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Original Article

# Old Habits Die Hard – Asbestos Exposure

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Abstract

**OBJECTIVE:** Although the damages to health that are caused by asbestos exposure are known, the mineral continues to be in use. Our main purpose in the study was to determine the relationship between awareness and asbestos use.

**MATERIAL AND METHODS:** A total of 100 residents from the Armutova village of Ergani District in the Diyarbakir province of Turkey, with previous asbestos exposure were studied between January 2010 and December 2010. Exposure to asbestos was questioned in all participants. Asbestos doses were measured in the setting where they lived. The pulmonary function tests (PFTs) including forced vital capacity (FVC) and forced expiratory volume in 1 second (FEV1) were performed, and chest radiography was taken.

**RESULTS:** The duration of asbestos exposure was found to be associated with reduced PFTs and the pathological lung findings on radiology. Although 97% of the participants were aware of asbestos and its health risks, the rates of its use were significantly higher, and associated with excessive exposure levels. Longer duration of asbestos exposure was significantly associated with reduced FVC. There were more prominent reductions in FEV1 with longer durations of asbestos exposure.

**CONCLUSION:** The high rates of asbestos use indicate that changing habits, particularly among individuals residing in rural areas, is difficult. In our country, the main route of asbestos exposure is through the environment, which is at least as hazardous as occupational exposure.

**KEYWORDS:** Asbestos, respiratory health, radiological
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## INTRODUCTION

Certain fibrous minerals may lead to lung and pleural disease when inhaled, and, asbestos is among these, one of the leading cause of respiratory diseases.[1] Asbestos has remained one of the most in-demand substances used in insulation worldwide for many decades, primarily in the construction sector.[2,3] Although it was termed as the "magic mineral" at the end of the 19th century due to its isolation properties, resistance to friction, and resistance to acidic dissolution, this definition was replaced by the term "killer dust" after the 1950s, as it was shown to be a carcinogenic mineral associated with health hazards in humans.

There are about 125 million individuals who are exposed to asbestos at the workplace, and previous studies have found that nearly 90 000 people die every year due to mesothelioma, asbestosis, or lung cancer caused by asbestos.[4] In 2007, the 60th World Health Assembly requested member states of the World Health Organization (WHO) to conduct global campaigns for the elimination of asbestos-related diseases.[5,6]

Asbestos in Turkey's rural areas has been shown to cause a high risk of malignant mesothelioma (MM). This soil is used in the villages for whitewashing walls or plastering material (white plaster), insulation, plastering cracks, baby powder, and also for making pottery.[7]

Bayram et al.[8] found the rate of MM significantly higher in those living in areas where asbestos was naturally occurring.

To the best of our knowledge, numerous studies have established the negative health impact of asbestos on the human body, such as interstitial pulmonary fibrosis (asbestosis), pleural changes (thickening, plaques, effusion), lung cancer, mesothelioma of the pleura or peritoneum, as well as abnormalities in pulmonary function tests (PFTs).[9,10] In the present study, we aimed to examine the long-term pulmonary effects of asbestos exposure among adult residents of a village in our country with known exposure to asbestos, to determine the level of awareness and use patterns of the participants, investigate the prevalence of asbestos-related diseases, and to analyze the effect of asbestos exposure on PFTs.

## MATERIAL AND METHODS

### Study Design and Study Population

This study was conducted at Armutova village of the Ergani district of Diyarbakir province, Turkey, between January 2010 and December 2010. The study region is located 65 km from the provincial center. In this village, asbestos has been

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mined, processed, utilized, and sold to the surrounding villages for many years. Also, this mineral is frequently utilized in the inner and outer coatings of cowsheds. The screening study team visiting the village consisted of 2 pulmonary disease specialists, 2 research assistants, 1 nurse, 1 PFT technician, and 1 radiology technician.

In order to investigate the effect of asbestos exposure on pulmonary health, individuals over 18 years of age with known exposure to asbestos were screened. Those younger than 18 years of age were excluded. Based on the 2010 Turkish Statistical Institute data, the total number of inhabitants in Armutova village was 760 individuals. The target population consisted of 20% of the total adult population of 385 individuals. During the screening, a total of 100 participants were included. All participants were informed about the nature of the study and a written informed consent was obtained. The study protocol was approved by the Ethics Committee, Dicle University Faculty of Medicine (No. 220 Date: November 30, 2010). The study was conducted in accordance with the principles of the Declaration of Helsinki.

