

Abstracts

Oral Session 4 – Lung function studies

04.1 LUNG FUNCTION IN A COHORT OF ASBESTOS EXPOSED WORKERS IN THE POWER INDUSTRY IN VICTORIA

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Background: In 1979, the State Electricity Commission of Victoria established a lung function screening programme for its employees. We wished to establish how lung function amongst participants varied in relation to asbestos exposure and whether this was related to mortality.

Methods: The study population consisted of 3138 former employees who had been medically assessed and had lung function testing between 1979 and 1992. Mortality was ascertained by linkage to the National Death Index and survival analysis performed using Stata software.

Results: At first attendance, 39.6% were current smokers, 32.3% former smokers, and 28.1% had never smoked. Forced expiratory volume in 1 second (FEV₁) was lower among current smokers, and an effect of smoking cessation emerged after the age of 40 years. On average, never smokers had a 7.6% (95% confidence interval 6.3% to 8.9%) greater mean FEV₁ predicted than current smokers, and former smokers had a mean FEV₁ of 5.7% (4.5% to 7.0%) greater than that of current smokers. Asbestos exposure was assessed as negligible (incidental) in 19.8%, environmental (background) in 48.8%, occasional direct handling in 24.5%, and handling in confined spaces for 6.9%. There were significant relationships between FEV₁% predicted at enrolment and both the duration (F=14.1, p<0.0001) and level (F=5.77, p=0.0006) of asbestos exposure. The lowest FEV₁ quintile had higher than expected mortality, with an excess of 70 deaths observed over the 163 deaths expected in that group. There was a clear gradient in observed deaths by FEV₁ quintile (log rank test $\chi^2=46.5$, p<0.0001).

Conclusions: The level and duration of asbestos exposure were significantly related to impaired lung function after allowing for the high smoking rates in this cohort. Impaired lung function significantly increased the risk of dying, although only 30 deaths were due to non-malignant respiratory diseases.

04.2 SHORT TERM CHANGES IN LUNG FUNCTION AMONG WORKERS MANUFACTURING BACTERIAL SINGLE CELL PROTEIN AND HIGHLY EXPOSED TO ENDOTOXINS

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Introduction: Workers in a plant producing bacterial single cell protein (SCP), a product used in animal feed, complained of attacks of fever, fatigue, and chest tightness. These attacks occurred principally after incidents with high exposure to bacterial aerosols generated from the culture fluid and the dry product. Epidemiological studies of endotoxin exposed populations and human challenge studies with pure endotoxins have shown considerable differences in no effect levels of endotoxins (mainly lung function changes). The exposure in the SCP plant is quite unique because the aerosol mainly consists of the gram negative bacterium *Methylococcus capsulatum* with its endotoxins. It was therefore interesting to study short term changes in pulmonary function in response to endotoxin exposure in this plant.

Methods: Lung function was measured in 28 workers by spirometry before and after a work shift following at least two exposure free days. Exposure to endotoxins was measured by personal filter sampling during the shift, and analysis used the Limulus amoebocyte method.

Results: Most workers performed any extraordinary task using powered respirators. The geometric mean endotoxin concentration was 10 000 EU/m³ (geometric SD 6.9). Forced vital capacity decreased significantly for the whole group by 84 mL (SE 32 mL), and forced expiratory volume in 1 second (FEV₁) by 77 mL (SE 33 mL) (both p<0.05) but was normalised the day after. There was a significant association between the endotoxin concentration and decrease in FEV₁ despite the use of respiratory protection. Fall in FEV₁ was mainly observed in workers with endotoxin concentrations >10 000 EU/m³. If a protection factor of 10 is applied, these results indicate that exposure levels below 1000 EU/m³ does not induce fall in FEV₁.

Conclusions: The results indicate that endotoxin levels exceeding approximately 1000 EU/m³ during a work shift induce a significant fall in FEV₁ in SCP workers exposed to a fairly homogeneous aerosol of gram negative bacteria. This level is high compared with other populations exposed to mixed bioaerosols, but substantially lower than in human volunteers exposed to an aerosol of purified endotoxin.

