Safety and Health at Work 5 (2014) 234–237

Contents lists available at ScienceDirect

Safety and Health at Work

journal homepage: www.e-shaw.org

Original Article

Lung Function Profiles among Individuals with Nonmalignant Asbestos-related Disorders

Eun-Kee Park [1,*], Deborah H. Yates [2], Donald Wilson [3]

[1] Department of Medical Humanities and Social Medicine, College of Medicine, Kosin University, Busan, Korea
[2] Department of Thoracic Medicine, St Vincent's Hospital, Sydney, NSW, Australia
[3] Department of Occupational Toxicology, Institute of Industrial Ecological Sciences, University of Occupational and Environmental Health, Kitakyushu, Japan

ARTICLE INFO

Article history:
Received 28 April 2014
Received in revised form
30 July 2014
Accepted 31 July 2014
Available online 7 August 2014

Keywords:
asbestos
asbestosis
diffuse pleural thickening
pleural plaques
lung function

ABSTRACT

Background: Inhalation of asbestos fibers can lead to adverse health effects on the lungs. This study describes lung function profiles among individuals with nonmalignant asbestos-related disorders (ARDs).
Methods: The study population was from the Workers' Compensation (Dust Diseases) Board of New South Wales, Sydney, Australia. Lung function measurements were conducted in males with asbestosis ($n = 26$), diffuse pleural thickening (DPT; $n = 129$), asbestosis and DPT ($n = 14$), pleural plaques only ($n = 160$) and also apparently healthy individuals with a history of asbestos exposure ($n = 248$). Standardized spirometric and single-breath diffusing capacity for carbon monoxide (DL_{CO}) measurements were used.
Results: Mean age [standard deviation (SD)] was 66.7 (10.3) years for all participants. Current and ex-smokers among all participants comprised about 9.0% and 54.8%, respectively. Median pack-years (SD) of smoking for ex- and current-smokers were 22.7 (19.9). Overall 222 participants (38.6%) and 139 participants (24.2%) had forced expiratory volume in 1 second (FEV_1) and forced vital capacity (FVC) measurements < 80% predicted, and 217 participants (37.7%) had FEV_1/FVC results < 70%. A total of 249 individuals (43.8%) had DLco values < 80% predicted and only 75 (13.2%) had DLco/VA results < 80% predicted. A total of 147 participants (25.6%) had peak expiratory flow (PEF) measurements < 80% predicted. The presence of ARDs lowered the lung function measurements compared to those of healthy individuals exposed to asbestos.
Conclusion: Lung function measurement differs in individuals with different ARDs. Monitoring of lung function among asbestos-exposed populations is a simple means of facilitating earlier interventions.

1. Introduction

Asbestos is a naturally occurring mineral fiber which is known as a human carcinogen [1]. More than 100,000 people die annually in occupational settings due to asbestos-related diseases caused by inhalation of asbestos fibers [2]. Diseases related to asbestos exposure mostly affect the respiratory system, but in rare cases they affect other locations such as the ovaries and larynx [1]. Reduced lung function among individuals with a history of asbestos exposure is common and has been well recognized [3–6]. Although substantial evidence for impairment of lung function is already described in populations exposed to asbestos, many studies have included cohorts of asbestos-exposed workers, with fewer comparisons between asbestos-exposed individuals without disease and those with asbestos-related disorders (ARDs). The use of lung function measurements to screen ARDs is still widely employed as a primary screening tool.

Several recent reports have warned that ARDs in Asian countries could increase in the near future [7–9] because asbestos consumption has been high since the late 1980s and into the 1990s [10].

* Corresponding author. Department of Medical Humanities and Social Medicine, College of Medicine, Kosin University, 262 Gamcheonro, Seogu, Busan 602-702, Korea.
E-mail address: ekpark@kosin.ac.kr (E.-K. Park).

http://dx.doi.org/10.1016/j.shaw.2014.07.007

Caution is necessary in ensuring that an accurate diagnosis of ARD is made prior to monitoring of lung function. Nevertheless, adverse health impacts from asbestos exposure are not well recognized in this region. The purpose of this study was to determine the lung function profiles among individuals with nonmalignant ARDs.

2. Materials and methods

2.1. Study population

We obtained data from a study population that is well-described elsewhere [11]. In brief, the study was conducted at the Workers' Compensation (Dust Diseases) Board of New South Wales, Sydney, Australia. This study had approval from the Human Research Ethics Committee of St. Vincent's Hospital, Sydney, Australia. All participants gave their written informed consent and were not compensated for their participation. Participants were diagnosed with their respective ARDs according to the American Thoracic Society (ATS) criteria [12]. Criteria for asbestosis included a history 25 fiber/mL-years exposure to asbestos, the presence of bilateral fine end-inspiratory crackles on auscultation, and the presence of subpleural interstitial opacities on chest radiology (usually high resolution computer tomography scan), in the absence of other causes of interstitial pulmonary fibrosis. Criteria for the diagnosis of diffuse pleural thickening (DPT) were involvement of >25% of the chest wall on plain chest radiology, 8 cm × 5 cm × 3 cm in total on chest computer tomography, and/or the presence of Blesovsky's syndrome [13]. Pleural plaques were diagnosed according to their presence on chest radiograph or computer tomography scan, and included calcified and non-calcified circumscribed pleural thickening.