**Study Questionnaire**

Data including age, sex, occupational status, educational status, history of past or current smoking, and history of biomass exposure were collected. To measure the level of awareness regarding the health hazards of asbestos, all participants were asked whether they were aware of asbestos and the associated health risks, and those responding positively to these questions were asked to provide information on the source of their knowledge. Symptoms such as dyspnea and productive cough were inquired. Physical examinations were performed by the chest disease specialists, chest X-rays were obtained, and spirometry analyses were performed. Data collected through these measurements were recorded in the standard questionnaires developed for the study.

**Radiological Assessment**

A posteroanterior (PA) chest X-ray was performed in all cases and was interpreted by 2 chest disease specialists and one radiologist, individually. Physicians assessing chest X-rays were blinded to the clinical data and asbestos exposure. Lesions were determined by the consensus of the 3 physicians.

A chest X-ray was considered normal in the absence of pathological findings. Lesions associated with asbestos exposure were categorized into pleural plaques (PPs), calcific lymphadenopathy (LAP), solitary pulmonary nodule, asbestosis, and suspected pleural effusion. A diagnosis of pleural effusion was confirmed by ultrasonography.

**MAIN POINTS**

- Asbestos is still a major problem in Turkey.
- Although the harms of asbestos are known, the society continues to use asbestos.
- Social awareness studies should be continued.

**PFT Measurements**

A PFT technician measured the forced vital capacity (FVC), forced expiratory volume in 1 second (FEV1), and the ratio between the 2 (FEV1/FVC), using a portable spirometry device (GOLD Pulmonary Analysis Computer, and Pulmograph, Holland). The measurements and analysis of the PFTs were performed according to the criteria of the American Thoracic Society.[11] The PFT technicians were blinded to the cases. The best measurement out of 3 was recorded as the percent of the predicted on the basis of age and height.

**Dust Measurements**

A Tecora Isostack Basic (TcrTecoraS.r.l, Corsico, Milan, Italy) device accredited by the Republic of Turkey, Ministry of Foreign Affairs, Turkish Accreditation Agency (TÜRKAK), and supplied from the Chamber of Mechanical Engineers was used for dust measurements. To detect inhalable dust particles less than 10 microns in size, a PM10 headpiece was attached to the device that operates on the principle of gravimetric dust measurements. All measurements were performed inside and outside the housing. The sampling was performed in a randomly selected house. Each measurement lasted 8 hours, and the device was operated at an air suction rate of 1 $m^3$ per hour.

**Statistical Analysis**

Statistical analysis was performed using the SPSS Version 12.0 software (SPSS Inc.; Chicago, IL, USA). Descriptive data were expressed as mean ± standard deviation (SD), median (min-max), or number and frequency. Comparisons between groups were performed using the Student's *t*-test or the Mann–Whitney *U*-test. For multiple group comparisons, the Kruskal–Wallis test was carried out. The chi-square test was performed to analyze variables between the groups. Pearson's correlation test was used to determine the correlations between values. A $P$ value of $< .05$ was considered statistically significant.

**RESULTS**

Of the participants, 60 were females and 40 were males, with a mean age of 44.67 ± 15.69 (range, 18-89) years. Demographic and clinical characteristics of the participants are summarized in Table 1.

Of the overall population, 58 had no formal education, while 42 had some level of education. There were 58 housewives, 30 farmers, 5 unemployed, 3 drivers, 2 shepherds, and 2 village guards among the participants. Except for 3 individuals, all were aware about asbestos and its presence in their surroundings. There were no significant differences in the level of knowledge on asbestos between the age, sex, and occupational groups ($P > .05$).

The mean duration of asbestos exposure was 36.85 ± 17.70 years. The measurements showed an asbestos concentration of 1.108 fibers/$cm^3$ and 0.07 fibers/$cm^3$ performed inside and outside the house, respectively. Of all participants, 70 were non-smokers, while 30 were past or current smokers. The mean duration of cigarette smoking was 29.70 ± 30.10 years. Forty participants had biomass exposure, while 60 did not. In the study, 77 had

