Mesothelioma in Qingdao, PRC (2000 – 2007)

Arthur L. Frank 1, Pang Zengchang 2, Zhang Huaqiang 3, Zhang Yun 2

1 Drexel University School of Public Health, Philadelphia, PA 19102
2 Qingdao Center for Disease Control and Prevention, Qingdao, PRC
3 Qingdao Institute of Women’s and Children’s Health Care, Qingdao, PRC

E-mail: alf13@drexel.edu

Abstract. The city of Qingdao, PRC has been the site of two asbestos product facilities that operated for almost fifty years, as well as a shipyard. Because of a new computerized data collection system for death certificates, almost all 48,000 yearly deaths from a population base of 7.5 million are now recorded with cause of death and “usual occupation”. All mesothelioma deaths from 2000 through 2007 are reviewed and the unusual finding is that of a predominance of cases in females. The issues of competing causes of death and potential underreporting are discussed.

1. Introduction
The city of Qingdao, on the coast of the Yellow Sea about 500 miles south of Beijing, has been the home to two of China’s largest asbestos production manufacturing facilities, and to a large shipyard known for its extensive repair work on ships from dozens of nations. Now closed, at the two factories a variety of products have been made. When operating, the factories were staffed by about 1,300 workers, and about 3,000 former workers had retired due to age or illness and were being supported by active workers. The factories operated from the mid-1950s until the end of the 20th century. At one, using about 98% chrysotile, much of it Chinese with some Canadian, building products were made including asbestos corrugated roofing materials and asbestos pipe. A small amount of crocidolite was the amphibole occasionally used. At the other factory, using primarily Chinese chrysotile, with some Canadian chrysotile, the products included textiles, brake shoes, and rubberized asbestos mats.

The shipyard employed about 4,000 workers and was also opened in the 1950s and closed and moved in 2004 to another site elsewhere on the Yellow Sea.

The Qingdao Center For Disease Control and Prevention (QCDC) has for many years been active in a variety of international research projects including a multi-center twin study, work in the area of non-communicable diseases including cardiovascular disease, and the authors have worked together for more than a decade on asbestos-related questions [1].

In the past few years certain leading research-oriented health centers the computerized operation began in 2000 in Qingdao, China, such as the QCDC, have been computerizing health data, including regional deaths certificates. The city of Qingdao itself has a bit over two million persons, but the QCDC records cover an area of some 7.5 million persons both in the city proper and regionally. Progress has been made in computerizing death certificates, and to attempt to have as complete reporting as possible from the region. Qingdao has been one of the fastest growing cities in China.
At the present time from the 7.5 million persons in the region some 48,000 death certificates are recorded yearly, representing mostly hospital records as well as some deaths recorded elsewhere. This number represents about 95% of all deaths in the area, a higher percentage than even just a few years ago when a file card system was used and many deaths went unrecorded, and cause of death could not be easily studied.

The leading cause of cancer deaths in some Western countries in both males and females is lung cancer. In China, at present, about 66% of all males are cigarette smokers while only about three percent of women smoke, though there is a rising trend among young women. Although smoking rates among women have been low, lung cancer rates have been surprisingly high. This has been attributed to the burning indoors, often in confined spaces, of waste vegetable or animal materials for cooking and heating. Coal is sometimes used as well. Considerable combustion products are found in homes and regularly expose women. Such exposures would not lead to mesotheliomas, however.

Mesotheliomas are recorded as part of the developing computerized data base and the findings from recent years are described here. Death certificates list the usual occupational, but there is no comprehensive list of former occupational exposures, nor any way to assess environmental exposures. Smoking histories are not currently computerized, but are recorded on a separate, non-computerized, file card system.

Data about past causes of death has been difficulty in the past to obtain in China for a variety of reasons [2], and with regard to the diagnosis of mesotheliomas the difficulties of correctly making this diagnosis has been documented [3]. Although unable to prove easily, the likelihood is that the diagnosis of mesothelioma is underreported in the data of the QCDC, as has been the case elsewhere [4].

A recent paper by Nishikawa and colleagues [5] reviews pleural mesothelioma mortality on a global basis, and plots such data along with increasing or decreasing use of asbestos. China is not covered, but data is given for more than thirty countries, and the pleural mesothelioma deaths range from 31 per million per year in the U.K. to 0.5 in Brazil and Ecuador. The author is personally aware of the gross underdiagnosis and underreporting in Brazil, and the Chinese data given here is reflective of a setting in which minimal diagnostic testing is done, special staining is virtually unknown, and underreporting clearly the case.

2. Results
Data from the eight years covering 2000 – 2007 is now available for causes of death including for mesothelioma. Mindful of the area population base of some 7.5 million, and the number of total deaths each year being about 48,000, it is clear that the number of mesothelioma deaths recorded by the QCDC appears to be significant.

In the Qingdao area, for the year 2000 there were 19 mesothelioma cases, all pleural, with 14 in females, 2 in males, and the gender of three cases was unknown. Five of the cases listed as the usual occupation “farmer”.

In 2001 there were again 19 mesothelioma cases, 17 in females, 1 in a male, and the additional case had no gender recorded. Again, all were pleural mesotheliomas.

