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TURKEY ASBESTOS CONTROL STRATEGIC PLAN

FINAL REPORT

TURKISH MESOTHELIOMA WORKING GROUP
PUBLIC HEALTH INSTITUTE OF TURKEY
ESKİŞEHİR OSMANGAZİ UNIVERSITY

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EXECUTIVE SUMMARY OF THE PLAN

INTRODUCTION AND OBJECTIVE: Asbestos exposure is a significant health problem in Turkey. However, in Turkey, different from the developed countries, asbestos exposure is often observed in the rural areas, and the asbestos-related diseases are more frequent among rural people. The frequency of the mesothelioma, lung cancer, and benign pathologies of the lung and pleura in the population exposed to asbestos in the rural areas is as high as for the people directly exposed to the asbestos in the industry. On the other hand, because there are insufficient records in Turkey with respect to the occupational environment, it is not fully possible to determine the occupational asbestos exposure.

The Turkey Asbestos Control Strategic Plan has been prepared and implemented to detect the incidence and importance of asbestos exposure in the rural areas, which is a serious public health problem and is the main reason for the related diseases in Turkey. Another objective of the Plan is to supply data for the studies aimed at detecting and preventing occupational asbestos exposure and developing a rehabilitation program aimed at avoiding this exposure.

Other objectives of the Plan are to detect the current and future mesothelioma risks for the whole of Turkey, to guide the studies for the elimination of asbestos in the rural areas by the end of 2015, to develop an action plan which will ensure that measures are taken to determine workplaces exposed to asbestos and to remove the use of asbestos by the end of 2015, and to provide the early diagnosis and efficient treatment of the cases detected by the follow-up of the group under risk.

The Turkey Asbestos Control Strategic Plan was prepared and performed by the Turkish Mesothelioma Working Group and the Public Health Institute of Turkey. Thirty-eight faculty members, including 19 professors, 16 associate professors, three assistant professors, two specialist physicians of the Turkish Mesothelioma Working Group, two mineralogist professors, and four foreign consultant scientists, took part in the Turkey Asbestos Control Strategic Plan.

METHOD: In this study, "from case to the field method" has been used. In other words, birth and living places of the cases with mesothelioma diagnosed between 2008 and 2012 to detect regions/villages exposed to asbestos in Turkey were determined; villages under the risk of being exposed to asbestos were identified. Soil samples were collected from these villages; these sampl es were analyzed for minerals and finally the locations exposed to asbestos were determined.

In hospitals of 30 provinces where mesothelioma cases are determined to be diagnosed mostly, the patients diagnosed with "mesothelioma" under the code of C45 between 2008 and 2012 were identified based on their names, ages, genders, diagnosis dates, birth places, villages, districts, provinces, provinces where they were diagnosed, and addresses based on the hospital records. The cases were checked one by one according to their identity, name, age, birth place, and register and address information with their identification numbers from the Central Register System (MERNIS). The deceased cases were identified; their death dates and ages were determined and these were verified by their registers. Following the identification of all deceased cases, the mean and median survivals were identified according to their diagnosis dates.

After obtaining the final records of the cases with mesothelioma, the cases born in villages/rural areas were determined; the villages where these cases were born were identified as "villages required to be examined for asbestos exposure risk." "Villages required to be examined for asbestos exposure risk" were classified according to provinces. The list of provinces was sent to the provincial coordinating researchers and to the provincial directorates of public health. The provincial coordinating researchers and the officials from the provincial directorates of public health combined the local and central information and initiated the work to determine the villages to be visited and collect samples. Therefore, training programs, creating awareness, and survey work were conducted in the provinces. Following the identification of the "villages required to be examined for asbestos exposure risk" on the provincial basis through local surveys, the officials of the provincial directorate of public health went to these villages to collect samples.

The teams of the provincial directorate of public health collected samples from the soil deposits, the walls of the houses, roofs, and other areas under the risk of asbestos exposure with the help of the mukhtar and the villagers. These samples were sent to the Eskişehir Osmangazi University for the classification and the first examination. The soil samples were coded according to their provinces, districts, villages, areas, and individual houses. Those found to have fibrous minerals were regarded as risky soil samples and were sent to the TUBITAK Marmara Research Centre Material Institute for mineral analysis with an x-ray diffractometer (XRD) by shipping.

The existence of the asbestos in the samples was examined in the TUBITAK Marmara Research Centre Material Institute based on the sub-types of asbestos. The samples found to contain asbestos and fibre mixture were listed in codes and were reported, including the formulation of asbestos and fibre type.

Following the evaluation of the mineral analysis results, the coded soil samples were classified based on the provinces, districts, villages, areas, and names of the owners of the houses. Thus, the villages, areas, and houses with asbestos exposure were identified.

The populations of the villages with asbestos exposure for 2012-2013 were determined based on the names of villages, districts, and provinces on the official websites www.yerelnet.org.tr and www.nufusu.com, including the data of the Turkish Statistical Institute (TUIK).

Finally, the "population exposed to asbestos in rural areas for a risky period of time," some of which comprise of mesothelioma cases, was determined. The number of mesothelioma, lung cancer, and benign lung and pleura diseases to develop in both populations for the next 20 years was estimated.

RESULTS: During the study, the demographic information of 5,617 mesothelioma cases out of 7,789 cases with the C45 code, whose data is reliable based on certain analyses, was collected from 2008 to 2012 in Turkey. Out of these cases, 3,718 were born/living in the village. It was found out that 3,495 of these mesothelioma cases died by July 2014. The median survival of the dead cases was found to be 8 months.

