Annals of Work Exposures and Health, 2020, Vol. 64, No. 1, 106–109
doi: 10.1093/annweh/wxz082
Advance Access publication 12 November 2019
Short Communication

Short Communication

Malignant Mesothelioma Among Employees of a Connecticut Factory That Manufactured Friction Materials Using Chrysotile Asbestos: An Update

Murray M. Finkelstein[1,2,*] and Christopher Meisenkothen[3]

[1]Department of Family Medicine, McMaster University, 336 Spadina Road, Suite 902, Toronto, Ontario M5R 2V8, Canada; [2]Department of Family and Community Medicine, University of Toronto, 336 Spadina Road, Suite 902 Toronto, Ontario M5R 2V8, Canada; [3]Early, Lucarelli, Sweeney & Meisenkothen, LLC, One Century Tower, 11th Floor 265 Church Street New Haven, CT 06510, USA

*Author to whom correspondence should be addressed. Tel: 416-886-6448; e-mail: murray.finkelstein@utoronto.ca

Submitted 9 April 2019; revised 26 September 2019; editorial decision 29 September 2019; revised version accepted 9 October 2019.

Abstract

There is an ongoing argument about the potency of chrysotile asbestos to cause malignant mesothelioma. Authors of chrysotile risk assessments have relied upon the results of an epidemiologic study, published in 1984, to state that there were no mesotheliomas found among workers at a Connecticut friction products plant. McDonald reported the first two cases in 1986. In 2010, we reported the work histories and pathologic reports of five individuals from the Connecticut plant who were diagnosed with mesothelioma. Despite this, a review of the health effects of chrysotile published in 2018 continued to state that there were no cases of mesothelioma from this plant. We report here two new cases that were diagnosed after the publication of our previous report, bringing the current total to nine cases. We also discuss the results of previously unpublished air sampling data from the plant. Chrysotile, mainly from Canada, was the only asbestos fiber type used until 1957 when some anthophyllite was added in making paper discs and bands. Beyond this original description of the anthophyllite usage from McDonald, there is a dearth of information about the amount of anthophyllite used in the plant, the frequency of its use, and the specific departments where it was used. For over 30 years in the published literature, this factory has alternatively been described as a 'chrysotile' or 'predominantly chrysotile' factory. While it is clear that some anthophyllite was used in the factory (in addition to 400 pounds of crocidolite in the laboratory), given the volume, frequency, and processes using chrysotile, it still seems satisfactory to describe this cohort as a predominantly, but not exclusively, chrysotile-exposed cohort.

Key Words: asbestos friction products; asbestos risk assessment; chrysotile; mesothelioma.

Introduction

The incidence of malignant mesothelioma among workers at the Raybestos-Manhattan friction products factory in Connecticut has been a source of ongoing interest. Two cases were initially reported by Teta *et al.* (1983) and McDonald (1986). Five additional cases were brought to light by Egilman and Billings (2005). We further clarified and refined the information on those five additional cases and calculated an approximate risk estimate based on the two cases that would have been cohort eligible in McDonald *et al.* (1984; Finkelstein and Meisenkothen, 2010). Most of these cases of mesothelioma among former plant workers have been overlooked in the literature (Finkelstein and Meisenkothen, 2010) and this continues to be the situation. A recent review of the toxicity of asbestos reported no cases of mesothelioma among workers at the plant (Garabrant and Pastula 2018). The aim of this paper is to remind readers that cases of mesothelioma have occurred in this plant and to report two additional cases among plant employees. We also briefly discuss previously unpublished air sampling data that provides rough context to the environmental exposures inside the factory in the 1970s.

Methods

The factory and the McDonald cohort

The factory

Our description of the factory is based upon the work of McDonald *et al.* who published an epidemiologic report in 1984 (McDonald *et al.* 1984). The factory began work in 1913. From the late 1930s, dry molded and roll extruded wire back brake linings were made. The dry process was discontinued around 1970, but the roll extruded process continued at least into the 1980s. In the 1940s, automatic transmission friction materials, friction discs, and bands were introduced in substantial volume. Chrysotile, mainly from Canada, was the only mineral type of asbestos used until 1957 when some anthophyllite was added in making paper discs and bands. About 400 pounds of crocidolite was handled experimentally on a few occasions in the laboratory but only between 1964 and 1972. According to records in our possession, over 5000 tons of asbestos were ordered from Canadian suppliers in 1968. One Canadian supplier shipped between 124 and 825 tons of chrysotile annually between 1967 and 1983.

A research team led by McDonald conducted an epidemiologic study of the Raybestos Connecticut plant (McDonald *et al.* 1984). A worker cohort was created that included everyone who had been employed for a calendar month or more before 1 January 1959 and who had a social security number that matched with data in the US Social Security files. The cohort included 3641 men and 905 women. Vital status was established as of 31 December 1977. Causes of death were coded using the seventh revision of the International Classification of Diseases.

