL) among the six symptomatic workers.

However, the average of FVC physiologically loss among Thai was 16.2 mL/year for male and 13.1 mL/year for female, which was calculated from average decline of predicted value among Thai of 160 cm and age between 25 and 70 year (Thoracic Society of Thailand)[21]. Therefore, the mean of FVC loss among sandstone worker was at least seven times greater than that found among normal population.

Discussion

The present study focused on loss of lung function in Thailand among early (low) silicosis grade (ILO classification chest radiograph profusion category 1/1 or less). Although there have been some studies showing a significant loss of lung function among silicosis workers, those studies focused on high-grade silicosis chest radiographs[14,19] in contrast to the current study.

The results of spirometry testing depended on the effectiveness of both the examinees and

Table 5. Factors associated with decreased FEV_1 at one-year follow-up

	Δ FEV_1 (mL)			
	Mean ± SD	M.diff	95% CI of M.diff	*p*-value
Smoking status				
Smokers (n = 16)	151.9±185.3	67.2	-10.8, 145.1	0.0898
Non- smokers (n = 36)	84.7±95.4			
Exposure duration				
≥10 years (n = 13)	161.5±152.6	74.9	-8.0, 157.8	0.0756
<10 years (n = 39)	86.7±120.4			
Exposure group				
High (n = 16)	184.4±160.4	114.1	40.7, 187.5	0.0030*
Medium & low (n = 36)	70.3±100.6			

M.diff = mean difference
* *p*-value <0.05

Table 6. Factors associated with decreased FEV_1 at one-year follow-up using multiple linear regression

	Δ FEV_1 (mL)		
	Regression coefficient	95% CI	*p*-value
Smoking	-35.87	-143.54, 71.81	0.506
Exposure duration (per year)	3.56	-2.49, 9.61	0.243
High exposure	136.70	28.98, 244.41	0.014*

* *p*-value <0.05

Table 7. FVC deterioration at one-year follow-up

	Δ FVC (mL)								
	Non-smokers			Smokers			Total		
	n	Mean ± SD	95% CI	n	Mean ± SD	95% CI	n	Mean ± SD	95% CI
Gender									
Male	2	170.0±240.4	-	16	183.1±220.7	65.4, 300.7	18	181.7±215.4	74.5, 288.8
Female	34	86.5±153.5	32.9, 140.0	0	-	-	34	86.5±153.5	32.9, 140.0
Exposure level									
High	3	253.3±80.8	-	13	191.5±228.2	53.6, 329.4	16	203.1±207.7	92.4, 313.8
Medium	23	87.4±139.5	27.1, 147.7	3	146.7±224.8	-	26	94.2±146.8	34.9, 153.5
Low	10	51.0±186.2	-82.2, 184.2	0	-	-	10	51.0±186.2	-82.2, 184.2
Exposure duration									
<10 years	28	98.2±137.1	45.1, 151.4	11	95.5±165.4	-15.6, 206.6	39	97.4±143.3	51.0, 143.9
≥10 years	8	66.2±218.8	-	5	376.0±216.2	-	13	185.4±261.0	27.7, 343.1
High exposure & >10 years exposed	1	180	-	5	376.0±216.2	-	6	343.3±209.3	-
Total	36	91.1±155.7	38.4, 143.8	16	183.1±220.7	65.5, 300.8	52	119.4±181.1	69.0, 169.9

examiners, so the current study standardized the examiners by using ATS/ERS 2005 standard[20] and the Thoracic Society of Thailand guideline[21]. Details on exposure to RCS, duration of exposure, exposure group, and smoking habits were obtained by experienced interviewers.

As generally known, the decline of 150 mL or less of FEV_1 and FVC are clinically insignificant as per ATS/ERS 2005[20]; however, as a medical surveillance tool, a loss of FEV_1 at 200 mL or more in two years is regarded as an effect of RCS exposure[5]. Even though, physiological declining of FEV_1 and FVC for Thai were about 13.1 to 30.1 ml/year (average deterioration of predicted value per year)[21]. The results of the current study, therefore, elucidate FEV_1 loss and were likely useful to be used as a medical surveillance test for detecting RCS exposure effect.

