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Health Status of Workers Exposed to Talcum Powder in Hospitals in Southern Thailand

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Abstract

The respiratory health of Thai healthcare workers who are exposed to talc from their work has not previously been investigated. The aim of this study was to survey the concentration of talc levels and health status of hospital workers. Two hospitals in southern Thailand were sampled. Altogether 105 workers voluntarily participated, but 99 workers completed physical examinations, spirometry and full-size chest radiograph. Area and personal sampling were conducted to determine levels of talcum concentration. To detect silica and asbestos contaminating the talcum, three bulk samples were taken and examined by X-ray diffraction. The average area talcum concentration was 0.0723 ± 0.0951 mg/m^3 and at the worker's breathing zone was 0.1493 ± 0.1867 mg/m^3. No asbestos or free silica was found in the three bulk samples. Six workers in the exposure group and only one of the control group had restrictive lungs. Five of the workers had small opacities. A high-resolution computed tomography in three workers found no talcosis or silicosis. Log FVC and log FEV_1 were significantly associated with age and sex, but for FEV_1/FVC ratio, only age was a significant parameter. The talcum concentrations under study were not beyond the standard limits. The working conditions in the hospitals were well-controlled and the talcum gradient was found to be asbestos free. The abnormal chest X-rays may be partly explained by past exposure in these two hospitals, or previous occupational exposure.

***Keywords*:** Talcum; Hospital; Pneumoconiosis; Exposure; Silicosis.

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INTRODUCTION

Talcum is widely used in many manufacturing processes as a dusting powder. China is the biggest talcum producer, followed by Korea, India, Finland, Brazil and France. Two grades of talc known as industrial talc and cosmetic talc are used in the paint, rubber, cosmetic and ceramics industries. Talc is resistant to heat and acids, and is a poor electrical conductor. Impure talc may contain asbestos, free silica, and/or other ore minerals. Talc is also the main ingredient of talcum powder, which is used as a lubricant for gloves in many hospitals. In the glove-reuse process, they were mixed with talcum powder in the mixing machine. The workers then manually checked the glove leakage with air-blowing machine and matched left glove to its right one. During this process, the workers in the central supply units were exposed to talcum which has been reported as cause of pneumoconiosis since early 20^{th} Century (Stellman, 1998). Moreover, other respiratory disorders can also develop among workers exposed to impure or high concentrations of talcum (Wild *et al*., 2002; Yasushi *et al*., 2002).

The respiratory health of Thai healthcare workers who are exposed to talc has not previously been investigated. The aim of this study was to survey the levels of talc concentration among a representative group of these workers and to determine the relationship between talcum concentration and pulmonary function among them.

METHODOLOGY

Subjects

A cross-sectional study was conducted comprised of 105 workers from two hospitals, Songkla Hospital and Songklanagarind Hospital in Songkhla Province, southern Thailand. Among these subjects, 50 were exposed workers (of which 46 were current workers at the central supply unit and four were retired workers), and 55 were controls from other units in the hospitals. All participants completed a general questionnaire from which demographic data, current health status, talc exposure, occupational history and work experience, personal protective equipment, and smoking habits were obtained.

Spirometry and chest radiographs

Pulmonary function tests (PFTs) are measured by spirometry to determine lung function in the amount (volume) and/or speed (flow) of air that can be inhaled and exhaled. Spirometry parameters included *Forced Vital Capacity* (FVC), which is the total amount of air forcibly blown out after full inspiration, measured in liters**.** *Forced Expiratory Volume* in 1 sec. (FEV_1) is

the amount of air forcibly blown out in one second, measured in liters/second. The ratio of FEV_1/FVC in healthy adults is approximately 75-80%.

Spirometry was performed at the worksites using Pony Graphic V5 following the standards of the Thoracic Society of Thailand. Each subject yielded at least three optimal measures in a sitting position. FEV_1, FVC, and FEV_1/FVC were recorded. Two valid spirometry tests were selected and interpreted by an occupational physician. To determine the pneumoconiosis feature of the lungs, full-size chest radiographs were taken and interpreted by the same occupational physician following the 1980 International Labour Office (ILO) classifications. Abnormal results were then interpreted independently by a radiologist and classified into the ILO categories. High-resolution computed tomography (HRCT) examinations were then performed to confirm the diagnosis of talcosis or silicosis.