Records reviewed

Two workers diagnosed with malignant mesothelioma sought legal representation from Early, Lucarelli, Sweeney & Meisenkothen, LLC of New Haven, Connecticut. We reviewed the work history and medical information from their case files for the preparation of this report.

Results

The subjects and their diseases

Table 1 gives information about the new subjects, their work histories, and the details of their diagnoses. Subject 1 is a male who worked at the plant from 1966 to 1983 (possibly 1984, according to his deposition testimony). He worked in Department 4 (Automatic Transmission Assembly Grinding) as a machine operator and reported exposure to asbestos from the grinding dust, the general room air, and during breaks when he would sit on bags of asbestos fiber. The subject also had paraoccupational exposure from work with brake linings on his personal vehicles from 1968 to 1977 and from the joint compound at his home in the 1970s. He denied any asbestos exposure at jobs prior to Raybestos or subsequent to

Table 1. New cases of mesothelioma among Raybestos-Manhattan employees

Subject	Work history	Pathology
Case 1 (male); date of birth 1945	Machine operator in Department 4 (automatic transmissions) 1966–1983/1984	2017 (pleural mesothelioma, epithelioid type)
Case 2 (male); date of birth 1943.	Machine operator in Department 4 (automatic transmissions) 1961–1967 and 1969. Occasionally 'loaned out' to Departments 1, 2, 15, and 32 and Quality Control.	2016 (pleural mesothelioma, epithelioid type)

Raybestos. The diagnosis of malignant pleural mesothelioma (epithelioid type) was confirmed by pleural biopsy, including immunohistochemical staining. Prior to his diagnosis with mesothelioma, his medical records variously noted a recurring pleural effusion, asbestosis, 'dense pleural plaque bilaterally', 'significant pleural disease', a 'calcified fibrotic pleura' and 'asbestos exposure'. Because he began work in 1966, he would not have been eligible for the McDonald cohort

Subject 2 worked at the factory from 1961–1967 and again in 1969. He worked primarily in Department 4 as a machine operator but was occasionally 'loaned out' to other departments, including Departments 1 and 2 (mixing raw materials and cutting sheets of preformed asbestos material), 15 (die cutting sheet metal), and 32 (brake grinding and finishing) and once to the Quality Control Department. He reported the occasional use of a dust mask during his employment but noted that it was ineffective to protect him from the pervasive dust. The subject also had paraoccupational exposure from work in his home with vinyl asbestos floor tiles, sheet flooring, and joint compound, as well as furnace cement at a relative's home. He denied any exposure at jobs other than Raybestos. The diagnosis of malignant pleural mesothelioma (epithelioid type) was confirmed by two separate biopsies, including immunohistochemical staining, from two hospitals. Because he began work in 1961, he would not have been eligible for the McDonald cohort.

Air sampling data

McDonald *et al.* (1984) provided 'best guess' estimates of average dust concentrations for various processes in the factory from 1930 to 1969, with an overall average of 1.84 mppcf. The exposure estimates were apparently based on midget impinger dust counts from the 1930s, employee interviews, plant records, and the 'best estimates' of their hygienist. They declined to convert these estimates into fiber measurements, noting the inherent unreliability of such an exercise: 'Conversion of particle to fibre measurements has not been attempted because of the large amount of work it entailed and the meagre confidence which we could have placed in the resulting estimates.' In 1984, a Committee of the National Research Council estimated that 1 mppcf equaled 6 long fibers cm^{-3} or 360 fibers by Electron Microscopy ± one order of magnitude (National Research Council (US) Committee on Nonoccupational Health Risks of Asbestiform Fibers, 1984).

Previously unpublished surviving fiber measurements from the 1970s revealed recurring asbestos dust problems throughout the factory, including specifically in the subjects' work areas. The measurements were done by Company hygienists using Phase Contrast Microscopy, but there are no discussions of Quality Control in the surviving reports. A report from October 1972 recorded asbestos dust problems in Departments 1, 4, and 32. A report from October 1974 included various jobs in Departments 1, 2, 4, and 32 among a number of other high-exposure positions over 2 f cm^{-3} but under 3 f cm^{-3}. Other jobs in Departments 2 and 32 were listed in another category, with exposures over 3 f cm^{-3} but under 4 f cm^{-3}. Departments 1 and 2 had other jobs in the category over 4 f cm^{-3} but under 5 f cm^{-3}. The report noted several specific dusty operations in Department 4, including the fact that 'some of the grinding dust adheres to the parts and is released to the room air at the point of discharge as they drop onto the stacking or collecting spider'.

