COMMENTARY

Asbestos Exposure and Malignant Mesothelioma in Korea

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Abstract

Although importation of asbestos to Korea has decreased, there are growing concerns of its hazardous effects. This paper describes the use and occupational exposure to asbestos, and the incidence and mortality of malignant mesotheliomas in Korea. Asbestos raw material imports from other countries peaked between 1990 and 1995, but importation of asbestos-containing and -processed materials has steadily increased until now. A comprehensive exposure survey was conducted in Korea between 1995 and 2006. The average airborne asbestos concentration was lower than from other countries and steadily decreased during the study period. The number of malignant mesothelioma cases in Korea was 48 in 1998, 39 in 1999, 45 in 2000, 38 in 2001, and 46 in 2002. There were 334 deaths due to malignant mesothelioma and an average of 30.4 deaths per year between 1996 and 2006. The number of deaths attributed to malignant mesothelioma ranged from 16 cases in 1999 to 57 cases in 2006. The magnitude of asbestos-related health problems in Korea has been underestimated due to under-diagnosis, incomplete reports, and shorter duration of exposure. A nationwide surveillance system for asbestos exposure and malignant mesothelioma should therefore be implemented.

Key Words: Asbestos - occupational exposure - malignant mesothelioma - Korea

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Introduction

Asbestos has been linked with a number of diseases, such as asbestosis, mesothelioma, and lung cancer. One hundred twenty-five million people are currently at risk from asbestos and there are about 90,000 asbestos-related deaths globally every year (Editorialist, 2008). The incidence of mesothelioma has risen in the United States and Europe during the past century, after high rates of exposure in workers between the 1940s and 1979 (Grondin and Sugarbaker, 1999; Yang et al., 2008). In a recent report, there were 18,068 deaths attributable to malignant mesothelioma, increasing from 2,482 deaths in 1999 to 2,704 in 2005 in the United States (Bang et al., 2009). The first Korean case of malignant mesothelioma was reported in 1993 involving an asbestos textile worker (Paek et al., 1995).

The purpose of the current study was to summarize the available information regarding asbestos exposure and malignant mesothelioma in Korea over the last several years.

Asbestos Use and Regulation in Korea

According to the Ministry of Labor in Korea, approximately 10,000 tons of asbestos were produced annually between 1978 and 1983. Asbestos-cement, -textiles, and -brake linings grew rapidly during the 1960s and 1970s. These products were then exported to Japan, Western Europe, and the United States. Chrysotile production steadily decreased and the asbestos mine finally closed in 1983. The asbestos industry in Korea depended on importation from other countries from China, Russia, and Canada (Kim, 2006). Between 1980 and 1995, the average amount of raw asbestos imported to Korea was approximately 70,980 tons (Figure 1). Importation of asbestos raw materials gradually decreased between 1996 and 2005, and only 6,500 ton of asbestos raw materials were imported in 2005. However, importation of asbestos-containing materials increased nearly 6-fold between 1995 and 2005 (7,932 tons in 1995, and 47,967 tons in 2005)(KCS, 2007).

The Ministry of Labor in Korea outlined the regulations for the use and manufacturing of asbestos in the Enforcement Decree of the Occupational Safety and Health Act (Decree number 13053). In 1986, the first threshold limit value for asbestos was set at 2.0 fibers/cc and this regulation changed to 0.1 fibers/cc in 2000. Amosite and crocidolite were regulated at 0.5 and 0.2 fiber/cc in 1986, respectively. The Korea government banned the use and manufacture of crocidolite and amosite in 2000; similarly, the use and manufacture of actinolite, anthophyllite, and tremolite was banned in 2003. The asbestos exposure limit was lowered from 2.0 fibers/cc to 0.1 fiber/cc in 2003 (Table 1). In February 2007, the Ministry of Labor in Korea announced a total ban on the manufacturing, importation, and use of asbestos, which will take full effect in 2009 (Table 1).