**Table 1.** Demographic and Clinical Characteristics of the Study Population

| **Age, years (mean ± SD)** | **44.67 ± 15.69** |
|---|---|
| Sex, *n* | |
| Male | 40 |
| Female | 60 |
| Mean duration of asbestos exposure (years) | 36.85 ± 17.70 |
| History of smoking, *n* | |
| Smoker | 30 |
| Non-smoker | 70 |
| Mean cigarette consumption (pack-year) | 29.70 ± 30.10 |
| Biomass exposure, *n* | |
| Yes | 40 |
| No | 60 |
| Mean Biomass Exposure (hour-year) | 33.61 ± 60.29 |
| Dyspnea, *n* | |
| Yes | 77 |
| No | 23 |
| Cough, *n* | |
| Yes | 57 |
| No | 43 |
| Sputum, *n* | |
| Yes | 52 |
| No | 48 |

Data are given as mean ± SD or number, unless otherwise stated.

dyspnea, 57 had a cough, and 52 had sputum production. Table 2 summarizes the PA chest X-ray findings in the overall study population.

There was a statistically significant correlation between the presence/absence of pathological findings in chest X-rays and dyspnea ($P < .05$).The PFTs were normal in 57 individuals, while these tests showed an obstructive pattern in 12 and a restrictive pattern in 31 participants. Longer duration of asbestos exposure was found to be significantly associated with reduced FVC ($r = -0.400$; $P < .000$). There was a significant decline in the FEV1 with longer durations of asbestos exposure ($r = -0.429$; $P < .000$). Totally, 20 of 34 (58.8%) participants with an asbestos exposure of more than 40 years had pathological findings in their chest X-rays, while 16 of the 66 participants (24.2%) with an exposure duration of fewer than 40 years had such findings, indicating a statistically significant difference ($P = .001$).

**Table 2.** Results of Posteroanterior Chest X-rays in the Study Population

| **PA chest X-ray findings** | ***n* (%)** |
|---|---|
| Normal | 64 (64) |
| Pleural plaques | 27 (27) |
| Asbestosis | 5 (5) |
| Pleural fluid | 2 (2) |
| Calcific lymphadenopathy | 1 (1) |
| Solitary pulmonary nodule | 1 (1) |
| Total | 100 (100) |

Data are given as number and frequency, unless otherwise stated.

## DISCUSSION

In this study, we saw that there is still a high rate of asbestos use. We also found a significant statistical relationship between the participants' X-ray findings and their shortness of breath. Pathological pulmonary findings increased as the exposure duration of the participants increased.

Asbestos is an important occupational and environmental hazard, and exposure to asbestos remains an important public health problem. In the present study, each participant was questioned regarding the current asbestos use. In general, participants reported no use of asbestos in the past 1 to 2-year period. However, the asbestos concentration in a randomly selected house was found to be 1.108 fibers/cm$^3$, which was 11-fold higher compared to the average allowable limit of 0.1 fibers/cm$^3$ for an 8-hour period, as stated in regulations dated December 26, 2003, which came into effect after April 15, 2006. This finding suggests that 97% of the study population continued to use asbestos despite being aware of its health hazards, as evidenced by the high concentrations measured. The values measured in this study were 5 times higher than this level, confirming a very high asbestos exposure. Interestingly, study participants continued to use asbestos although they were aware of its potential health hazards, and denied such use in the study. Metintaş et al.[7] found in their study that asbestos exposure continues in 379 villages, covering a population of 158 068. They reported the possibility of at least 2511 new MM cases between 2013 and 2033, if this risk is not removed.[7]

The mean age of our study population was 44.6 years and the mean duration of asbestos exposure was 36.8 years. While 58.8% of the individuals with ≥ 40 years of asbestos exposure had pathological chest X-ray findings, this rate was 24.2% in those with < 40 years of exposure, consistent with previous reports, showing an increased incidence of radiological findings with increasing duration of exposure.[12-15] Based on the findings of PA chest X-rays, 34 individuals (34%) had asbestos-related lesions, mostly consisting of PPs (27%). However, a much lower incidence of PP was reported previously (15.7%) by Akkurt et al.,[16] who investigated a group of asbestos workers in our country. The mean duration of asbestos exposure was 10.3 years in the aforementioned study compared to 36.8 years in our study, probably explaining the difference in the incidence of PPs.

Among respiratory symptoms, 77% of the study participants had dyspnea, and an association between dyspnea and X-ray findings was observed ($P < .05$). However, we found no correlation between the PFT results and the presence/absence of X-ray findings associated with asbestos exposure, which can be attributed to the lack of more sensitive tests for use in the study. In the study of Cha et al.,[17] the number and size of PPs were negatively correlated with

FVC and the carbon monoxide diffusion test. On the other hand, Emri et al.[18] failed to detect a significant relationship between X-ray findings and PFT results, in their study investigating asbestos and erionite exposure-related lung disease. In our study, significantly lower FEV1 and FVC values were observed with increasing duration of asbestos exposure. Similarly, duration of exposure was associated with an increasing number of radiological findings. Consistent with these findings, Barnikel et al.[19] found that radiological findings increased as the duration of asbestos exposure increased. Similarly, loss of respiratory function increased with increasing asbestos exposure.