A report from November 1975 recorded several jobs in several departments as being in excess of 2 f cm^{-3}, including Departments 1, 2, and 4. Another report from January 1977 stated: 'It is not possible to define asbestos exposure of employees within strict limits as all employees are probably exposed to some extent at some time during their service at the plant. The plant lay-out is not based on distinct product flow-lines and it is impossible to assess to what extent each manufacturing process for each product contributes to any one worker's asbestos exposure'. The report noted several problem areas in the plant, including in Departments 2 and 4. The main asbestos type in all of these Departments was chrysotile. However, as reported by McDonald *et al.* (1984), some anthophyllite had been used in the plant for 'paper disks and bands'. We were unable to obtain any additional information about the use of anthophyllite and it is uncertain whether or not anthophyllite may have been used in Department 4, where they made automatic transmission disks, or what part of the measured fiber exposures may have been comprised of anthophyllite. As noted by McDonald, 'about 400 lb of crocidolite was handled experimentally on a few occasions in the laboratory but only between 1964 and 1972'. These laboratory experiments do not appear to apply to either of these men since the laboratory was not Department 4 (nor any of the other departments that have been identified by either man).

Discussion

This report adds to the previously identified cases of malignant mesothelioma among the workers at the Raybestos-Manhattan friction products plant in Connecticut. Combining the earlier reports by Teta *et al.*

(1983) and Egilman and Billings (2005; as refined by Finkelstein and Meisenkothen (2010)), we now count nine cases of mesothelioma from this plant. One of those cases—Subject 3 in Finkelstein and Meisenkothen (2010)—was excluded due to a history of mixed exposure, leaving eight cases, three women and five men. Three of the cases of mesothelioma in the plant were diagnosed in women. To the best of our knowledge, these subjects were clerical workers. There is no information about possible asbestos exposures in the office areas or about their possible visits to production areas.

Both of the new case subjects had exposure to asbestos outside of the plant. Subject 1 had paraoccupational exposure from work with brake linings on his personal vehicles from 1968 to 1977 and from the joint compound at his home in the 1970s. Subject 2 also had paraoccupational exposure from work in his home with vinyl asbestos floor tiles, sheet flooring, and joint compound, as well as furnace cement at a relative's home. Any fibers inhaled from this paraoccupational work would likely have been Chrysotile (because amphiboles were not used in the manufacture of friction products, flooring, joint compound, or furnace cement in the United States) and these exposures would have added to the risk arising from occupational exposures.

Conclusions

As we noted in 2010, the oft-repeated statement that there are no cases of mesothelioma among the Connecticut Raybestos factory workers is not correct. Two cases were originally described by Teta *et al.* (1983), followed by five cases described by Egilman and Billings (2005) and Finkelstein and Meisenkothen (2010), followed by the two new cases contained in his report. Our prior calculations suggested that mesothelioma rates at this plant were similar to those observed among South Carolina textile workers and in Quebec miners and millers.

Chrysotile, mainly from Canada, was the only asbestos fiber type used until 1957, when some anthophyllite was added in making paper discs and bands. Beyond this original description of the anthophyllite usage from McDonald, there is a dearth of information about the amount of anthophyllite used in the plant, the frequency of its use, and the specific departments where it was used. For over 30 years in the published literature, this factory has alternatively been described as a 'chrysotile' or 'predominantly chrysotile' factory. While it is clear that some anthophyllite was used in the factory (in addition to 400 pounds of crocidolite in the laboratory), given the volume, frequency, and processes using chrysotile, it still seems satisfactory to describe this cohort as a predominantly, but not exclusively, chrysotile-exposed cohort.

Declarations

Dr Finkelstein has acted as a consultant for plaintiffs' attorneys in asbestos litigation. Mr Meisenkothen represents plaintiffs in asbestos litigation.

Funding

No finding from external sources was received for this work.

References

Egilman DS, Billings MA. (2005) Abuse of epidemiology: automobile manufacturers manufacture a defense to asbestos liability. *Int J Occup Environ Health*; **11**: 360–71.

Finkelstein MM, Meisenkothen C. (2010) Malignant mesothelioma among employees of a Connecticut factory that manufactured friction materials using chrysotile asbestos. *Ann Occup Hyg*; **54**: 692–6.

Garabrant DH, Pastula ST. (2018) A comparison of asbestos fiber potency and elongate mineral particle (EMP) potency for mesothelioma in humans. *Toxicol Appl Pharmacol*; **361**: 127–36.

McDonald AD. (1986) Mesothelioma in Connecticut. *J Occup Med*; **28**: 808–9.

McDonald AD, Fry JS, Woolley AJ *et al.* (1984) Dust exposure and mortality in an American chrysotile asbestos friction products plant. *Br J Ind Med*; **41**: 151–7.

National Research Council (US) Committee on Nonoccupational Health Risks of Asbestiform Fibers. (1984) 4, measurement of exposure to asbestiform fibers. In *Asbestiform fibers: nonoccupational health risks*. Washington, DC: National Academies Press; Available at http://www.ncbi.nlm.nih.gov/books/NBK216742/. Accessed 1 August 2019.

Teta MJ, Lewinsohn HC, Meigs JW *et al.* (1983) Mesothelioma in Connecticut, 1955-1977. Occupational and geographic associations. *J Occup Med*; **25**: 749–56.