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Table 1. History and Regulation of Asbestos in Korea

Year	History and Regulation
1983	Asbestos mines in Korea closed
1986	Permissible occupational exposure limits for asbestos established : chrysotile: 2.0 fibers/cc, amosite : 0.5 fiber/cc, and crocidolite: 0.2 fiber/cc
1993	First case of malignant mesothelioma diagnosed
2000	Use and manufacture of crocidolite and amosite banned; threshold limit of chrysotile is changed to 0.1fiber/cc
2003	Use and manufacture of actinolite, anthophyllite and tremolite banned.
2009	A complete ban on the use of asbestos will be enacted

Occupational Exposure to Asbestos

There is no nationwide surveillance program for occupational exposure to asbestos (Choi, 2006). However, the Korea Occupational Safety and Health Agency (KOSHA) evaluated the asbestos concentrations through a working environment monitoring program between 1995 and 2006 (Choi, 2006). The airborne asbestos concentration ranged from 0.005-26.700 fiber/cc, with a geometric mean of 0.15 and an arithmetic mean of 015 (Choi, 2006). This surveillance program reported that the asbestos concentrations in the working environment decreased during the study period (Figure 2).

Until the mid-1990s, the highest asbestos exposure group was primary exposure group A which directly handled asbestos as a raw material. Recently, however, groups B and C which handle or eliminate asbestos containing materials, such as in construction, ship

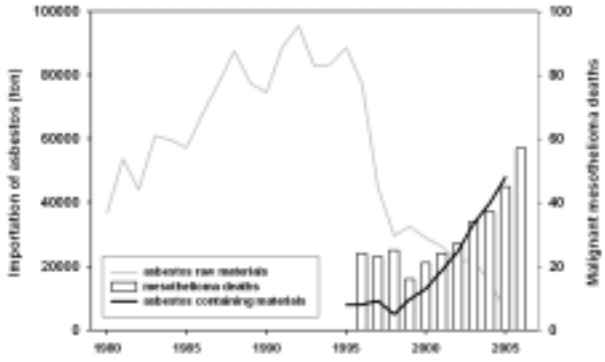

Figure 1. Importation of Asbestos and Mesothelioma Deaths in Korea

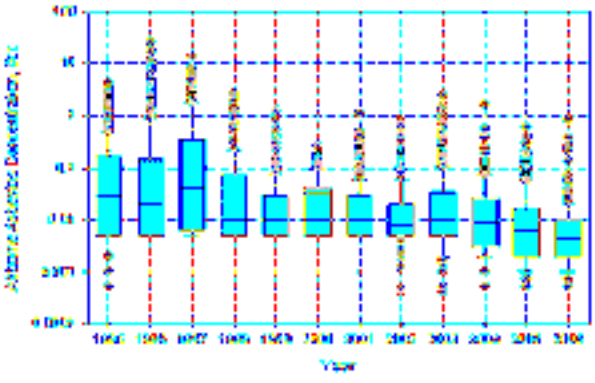

Figure 2. Trends in Asbestos Concentrations in Working Environments between 1995 and 2006 in Korea (Choi, 2006)

Table 2. Asbestos Concentrations in Various Industries (1995-2006)

Group/Industry	N	Mean±SD*	M*
A gasket, construction and insulating materials, asbestos products, asbestos spinning and weaving, components of cars, asbestos abrasive materials	1,617	0.30 ± 1.40	0.02
B metal products, mechanical products, bond products, plastic products, air planes	145	0.04 ± 0.09	0.01
C components of electric appliances, steel industry, manufacturing of cars, repair of trains and cars, construction, ship building	355	0.07 ± 0.26	0.01
D others[a]	151	0.01 ± 0.02	0.01

Data from Korea Occupational Safety and Health Agency (KOSHA), 2006; *units: fiber/cc; M, median; A: directly handling raw asbestos; B and C: handling and eliminating asbestos containing materials; D: technically, not a use of asbestos in the industry

demolition or car servicing, are on an upward trend, suggesting they require special attention (Table 2).

Incidence of Malignant Mesothelioma

The annual report of the Korea Central Cancer Registry (KCCR) was used to estimate the incidence of malignant mesothelioma. The total number of cases of malignant mesothelioma (morphology in primary cancer sites, M905) was 48 in 1998, 39 in 1999, 45 in 2000, 38 in 2001, and 46 in 2002. In the Annual Report of the Central Cancer Registry in 2002, the total number of cases of mesothelioma was 46 by the M-Code, but only 43 cases (males, 32 cases, females, 11 cases) reported according to International Classification of Diseases (ICD)-10 (MIHWAF, 2003). This discrepancy resulted from incomplete code transformations. The age distribution of 43 malignant mesothelioma cases in 2002 was 12 (28%) in the 30-49 year-old age group, 23 (53%) in the 50-69 years of age, and 8 (19%) in the > 70 year-old age group.