Quantity and quality of talcum powder

Concentrations of talcum in the air were measured using a 10-mm nylon cyclone (Dorr-Oliver) and Polyvinyl Chloride (PVC) membrane filter attached to a personal pump following the Occupational Health and Safety Administration (OSHA) Chemical Sampling Information (OSHA, 1999). Area and personal samplings were obtained at the breathing zone level of the workers during work hours as follows: three area and seven personal samples at Songklanagarind Hospital; seven area and nine personal samples at Songkla Hospital. All equipment and samples were prepared and analyzed at the Occupational Health Unit, Prince of Songkla University. To detect silica and asbestos contamination in impure talcum, two bulk samples from Songklanagarind Hospital and one sample from Songkla Hospital were examined using the X-ray diffraction method (XRD). All samples were interpreted at the Scientific Equipment Center, Prince of Songkla University, according to standard procedures.

Statistic analysis

The general characteristics of the exposure and control groups were compared using Pearson Chi-Square and Fisher's Exact Test. The relationship between the lung function tests and the exposures was evaluated by T-test. Multiple regression models were then performed to investigate the association between all variables and lung function tests.

RESULTS

General characteristics

The study population of 105 workers consisted of 25 males and 80 females, with a median age of 45.0 ± 7.8 years (range 21 - 62 years), and average work experience of 18.3 ± 7.9 years (range 0.1 - 34 years). There was no significant difference in age, sex, smoking habits, and working experience between the exposure and control groups (Table 1).

Table 1. Demographic characteristics of exposure and control groups.

Demographic characteristics	N	Exposure group	Control group	p-value
Age (years)	105			
Mean ± S.D.		47.2 ± 6.5	43.2 ± 8.3	< 0.05***
Range		36-62	21-60	
Sex	105			
Male	25 (23.8%)	11 (22%)	14 (25.5%)	> 0.05**
Female	80 (76.2%)	39 (78%)	41 (74.5%)	
Smoking habits	105			
Smoker	11 (10.5%)	4 (8%)	7 (12.7%)	> 0.05*
Non-smoker	93 (88.5%)	45 (90%)	48 (87.3%)	
Ex-smoker	1 (1%)	1 (2%)	0	
Experience (year)	105			
Mean ± S.D		19.4 ±7.8	17.5 ± 7.8	> 0.05***
Range		0.6-34	0.1-27.9	

*Fisher's Exact Test, **Chi-Square Test, ***T-Test

Workplace conditions and contamination of talcum powder

Conditions in the central supply divisions of the two hospitals differed. In Songklanagarind Hospital, it was located on the basement floor; while at Songkla Hospital it was located in a separate building. Both natural and mechanical ventilations were used in the glove room at Songkla Hospital, but only mechanical ventilation at Songklanagarind Hospital. The area concentration of talcum of Songklanagarind Hospital was 0.0147 ± 0.0030 mg/m^3 and the personal sampler concentration was 0.2095 ± 0.2753 mg/m^3. The area concentration of talcum in Songkla Hospital was 0.097 ± 0.1057 mg/m^3 and the personal sampler concentration was 0.1025 ± 0.0533 mg/m^3. The average talcum concentration in both hospitals was 0.0723 ± 0.0951 mg/m^3 for the area sampler, and 0.1493 ± 0.1867 mg/m^3 for the personal sampler; both of which are within occupational standard limits of 2 mg/m^3 (ACGIH, 2005). There was no asbestos or

free silica found in the three bulk samples, but two samples from Songklanagarind Hospital contained dolomite and synthetic magnesite (Table 2).

Table 2. Talcum contamination (x-ray diffusion).

ID / Place	Result	
	Chemical name	Chemical Compound
1/ Songkla Hospital	Talc-2M	$Mg_3Si_4O_{10}$ $(OH)_2$
2/ Songklanagarind Hospital	Talc-2M Dolomite Magnesite, syn	$Mg_3Si_4O_{10}$ $(OH)_2$ $CaMg$ $(CO_3)_2$ $MgCO_3$
3/ Songklanagarind Hospital	Talc-2M Dolomite Magnesite, syn	$Mg_3Si_4O_{10}$ $(OH)_2$ $CaMg$ $(CO_3)_2$ $MgCO_3$

Health status

Of the 50 exposure and 55 control subjects, 14% of the exposure group and 7.27% of the control group reported abnormal symptoms, such as difficulties in breathing, rash, cough, or eye or throat irritation. 99 workers completed spirometry tests and chest radiograph. 92 subjects had a normal lung function test. Of 7 subjects with abnormal spirometry, six had mildly restrictive lung (five from the exposure group and one from the control group), and another one from exposure group had moderately restrictive lung function. Of 5 subjects with abnormal radiographs, three from the exposed group showed small irregular opacities as: s/p, 1/0 with perihilar thickening (Fig. 1); s/s, 1/1, and; s/t, 1/1 whereas the other two in control group showed s/s, 2/1, and p/p, 1/1. A high-resolution computed tomography (HRCT) was taken from three workers who had s/s or s/t with 1/0 profusion, but no talcosis or silicosis was found (Fig. 2). The restrictive spirograms were significantly higher in the exposure group than the control group. However, log FVC, log FEV_1 and the FEV_1/FVC ratio were not significantly different between the two groups (Table 3).