A well-known effect of RCS to human is direct cell toxicity and subsequent lung parenchymal fibrosis via majority of macrophages responsive pathway[4]. Airflow obstruction is also evident among RCS exposed workers and related to chronic obstructive pulmonary disease (COPD), especially emphysema which affects FEV_1 more than FVC[11-13]. Churg et al[22] showed morphologic evidence of emphysema and small-airway change in rat models. Similarly, chronic bronchitis prevalence increases among RCS-exposed workers, which presents in mucus gland hyperplasia and minimal airflow obstruction[23]. Small airway abnormality is also a sequel of mineral dust airway disease due to deposits of mineral dust and fibrous tissue in the respiratory bronchioles and alveolar ducts[24]. This current study demonstrated FEV_1 loss and FVC loss among RCS-exposed workers were similar to COPD with annual loss of FEV_1[25], which confirmed the RCS effect on the airways resulting in airflow obstruction. Small airway disease also presented in the present cohort, so an RCS effect leading to small airway should be considered and distinguished from smoker effect (Table 3).

According to the descriptive results of FEV_1 loss and FVC loss, workers classified in the high exposure group, smokers, male workers, and those exposed to RCS for 10 years or longer were likely to show FEV_1 loss and FVC loss. Similarly, Ehrlich et al[14] reported a mean FEV_1 excess loss of 224.1 mL and a mean FVC excess loss of 123.6 mL among South African gold miner silicosis when compared to predicted value. The current study revealed a similar FEV_1 and FVC decline among workers who showed borderline or early grade of silicosis chest radiographs (Table 4, 7).

Further analyses using bivariate association of exposure measures and associations in multivariate analysis of FEV_1 showed that significant deterioration of FEV_1 was found among workers classified in the high-exposure group and that a higher-grade exposure trended to reveal more effect than those in the lower grades of exposure[14,19]. A follow-up of FEV_1 loss is likely to confirm this tool as a useful medical surveillance measure; especially in workers heavily exposed to RCS with low grade of silicosis chest radiographs. In addition, low grade silicosis chest radiographs may reveal subclinical changes as per Verma et al[10]. They found silicotic nodules in autopsied coal workers even though normal ILO classification radiographs.

Other factors perhaps linked with the decline in FEV_1 and FVC including duration and intensity of exposure and being male smoker[14]. In the current study males showed more loss of FEV_1 than female workers. According to the statistical analyses, being male might have an influence of smoking habits (Table 4), and being enrolled in the high exposure group. Cigarette smoking and heavy exposure may synergize to affect airways as reported by Hochgatterer et al[26]. Notwithstanding, among high RCS-exposed smoking workers, FVC declined more than non-smokers who present RCS effect rather than a cigarette smoking effect as well as result of Ehrlich et al[14], which showed the greater coefficient of FVC excess loss per cumulative respirable quartz rather than per smoking factor.

This current study presented only normal or early abnormal ILO chest radiographs; therefore, the respiratory symptoms (cough and wheezing) that occurred among workers may be the result of a RCS-exposed airway effect[12]; as indicated by the greater decline of FEV_1 and FVC.

Conclusion

Despite having only a one-year follow-up, the current study demonstrated appreciable loss of lung function attributable to dust exposure among sandstone workers. Spirometry using FEV_1 was a good parameter for medical surveillance testing among workers who were exposed to RCS. In addition, FEV_1 is appropriate to be a tool for screening an effect of RCS exposure especially worker who is heavy exposures and/or non- or low-grade silicosis workers. The present study confirms the 2016 Health and Safety Executive (HSE) UK Health Surveillance for those Exposed to RCS[5].

Recommendation

A further study is needed among a larger sandstone-exposed population, with a comparison to a reference group. A re-examination of the spirometry of the 52 workers at a two-year follow-up may confirm the current findings. For workers exposed to silica (working with sandstone or quartz) the UK Silica Dust Exposed Health Surveillance Guideline in 2016[5] is an appropriate guideline for a health surveillance program in Thailand.

What is already known on this topic?

HSE UK[5] recently recommended spirometry and FEV_1 deterioration as a part of medical surveillance for silica dust-exposed workers. If workers have a FEV_1 decline of of 200 mL or more over two consecutive years, they should undergo further evaluation of their health irrespective their ILO chest radiographs classification. Spirometry is a useful measure for medical surveillance of RCS-exposed workers. Thailand has no compulsory medical surveillance program for RCS-exposed workers.