Deaths Caused by Malignant Mesothelioma

Malignant mesotheliomas have been diagnosed since the 1970s in Korea. It was only in 1993 when the first case of compensable malignant mesothelioma was diagnosed. Diagnosis of malignant mesotheliomas in Korea follows the ICD-10 (C45.0, mesothelioma of the pleura; C45.1, mesothelioma of the peritoneum; C45.2, mesothelioma of the pericardium; C45.7, mesothelioma of other sites; and C45.9, mesothelioma of unspecified). There were 334 deaths attributed to malignant mesothelioma between 1996 and 2006 (Figure 1). The distribution of diagnoses for malignant mesothelioma was as follows: 85 cases (25.5%, C45.0), 25 cases (7.5%, C45.1), 4 cases (1.2%, C45.2), 15 cases (4.5%, C45.7), and 205 cases (61.3%, C45.9; Korea National Statistical Office, 1996-2006) (Figure 3). The mean age of the patients with malignant mesothelioma at the time of death was 61.0 ± 13.9 years (KNSO, 2007).

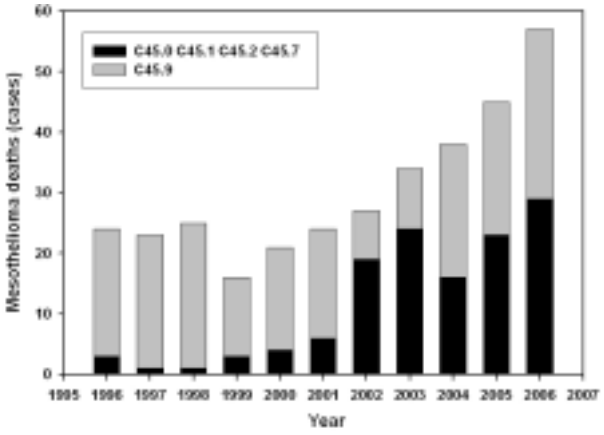

Figure 3. Diagnosis of Deaths Caused by Malignant Mesothelioma between 1996 and 2006

Discussion

The importation of asbestos raw materials has decreased steadily since 1995 but asbestos-containing materials have gradually increased in Korea. Workers who are exposed to asbestos have been registered for regular health examinations by the Ministry of Labor in Korea since 1992. There were 334 malignant mesothelioma deaths in Korea between 1996 and 2006 (approximately 30.4 deaths per year). In the UK, malignant mesothelioma deaths have steadily increased since 1986, reaching almost 1,800 deaths in 2000 (Hodgson et al., 2005). Japan reported approximately 300 malignant mesothelioma deaths per year since 1995, reaching >500 cases in 2001 (Murayama et al., 2006). Although the UK and Japan used asbestos and industrialized earlier than Korea, we speculate that malignant mesothelioma cases were underreported in Korea. There are a few possible reasons for underestimating malignant mesothelioma in Korea. First, it is known that the latency period of malignant mesothelioma is generally 35 years, ranging between 10 and 60 years (Bianchi and Bianchi, 2007; Bianchi et al., 1997; Hodgson et al., 2005). Figure 1 shows that importation of asbestos peaked in Korea in the 1990s. Considering the importation of asbestos, Korea is still within the latency period of malignant mesothelioma. Second, the previous study conducted in Japan reported 2,881 malignant mesothelioma deaths between 1995 and 1999 and the distribution of malignant mesothelioma according to ICD-was as follows: C45.0 - C45.3, 2,106 cases (73.1%); and C45.9, 775 cases (26.9%) (Morinaga et al., 2001). This comparison revealed that there is a lack of detection of malignant mesothelioma in Korea (Figure 3). Therefore, it is likely that many cases of malignant mesothelioma were excluded from the accounting in the Korean population. Third, although there are remaining many debates of harmful effects of serpentine (chrysotile) and amphibole (amosite and crocidolite) (Luo et al., 2003; Stayner et al., 1996; Yano et al., 2001), the Korean government prohibited the use of amphibole asbestos since 2000, and it is not expected to have any connection with the disease development between 2000 and 2008, as the latency is too short to account for any responsible change in disease development.

The magnitude of asbestos-related health problems in Korea appears to be underestimated due to under-diagnosis, incomplete reports, and shorter exposure duration. A nationwide surveillance system for asbestos exposure and malignant mesothelioma should be implemented in Korea.

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