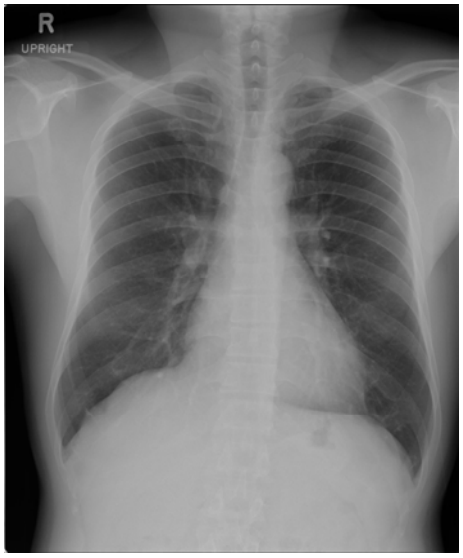

Fig. 1. Example of a worker's radiograph (p/p, 1/1).

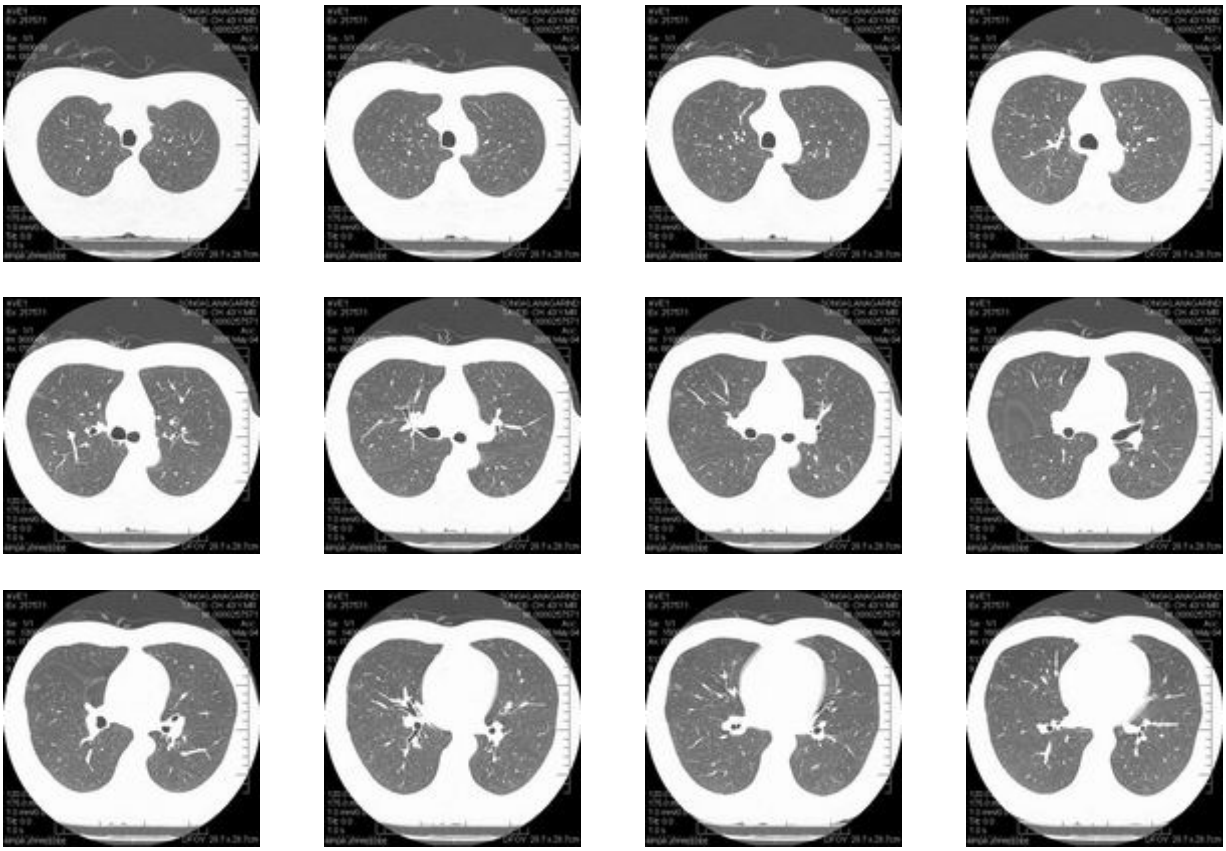

Fig. 2. Example of a worker's HRCT scan (negative finding).