What this study adds?

This is the first study to examine the loss of lung function among RSC-exposed workers in Thailand. Spirometry using FEV_1 was a good parameter for medical surveillance testing among workers exposed sandstone dust. Spirometry can be used in workers exposed in heavy dust environments.

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Potential conflicts of interest

None.

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ค่าสมรรถภาพปอดที่เปลี่ยนแปลงของผู้ทำงานสัมผัสฝุ่นหินทรายที่มีภาพถ่ายรังสีทรวงอก ตั้งแต่ระดับปกติถึงระยะเริ่มแรกตามเกณฑ์ ILO นิวโมโคนิโอซิส

พีรวัฒน์ ตระกูลทวีสุข, เนสินี ไชยเอีย, วัชรา บุญสวัสดิ์, จิราพร เขียวอยู่, ภานุมาส ไกรสร, กฤติณ ศิลานันท์

วัตถุประสงค์: *เพื่อประมาณค่า FEV_1 ที่ลดลงในผู้ทำงานสัมผัสฝุ่นหินทรายที่มีภาพถ่ายรังสีทรวงอกตามเกณฑ์ ILO classification ปกติถึงผิดปกติเริ่มแรกที่ 1 ปี*

วัสดุและวิธีการ: *กลุ่มตัวอย่างผู้ทำงานสัมผัสฝุ่นหินทรายที่มีภาพถ่ายรังสีทรวงอกตามเกณฑ์ ILO classification น้อยกว่าเท่ากับ 1/1 จะได้รับการตรวจสมรรถภาพปอดด้วยวิธี spirometry (FVC maneuver) เพื่อประเมินค่า FEV_1 และ ค่า FVC ที่ลดลงใน 1 ปี ส่วนประวัติการสัมผัสฝุ่น การสวมอุปกรณ์คุ้มครองระบบหายใจส่วนบุคคลและอาการระบบหายใจ ได้จากการสัมภาษณ์จากแบบสอบถาม*

ผลการศึกษา: *มีอาสาสมัคร 52 คน ส่วนใหญ่เป็นผู้หญิง และไม่สูบบุหรี่ อายุเฉลี่ย 47±8.9 ปี มีค่า FEV_1 ลดลงที่ 1 ปี เฉลี่ย 105.4±131.7 mL (95% CI 68.7, 142.0) และจะลดลงมากในกลุ่มที่สัมผัสฝุ่นเข้มข้นสูง สูบบุหรี่ และสัมผัสมากกว่า 10 ปี โดยพบลดลงเฉลี่ยถึง 272.0±155.5 mL และเมื่อวิเคราะห์ด้วย independent t-test และ multiple linear regression พบความสัมพันธ์เฉพาะกับการสัมผัสฝุ่นเข้มข้นสูง สำหรับ FVC ที่ลดลง พบมีลักษณะคล้ายคลึงกับ FEV_1 ที่ลดลง โดย FVC ลดลงเฉลี่ย 119.4±181.1 mL (95% CI 69.0, 169.9) และค่าเฉลี่ยของการลดลงพบสูงถึง 376.0±216.2 mL ในกลุ่มที่สัมผัสฝุ่นเข้มข้นสูง สูบบุหรี่ และสัมผัสมากกว่า 10 ปี แต่อย่างไรก็ตามค่า FEV_1 และ FVC ที่ลดลงนี้ลดลงมากกว่าประชากรทั่วไปอย่างน้อย 3 เท่า*

สรุป: *FEV_1 ลดลงมากผิดปกติ แม้ว่าภาพถ่ายรังสีทรวงอกตามเกณฑ์ ILO classification จะปกติหรือผิดปกติในระยะเริ่มแรก ดังนั้นในการเฝ้าระวังสุขภาพของผู้ที่ทำงานสัมผัสหินทรายควรใช้ การติดตามการลดลงของค่า FEV_1 เช่นเดียวกับแนวทางของประเทศสหราชอาณาจักร โดยเฉพาะในกลุ่มที่สัมผัสฝุ่นหินทรายความเข้มข้นสูง*