In New South Wales, compensation for ARDs is provided by the Dust Diseases Board (DDB) according to the Workers' Compensation (Dust Diseases) Act 1942. Individuals with known or suspected "dust diseases" are referred to the DDB and undergo a standardized occupational history documenting asbestos exposure, clinical examination, lung function testing, and medical imaging as required. Information is then reviewed by a Medical Authority consisting of at least three appropriately qualified thoracic physicians. A diagnosis is reached or declined, and an assessment of disablement made according to American Medical Association IV criteria [14].

2.2. Pulmonary function assessment

Forced expiratory volume in 1 second (FEV_1), forced vital capacity (FVC), percent ratio between FEV_1 and FVC (FEV_1/FVC), single-breath carbon monoxide diffusing capacity (DLco) and DLco/alveolar volume (DLco/VA), and peak expiratory flow (PEF) were measured by spirometry using the Sensormedics Vmax 22D-Spectra (Viasys Healthcare, Conshohocken, PA, USA). During the study period, the same equipment was used by the same trained technician. At least three FVC manoeuvres and DLco trials were obtained for each participant according to ATS guidelines [15,16]. The results were expressed as absolute values and as percent of the predicted values for FVC, FEV_1, and DLco calculated on the basis of age, height, and gender for Caucasians, using the predictive equations provided by the European Respiratory Society 1993 update [17].

2.3. Data analysis

Descriptive statistics were performed for outcome and predictor variables and covariates. Analysis of variance test and generalized liner models (GLM) were used to compare means, while adjusting for confounding factors, namely age, smoking pack-years, and body mass index (BMI). The GLM procedure uses the method of least squares and analyzes data within the framework of general linear models, and in this case, we use the models not only to compare two or more means, but also as linear regressions, to predict the effect of a factor on an outcome variable. All comparisons were two-sided and $p < 0.05$ was treated as significant. Analyses were performed in SAS, version 10 (SAS Institute Inc., Cary, NC, USA).

3. Results

3.1. Study population

Baseline characteristics of the participants in this study are shown in Table 1. Data analyzed from the 577 males comprised the following categories: asbestosis ($n = 26$), DPT ($n = 129$), asbestosis and DPT ($n = 14$), pleural plaques only ($n = 160$, PPs) and apparently healthy individuals formerly exposed to asbestos ($n = 248$). Mean age (SD) was 66.7 (10.3) years for all participants. Current and ex-smokers among all participants comprised about 9.0% and 54.8%, respectively. Median pack-years (SD) of smoking for current and ex-smokers were 22.7 (19.9). A total of 469 participants (81.3%) were overweight and obese (BMI ≥ 25).

3.2. Pulmonary function measures

Pulmonary function outcome measures are described in Table 2. Out of the sample population, 222 participants (38.6%) and 139 participants (24.2%) had FEV_1 and FVC measures that were <80% predicted, respectively, and 217 participants (37.7%) had FEV_1/FVC

Table 1
Characteristics of participants by asbestos-related disorder category

Characteristic	All	Asbestos-related disorder category					
		Healthy*	Asbestosis	DPT†	Asbestosis/DPT	Pleural plaques	p‡
Subjects included in final analysis [n (%)]	577 (100)	248 (43.0)	26 (4.5)	129 (22.4)	14 (2.4)	160 (27.7)	
Age [Mean (SD)] (y)	66.7 (10.3)	60.9 (10.5)	72.7 (6.7)	71.8 (6.8)	72.9 (6.7)	69.3 (8.9)	<0.0001
Smoking status (%)							
Ex-smoker	54.8	42.3	61.5	73.6	85.7	55.0	<0.0001
Current smoker	9.0	11.7	11.5	5.4	0	8.1	
Never smoker	36.2	46.0	26.9	20.9	14.3	36.9	
Pack years [mean (SD)]	22.7 (19.9)	21.0 (18.2)	24.8 (14.4)	23.5 (18.8)	15.9 (18.0)	24.5 (23.7)	0.0076
Body mass index, kg/m^2 [n (%)]							
18.5–24.9	105 (18.2)	46 (18.6)	3 (11.5)	17 (13.2)	2 (14.3)	37 (23.1)	0.2027
25.0–29.9	294 (51.0)	117 (47.2)	17 (65.4)	69 (53.5)	10 (71.4)	81 (50.6)	
≥30	175 (30.3)	83 (33.5)	6 (23.1)	43 (33.3)	2 (14.3)	41 (25.6)	

ANOVA, analysis of variance.
* Apparently healthy with a history of asbestos exposure.
† Diffuse pleural thickening.
‡ For significance testing: Chi-square tests were performed for proportions and ANOVA analyses for arithmetic means.