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Bacterial Endotoxins and their Impact on Respiratory System among Greek Cotton Industry Workers

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Exposure to cotton dust is associated with several occupational lung diseases. The dust is often contaminated with Gram-negative bacteria containing endotoxins.[1-4] This article is a secondary analysis from a cross-sectional study on respiratory symptoms and lung function of cotton industry workers in Greece. Details on the assessment of respiratory symptoms and lung function indices have been reported elsewhere.[5]

To measure airborne endotoxins, 37-mm endotoxin-free fiberglass filters were used. For each measurement, the whole air sampling head was decontaminated using depyrogenation procedures. A dust sampling head attached to a Gillian high-flow pump (Model HFS513A, Sensidyne, USA) was used; the airflow was set to 2.0 L/min. Each single measurement lasted four hours. Non-pyrogenic tools were used to place each sample at a sealed container and prepare them for transport. The filters were then sent to University of Thessaly, at the Regional Laboratory of Public Health for endotoxin analysis.

Endotoxin levels were measured using Limulus Amebocyte Lysate (LAL) endpoint method (Regional Public Health Laboratory, University of Thessaly, Katsigras Building, 41222, Larissa, Greece). The LAL test performed was qualitative, indicating endotoxin level above specific thresholds or not. Air particulates collected on filters were extracted by shaking filters in pyrogen-free tubes with 5-mL endotoxin-free water. By consequent dilutions, four different endotoxin concentrations were made. The endotoxin level was expressed as endotoxin units per cubic meter of air volume (EU/m^3) and categorized into "<100," "100–1000," "1000–2000," and ">2000" EU/m^3.

For the time being, there is only one recommendation on endotoxin exposure limit (an average of 90 EU/m^3 over an 8-hour working day) proposed by the Health Council of the Netherlands.[6] High exposure levels were recorded in our study, near the ginning machines (>2000 EU/m^3) and the blending machines—before the spinning process (>2000 EU/m^3).

Statistical analysis revealed a significant (p=0.02) linear correlation between endotoxin levels and FEV_1/FVC among studied workers. However, in order to estimate the level of cumulative exposure to endotoxins, a new variable "endotoxin exposure" (EXP) was defined as multiplication of "working years at a certain position in cotton industry" by "respective endotoxin exposure level measured at that working

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position." EXP can vary from '0' to '3.'

Multiple linear regression analysis showed that FEV_1/FVC% can be predicted according to the following equation:

$$FEV_1/FVC\% = 87.29 - 0.09Age - 0.10\ Smoking\ \text{(pack-years)} - 0.09EXP$$

It was found that exposure to high levels of airborne endotoxin (>2000 EU/m^3) was significantly ($p<0.001$) associated with reduced spirometry scores. Endotoxin exposure was also found to be highly correlated with presence of dyspnea ($p<0.001$), chronic cough ($p=0.016$), and spitting ($p<0.001$).

Measuring endotoxin levels may be a useful tool for the prevention of obstructive respiratory disorders among cotton industry workers. However, there is no consensus on the threshold concentration of endotoxin at workplace.

Conflict of Interest: None declared.

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