04.3 RESPIRABLE DUST RELATED LUNG FUNCTION EFFECTS BETWEEN CURRENT AND FORMER SOUTH AFRICAN COALMINERS

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Background: Dust related dose–response decrease in lung function among coalminers has been reported with varying magnitudes in several studies. Few studies have compared differences between current and former coal miners. No studies on the respiratory health of coalminers have been conducted in South African, one of the top three producers of coal internationally.

Objectives: To describe the relationship between respirable dust exposure and lung function among South African current and former coalminers and to determine whether differential dust related effects were present in these employment categories. To examine dose–response relationships, controlling for potential confounding by smoking and a history of tuberculosis.

Methods: We studied 684 current and 188 former miners from three bituminous coal mines in Mpumalanga province. Interviews assessing work histories, smoking profiles and other risk factors were conducted. Work histories were also obtained from company records. Standardised spirometry was performed by trained technicians. Cumulative respirable dust exposure (CDE) estimates were constructed from company dust data and researcher collected data. Regression models examined the associations of CDE with percent predicted forced expiratory volume in 1 second (FEV₁) and forced vital capacity (FVC), controlling for smoking, past history of TB and employment status.

Results: A statistically significant decline in FEV₁ of 1.1 ml/mg year/m³ ml and 2.2 ml/mg year/m³ in a representative 40 year old, 1.7 m tall current and ex-miner respectively, was observed. Significant differences were found between the highest and medium exposure categories. Ex-miners had a lower mean per cent predicted lung function than current miners for each cumulative exposure category, suggesting a “healthy worker” effect. Past history of TB contributed to 21% and 14% declines in percent predicted FEV₁ and FVC respectively.

Conclusions: In this cohort, a dose related decline in lung function was associated with respirable dust exposure, with an effect similar to that seen in other studies and important differences between current and former employees. A “healthy worker” effect may have attenuated the magnitude of this relationship.

04.4 LUNG FUNCTION LOSS IN SOUTH AFRICAN GOLDMINERS

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Objective: To measure the exposure–response relationships between respirable dust, past tuberculosis (TB) history, and lung function indices

of currently serving goldminers. This was the first study of South African goldminers to use measured gravimetric dust exposure information.

Methods: We enrolled 520 goldminers >38 years of age in a cross sectional study. Complete job histories were obtained using three sources: a questionnaire, company personnel data, and employment bureau data. Research and routine occupational hygiene sources were used to construct a job exposure matrix. Cumulative respirable dust years for each miner were then calculated. Jaeger measured forced expiratory volume in 1 second (FEV₁) and forced vital capacity (FVC) were performed according to American Thoracic Society specifications. Linear regression adjusted for past TB, cumulative dust exposure, age, height, and smoking.

Results: Mean length of service was 21.8 years (range 6.3 to 34.5), with the median number of jobs held being 5 (range 1 to 16). The mean

intensity of respirable dust exposure was 0.37 mg/m³ (range 0 to 0.70) and 29% and 23% of the miners, respectively, were current and former smokers. Mean FEV₁ was 3256 ml (95% confidence interval 3202 to 3310), and FVC was 4069 ml (4008 to 4130), being 105% (9103 to 106) and 104% (103 to 105) of predicted values respectively. In those with past TB, excess FEV₁ loss was 283 ml (159 to 407) and excess FVC loss was 188 ml (52 to 323). Cumulative respirable dust was associated with excess FEV₁ loss of 19 ml/mg/m³ year (2 to 37), and an excess FVC loss of 18 ml/mg/m³ year (1 to 38). Smoking was surprisingly not associated with excess loss.

Conclusion: Past TB had the greatest impact on lung function loss, with the impact of cumulative dust exposure being approximately half that at current dust levels. This highlights the need to control both TB and dust.