Online Data Supplement

Title:

Long-term Effects of Work Cessation on Respiratory Health of Textile Workers

A 25-year Follow-up Study

Author:

Jing Shi, Amar Mehta, Jin-qing Hang, Hong-xi Zhang, He-lian Dai, Li Su, Ellen A. Eisen, David C. Christiani

Exposure assessment

Six work areas in yarn preparation and weaving in the cotton mills were measured for full shift airborne cotton dust and associated endotoxin at the first four surveys using the vertical elutriator (VE). Samplers and sample locations were identical for all three surveys, as were handling techniques and measurements. The work areas for all phases of yarn preparation included: opening, cleaning, carding, drawing, roving, combing, and spinning. Samples were collected in the same areas on follow-up as in the initial survey, and there was no change in the handling or method of weighing the filters. A total of 730 samples were collected over the three surveys in the yarn preparation areas of the two cotton mills. Measurements of typical work activities were taken during a 4-month period (September–December) for the first two surveys, and expanded over a four-season (12-month) period during the third survey. Hence, the sampling period covered 20 months over the 11-year period of follow-up. Between the first and second surveys, production and conditions were stable. During the 6 years between survey 2 and 3, changes in cotton processing had taken place. Specifically, the mills began to blend synthetic fiber with cotton in the interval between the second and third surveys, and pure yarn production slowed. A limited number of full-shift samples (n = 512) were also taken in the silk mill, and measurements for endotoxin were non-detectable (below the limit of detection).

Endotoxin assays were performed by the same laboratory on the dust samples using the Limulus amoebocyte lysate assay, chromogenic method (Kinetic-QCL; BioWhittaker, Walkersville, MD), as previously described [1]. Although the LAL assay is common assay for quantifying airborne endotoxin concentration from cotton dust samples, there is no universally agreed upon standard protocol [2]. Spaan et al's study on sewage endotoxin exposure suggested that the LAL-assay did not result in much exposure misclassification after comparison of sampling and analytical techniques [3]. In the Shanghai cotton textile industry, Mehta et al. [4] observed a high correlation in estimated airborne endotoxin concentration (log EU/m^3) between two laboratories performing an analysis of duplicate samples of airborne cotton dust. In general, background levels of endotoxin in the environment are below 10 EU/m^3, but mean endotoxin concentrations in occupational settings have ranged from several EU/m^3 [5] to 7500 EU/m^3 [6]. The measurements from our study also are within the ranges reported in other studies.

Exposure measurements collected from the first survey were used to estimate pre-1981 levels. A cumulative exposure index was calculated by the addition of the products of the years exposed in each work area by the geometric mean endotoxin exposure. Since the dust level refers to cotton dust, cumulative dust level for silk workers is always zero. Endotoxin level for silk workers was also set at zero because full-shift measurements in the silk mill were below the limit of detection.

Years since cessation of exposure was defined as the difference (in years) between the survey date and the date last worked in a job exposed to cotton dust (for cotton workers) or last worked in a silk textile processing job (for silk workers). If the survey date preceded date of exposure cessation, then year since cessation of exposure was assigned a value of '0', meaning they were actively exposed/working.

References:

[E1] Olenchock SA, Christiani DC, Mull JC, Ye TT, Lu PL. 1990. Airborne endotoxin concentrations in various work areas within two cotton textile mills in the People's Republic of China. Biomed Environ Sci 3(4): 443-451.

[E2] Dungan Robert, Leytem April, Ver Wey Shery. Optimizing the extraction, storage, and analysis of airborne endotoxins. American Society of Microbiologists Abstracts, Feb. 20, 2009

[E3] Suzanne Spaan, Lidwien A. M. Smit, Wijnand Eduard, Lennart Larsson, Huib J. J. M. Arts, Inge M. Wouters, Dick J. J. Heederik. *Ann Agric Environ Med* 2008, 15, 251-261

[E4] Mehta AJ, Wang XR, Eisen EA, Dai HL, Astrakianakis G, Seixas N, Camp J, Checkoway H, Christiani DC. Work area measurements as predictors of personal exposure to endotoxin and cotton dust in the cotton textile industry. *Ann Occup Hyg* 2008, 52, 45-54.

[E5] Bünger J, Schappler-Scheele B, Hilgers R, Hallier E. A 5-year follow-up study on respiratory disorders and lung function in workers exposed to organic dust from composting plants. *Int Arch Occup Environ Health* 2007, 80, 306-12.

[E6] Schierl R, Heise A, Egger U, Schneider F, Eichelser R, Neser S, Nowak D. Endotoxin concentration in modern animal houses in southern Bavaria. *Ann Agric Environ Med* 2007, 14, 129-36.

Table E1 Values of cumulative exposure cut points at the 75^{th} percentile

Year of survey	**75^{th} percentile of exposure, EU/m^3-yr**
1981	32111.50
1986	43771.26
1992	60924.39
1996	75183.12
2001	77316.13
2006	75876.31