For 2002 some 15 cases of mesothelioma were recorded on death certificates, representing two males and 13 females. One case was in a child, aged twelve. No data was recorded that year for the location of the lesion. For 2003 there were six cases, four recorded as pleural and two as peritoneal. The three cases among males were all pleural, while the three female cases contained the two peritoneal cases.

In 2004 six mesothelioma cases, all pleural, were recorded, four in males, and two in females. For 2005 there were also six cases, one a peritoneal case in a female, with four male pleural and one female pleural cases recorded.

For 2006 there were 17 mesotheliomas, 12 in males and 5 in females. “Farmers” was again the leading occupation listed. Eleven were listed as pleural mesotheliomas, with one peritoneal mesothelioma and five as “other”. The youngest death was at 19 years of age.
For 2007 there was 6 mesotheliomas, equally split between men and women. There was one pleural mesothelioma in a woman, three peritoneal cases (2 women), and two in men listed as “other”. One individual was 90. The age range between 2000-2007 was 12 to 93, with a predominance among women, as noted in Table 1.

The recorded job categories vary greatly, and as noted above, are not record as a lifetime work history, but only as “usual occupation”. Short periods of factory work would not be recorded nor would cases reflecting household or other environmental exposure. Many cases were recorded among farmers, with a variety of factory workers noted. These reports included transportation facility workers, a health worker, a housewife, and even a lawyer. No Chinese asbestos mines are in this area.

Taken together, there were 94 mesotheliomas recorded in the Qingdao area between 2000 and 2007. The majority, quite different from data elsewhere in the world, were found among woman. As elsewhere, most were pleural lesions. The age range was as noted elsewhere [6].

3. Discussion
With the advent of electronic data bases it will now be possible to better record cases of mesothelioma in the Qingdao area. A continuing problem is one of potential under-diagnosis since the level of pathologic sophistication may not yet rival the experiences in North America or Europe. Special staining techniques, often useful to establish the diagnosis, may be lacking for some cases. Also, to a greater extent than in other venues, diagnoses are more often made on clinical grounds. The extent of underreporting of mesothelioma cases cannot be accurately assessed, but may be significant.

Striking in Qingdao is the overwhelming proportion of females among these cases, with roughly twice as many cases seen in women compared to men. This may not be as striking as it seems at first because many asbestos exposed workers in the two Qingdao factories were women. Open since the 1950s, and closed in 2000, the two asbestos factories in Qingdao operated in the city making a wide variety of asbestos containing products including textiles, asbestos/rubber matting, brake shoes, and asbestos cement building products, with one-half the workforce being female. With few exceptions, such as gas mask workers during World War II, the majority of workers in Europe and North America, as well as at mine sites throughout the world, have been males. There was also large shipyard that operated in Qingdao until recently, doing major ocean-going vessel repairs.

Also, with a much higher smoking rate among men, there may be a considerably higher death rate from lung cancer in men compared to women, and as a competing cause of death men may not live long enough to develop mesotheliomas, the disease with the longest average latency after exposure to asbestos.

In addition to traditional occupational exposures there are several sources of exposure in the general population, leading to potential significant environmental exposure. This comes from the use of asbestos cement water pipes, as well as home construction materials built of asbestos cement. Some water collection from run-off from asbestos corrugated sheets might further add to the overall exposure.

A deficit in our analysis is not having anything like a complete exposure history for any of these individuals, and when available only having “usual occupation” recorded. Farmer was a frequently noted job category but also found were such occupations as factory manager, health care worker, chemical worker, smelter worker, transport facility workers, lawyer, and others.

As noted earlier, one Qingdao factory used only chrysotile, the other only about 2% crocidolite, and mined Chinese asbestos appears to be of the chrysotile variety, and it has been reported to lack tremolite contamination [7].

In future efforts more detailed exposures may be undertaken to better assess asbestos exposure. It may also be possible to review mesothelioma rates in other Chinese locations with similar computerized data systems such as in Harbin, Shanghai and Wuhan. Unfortunately, Shenyang, a major industrial city with a major asbestos facility does not yet have as good a data-recording system.

As noted earlier, data in China has been difficult to collect and analyze, but with new systems in place this should soon improve in some respects. Both the percentage of deaths recorded, and the recording in an electronic system will facilitate further work. The potential to study other aspects of asbestos-related
disease, such as the unsettled matter of excess cervical and uterine cancer rates, may be possible in the future.

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Table 1
Mesothelioma Cases Recorded in Qingdao, PRC (2000 – 2007)

| Year | Total # | # Male | # Female | # Gender Unknown | Pleural | Peritoneal | “Other” |
|------|---------|--------|----------|------------------|--------|-----------|--------|
| 2000 | 19      | 2      | 14       | 3                | 19     | 0         | 0      |
| 2001 | 19      | 1      | 17       | 1                | 19     | 0         | 0      |
| 2002 | 15      | 2      | 13       | 0                | NR     | NR        | NR     |
| 2003 | 6       | 3      | 3        | 0                | 4      | 2         | 0      |
| 2004 | 6       | 4      | 2        | 0                | 6      | 0         | 0      |
| 2005 | 6       | 4      | 2        | 0                | 5      | 1         | 0      |
| 2006 | 17      | 12     | 5        | 0                | 11     | 1         | 5      |
| 2007 | 6       | 3      | 3        | 0                | 1      | 3         | 2      |

NR – Not reported