

ORIGINAL ARTICLE

Airborne asbestos take-home exposures during handling of chrysotile-contaminated clothing following simulated full shift workplace exposures

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The potential for para-occupational, domestic, or take-home exposures from asbestos-contaminated work clothing has been acknowledged for decades, but historically has not been quantitatively well characterized. A simulation study was performed to measure airborne chrysotile concentrations associated with laundering of contaminated clothing worn during a full shift work day. Work clothing fitted onto mannequins was exposed for 6.5 h to an airborne concentration of 11.4 f/cc (PCME) of chrysotile asbestos, and was subsequently handled and shaken. Mean 5-min and 15-min concentrations during active clothes handling and shake-out were 3.2 f/cc and 2.9 f/cc, respectively (PCME). Mean airborne PCME concentrations decreased by 55% 15 min after clothes handling ceased, and by 85% after 30 min. PCM concentrations during clothes handling were 11–47% greater than PCME concentrations. Consistent with previously published data, daily mean 8-h TWA airborne concentrations for clothes-handling activity were approximately 1.0% of workplace concentrations. Similarly, weekly 40-h TWAs for clothes handling were approximately 0.20% of workplace concentrations. Estimated take-home cumulative exposure estimates for weekly clothes handling over 25-year working durations were below 1 f/cc-year for handling work clothes contaminated in an occupational environment with full shift airborne chrysotile concentrations of up to 9 f/cc (8-h TWA).

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INTRODUCTION

Previously published studies and reviews related to asbestos and take-home exposures have primarily explored the association between disease incidence and the reported potential for household or non-occupational exposure.^{1–9} Beginning in 1976, a number of epidemiological studies reported on the risk for developing pleural mesothelioma in the household contacts of asbestos workers.^{1,4,9–13} Some studies have also noted that cases of disease in the household contacts of asbestos workers occurred more commonly in certain professions, such as insulation workers and miners, as well as some asbestos product manufacturing and shipyard workers.^{2,3,5,8–10}

When studies have reported the asbestos mineral fiber type associated with disease in household contacts, authors have specifically cited exposure of the workers to amosite,^{4,13} crocidolite,⁶ or general/mixed amphibole and chrysotile exposure.^{8,9} It is notable that there is a large body of evidence in the published literature supporting substantial differences in fiber potency according to asbestos mineral type, with chrysotile being the least potent of the common industrial mineral types for lung cancer and mesothelioma, and the amphiboles (including both amosite and crocidolite) being far more potent.^{14–18} The accumulated evidence to date points to the potential for increased risk of disease in

household populations with take-home exposure above some cumulative lifetime exposures to amphiboles or mixed asbestos fiber types.^{8,9,13}

World asbestos production data have shown that the use of amphibole asbestos began to decline in the 1970s and ceased in the 1990s, whereas chrysotile production did not begin to decrease until the 1990s.^{19,20} Owing to the marked differences in potency, epidemiological study results of take-home exposures to amphiboles or mixed fibers are not relevant to populations exposed to predominantly or only chrysotile.^{15,21} Additionally, the epidemiology studies on take-home exposure generally involved persons who historically worked in industries with asbestos exposure beginning in the 1930s and 1940s through the 1970s or 1980s.^{9,13,22,23}

Few studies have addressed the magnitude of airborne asbestos concentrations in the home environment associated with take-home contamination potential from the workplace. The National Institute for Occupational Safety and Health (NIOSH) and others have examined available indirect evidence of the asbestos take-home exposures of household members using such methods as questionnaire responses, evidence from medical evaluations, and reports of possible sources of asbestos exposure in the home.^{7,10,24} NIOSH highlighted laundering of the asbestos-contaminated

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