The PFT exhibited a normal pattern in 57%, restrictive pattern in 31%, and obstructive pattern in 12% of the participants. In a previous study, Wang et al.[20] compared radiological findings and physiological parameters among asbestos workers, and observed mainly restrictive abnormalities. On the other hand, Alfonso et al.[21] observed no association between FEV1/FVC and radiological findings in asbestosis, with no reduction in FEV1/FVC among a group of smokers and individuals with asbestos exposure. Again, similar to that study, the findings by Neri et al.[22] did not support an obstruction in the airways due to asbestos exposure. It appears that further research is required to gain a better understanding of the relationship between asbestos exposure and respiratory functions.

Although its use was banned about 2 decades ago, asbestos is still a topic to be addressed in certain regions. In our study, although 97% of the participants were aware of asbestos and its health risks, the usage rates were significantly higher, as evidenced by the excessive exposure levels. In particular, individuals residing in rural areas may have difficulty in adopting the "new" rules to be obeyed. Although the published data on asbestos exposure and PFT use are somewhat controversial, the health effects of asbestos are unquestionable.

The number of MM cases due to asbestos exposure in rural areas between 2013 and 2033 was estimated at 2511. MM incidence in Turkey is as high as in the industrialized countries. Preventive measures are required in rural areas. Asbestos exposure continues to be a serious problem in Turkey.[7]

To decrease or prevent environmental asbestos exposure, the presence and absence of asbestos in houses and in the ground, the type of asbestos present in houses and extensions, and the patterns of use should be identified. Soil and rock sampling should be performed by geology engineers specialized in medical geology, and sampling sites and coordinates should be provided together with photographs. Abandoned or old houses and ruins of houses constructed with materials containing asbestos should be demolished, and the remains should be covered with asbestos-free soil or should be burrowed into the ground in a distant place and covered with asbestos-free soil. In addition, alleyways should be asphalted to prevent dusting. On the subject of prevention of asbestos exposure, the Turkey Asbestos Control Strategic Plan Final Report should be given attention.[23]

On the other hand, occupational asbestos exposure is as important as environmental asbestos exposure.[24] However, there are almost no data regarding occupational exposure in Turkey.[7] Many measures should also be taken to prevent occupational asbestos exposure.[25]

Emphasis should be placed on silicosis, another occupational lung disease. Silicosis is an old but still life-threatening occupational lung disease. Although the risk of silicosis in many professional environments is known and there are well established effective control strategies, new cases in different sectors of Turkey, even on an epidemic scale, continue to be seen. Sandblasting appears to have the highest risk for silicosis development. Prevention should be the main goal. Better occupational disease registry systems would be useful for assessing the magnitude of the problem.[26]

In our study, dose measurement was made in a random home. Lack of knowledge about other houses is one of the limitations of our study. In addition, further tests (such as carbon monoxide diffusion test) to evaluate lung functions were not performed in our study.

## CONCLUSION

Although the hazards of asbestos are known, it is still used at a high rate in our country. In this study, the asbestos was measured in a settlement where asbestos-related diseases are common. Our study results showed that although the hazards of asbestos are well known, high quantities of asbestos were used and asbestos exposure at increased levels was associated with adverse health outcomes. Taken together, not only should the asbestos ban be discussed, but steps should also be taken to remove existing asbestos products to protect public health in the future.

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**Ethics Committee Approval:** Ethics Committee approval for the study was obtained from the Dicle University, Faculty of Medicine, Ethics Committee (No. 220 Date: November 30, 2010).

**Informed Consent:** A written informed consent was obtained from each participant.

**Authors Contributions:** Concept - B.Ç.; Design - M.R.P.; Supervision - B.Ç.; Resources - M.K.; Materials - B.Ç.; Data Collection and/or Processing - B.Ç., M.R.P., M.K.; Analysis and/or Interpretation - M.K.; Literature Review - M.R.P.; Writing - B.Ç.; Critical Review - M.K., M.R.P.

**Conflict of Interest:** The authors have no conflict of interest to declare.

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