Table 3. Lung function tests and radiographs comparing exposure and control groups.

	No. (%)			
	Total	**Exposure group**	**Control group**	**p-value**
Pulmonary function test	**99**	**46**	**53**	
normal	92 (92.9%)	40 (86.9%)	52 (98.1%)	< 0.05*
abnormal	7 (7.1%)	6 (13.1%)	1 (1.9%)	
- *mildly restrictive*	*6*	*5*	*1*	
- *moderately restrictive*	*1*	*1*	*0*	
Functional variables (mean ± SD)				
- log FEV_1		0.79 ± 0.03	0.86 ± 0.03	> 0.05†
- log FVC		0.94 ± 0.03	1.01 ± 0.03	> 0.05†
- FEV_1/FVC		86.12± 0.81	85.92± 0.72	> 0.05†
Full chest radiography‡	**105**	**50**	**55**	
normal	90 (86.7%)	41 (82%)	49 (89.1%)	> 0.05**
abnormal	15 (14.3%)	9 (18%)	6 (10.9%)	
- *no association with inorganic dust*	*10*	*6*	*4*	
- *association with inorganic dust*	*5*	3	*2*	

*: Pearson Chi-Square, **: Fisher's Exact, †: T-test, ‡: ILO 1980 classification.

DISCUSSION

The average talcum concentration in the two hospitals was 0.0723 ± 0.0951 mg/m^3 (area sampler) and 0.1493 ± 0.1867 mg/m^3 (personal sampler). These values are quite low compared with data from other studies at talcum-producing factories (Wild *et al*., 1982; Stellman, 1998) and lower than the threshold limits of value-time weight average (TLV-TWA). This can be explained by the fact that appropriate general mechanical ventilation was installed in both hospitals, and that an automatic machine was used for applying talcum to gloves. In addition, the workers were exposed to talcum only 4-6 hours/day. No asbestos or free silica was detected in the bulk samples since two main talcum suppliers in these two hospitals were the Thailand Drug and Food Organization which produces only a pharmaceutical or purified grade of talcum; and a supplier from Korea, where the original ores contain no asbestos (Shin and Lee, 2002).

The radiographs showed that three subjects, or 6% of the exposed workers, had abnormal lung parenchyma regarding ILO classification without localized or diffuse pleural thickening. Previous studies involving talc-processing and milling workers reported both irregular and round opacities with profusion of 1/0 or bigger in 11.65% of the subjects, twice as much as our study (Wegman *et*

al., 1982; Wild *et al*., 1982; Avolio *et al*., 1996). This could be explained by the fact that the talcum powder used in the hospitals was a cosmetic grade, so the hospital exposure level may be much lower than in talc mills and mines, which were the focus of previous studies.

The association between talcum level and FEV_1 or FVC were also reported in previous studies, but was not seen in this study. Only age and sex showed association with log FEV_1, log FVC_1 and FEV_1/FVC after adjustment for confounding variables. It is, however, known that differences in age, sex, height, and race can influence the anatomy of the lungs and thus affect the pulmonary function test (Baraldo and Saetta, 2003; NIOSH, 2003). General physical health examinations demonstrated six workers with abnormal respiratory, eye, skin, and nose symptoms, but not significantly different between the exposure and the control groups. This is consistent with a study by Hildick-Smith (1976), which also found no significant difference between workers exposed to low concentration of cosmetic grade talc and their control subjects. In this study, six workers got mildly restrictive lung (five in the exposure group and one in the control group), and one worker in the exposure group reported moderately restrictive lung. The cross-sectional design, at which the studied talcum could represent only the current talcum level in the working environment, but not past exposure, possibly explained the negative association between the talc level and the pulmonary function test.

At present, the studied hospitals are using automatic machines to apply the talcum powder to gloves, and general ventilation is adequately installed. The workers with abnormal lungs described that in former jobs they applied talcum powder to gloves manually in an open area; however, no previous data on talc levels are available. Healthy worker effect, which is perhaps the most common selection bias in occupational studies (Checkoway *et al*., 1989), was avoided in this study by recruiting 4 previously retired workers.

CONCLUSIONS

The talcum concentrations in the studied hospitals were not beyond standard limits. The working conditions were well-controlled and the talcum gradients were asbestos free. The abnormal chest X-rays of a few workers may be at least partly explained by past talcum exposure in these two hospitals or previous occupational exposure.

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