Following the analysis of the cases born and living in rural areas, 1,236 villages in 58 provinces were determined as "villages required to be examined for asbestos exposure risk." Trained officials from the provincial directorates of public health visited 1,018 villages and collected 2,447 samples from the walls of houses, roofs, and soil deposits around the villages. It was found that 218 villages were not visited because the statements of the mukhtars and minutes were taken. However, these villages should also be visited because two or more mesothelioma cases were observed in 120 of these villages.

The soil samples (n=2,447) were sent to the Eskişehir Osmangazi University. Of these samples, 1,251 were subjected to mineral analysis at the TUBITAK Marmara Research Centre Material Institute with an XRD. As a result, 379 samples were found to contain fibres. According to the registers for the period of 2012 and 2013, 158,068 people lived in these rural areas/villages. Apart from the settlements with a population of more than 1,000 people, the number of those people living in these areas is 98,453. These populations include the cases with asbestos exposure and who would continue to be exposed to asbestos if no preventive measure is taken. Moreover, the population exposed to asbestos for a risky period of time in terms of related diseases that may lead to 3,718 mesothelioma cases was estimated to be 571,460. Thus, the population exposed to asbestos for a risky period of time and the one who continues to be exposed to asbestos in rural areas was estimated and identified.

It was projected that 15,450 mesothelioma, 5,737 lung cancer, 82,290 pleural plaque, 59,431 diffuse pleural fibrosis, and 2,286 asbestosis cases will emerge in the population exposed to asbestos for a risky period of time in the abovementioned rural areas. Moreover, it was projected that 2,511 mesothelioma, 1,322 lung cancer, 17,344 pleural plaque, 12,526 diffuse pleural fibrosis, and 482 asbestosis cases will emerge in the population who continues to be exposed to asbestos between 2013 and 2033.

OCCUPATIONAL ASBESTOS EXPOSURE: In the Plan, 1,879 cases who were diagnosed with mesothelioma between 2008 and 2012 but were not born and/or living in the village are among the patients with mesothelioma who are under a heavy risk of occupational exposure. These cases should be examined based on occupation and workplace, and in line with the obtained data, the existence of the occupational asbestos exposure should be analyzed.

KEYWORDS: Asbestos exposure, mesothelioma, environmental exposure, public health

JUSTIFICATION OF THE PLAN

All forms of asbestos is a serious cause of mortality and morbidity in the exposed population because of benign pleural and parenchymal changes, particularly with respect to mesothelioma and a higher risk of lung cancer. Although it is an industrial issue, asbestos has caused serious health problems in several parts of Anatolia because of the exposure arising from the use of white soil (or soil with similar names) in the rural areas. Although such exposure has decreased in the rural areas, there remains a great number of people who continue to be exposed to asbestos. This group will cost much both directly and indirectly in the economic life, particularly with the loss of many people in the next 20 years. In fact, this cost may be avoided because the areas of exposure can be easily detected and are accessible and the asbestos exposure may be avoided by a simple rehabilitation program. The Turkey Asbestos Control Strategic Plan has been prepared with a view to determine the dimensions and potential results of the asbestos exposure, thus taking the necessary measures and implementing them accordingly. The members of the Turkish Mesothelioma Working Group, who prepared the Plan and were mentioned in detail in the previous sections, have stood out with their studies and diagnosed the relevant diseases while following up the patients. The Plan is one of the studies on "public health" with the highest level of "benefit/cost" in Turkey as specified in the section titled "the expected benefit."

OBJECTIVE OF THE PLAN

This Plan aims at determining the dimension and prevalence of the asbestos exposure in the rural area, which is a serious public health problem and is the main reason of the relevant diseases. This Plan also aims at developing a rehabilitation implementation program which will eliminate the asbestos exposure and supply the data to detect and prevent the occupational asbestos exposure.

THE TARGETS OF THE PLAN

1. Identifying the current and future mesothelioma risk in Turkey.
2. Stopping asbestos exposure in the rural area of Turkey by the end of 2015.
3. Paving the way for the draft of an action plan to detect the workplaces with asbestos exposure and to take the necessary measures for the elimination of asbestos use by the end of 2015.
4. Ensuring the early diagnosis and effective treatment of the cases which may be determined by the follow-up of the risky group.

STRATEGIC IMPLEMENTATION OF THE PLAN

An organizational and work flow chart has been formed to achieve the targets of the Plan. The main study fields and the work implementation steps forming the basis of both organization and practice are as follows:

A. Analyzing and detecting the risk of asbestos exposure in Turkey

1. Determining the incidence and distribution of the mesothelioma and demographic features of the patients with mesothelioma in Turkey.
2. Detecting the villages of the mesothelioma cases where they were born and now live.
3. On-site examination of the villages, which are the birth places of mesothelioma cases, for asbestos exposure risk and thus detecting the villages where soil samples will be collected for the analysis of asbestos exposure.
4. Training of the mukhtars and technical staff who will visit the villages.
5. Collecting the samples by the trained technical teams in the specified villages.
6. Determining the samples of asbestos mixture through their mineralogical analysis.
7. Following the determination of the villages/areas where the samples will be collected, the incidence of environmental asbestos exposure in the rural areas of Turkey as well as the geographical location of the exposure will be identified.
8. Detecting the number of the people under the risk of being exposed to asbestos in the rural area along with the number and distribution of the people already exposed to asbestos.

9. Determining the risk of the relevant diseases and the number of potential mesothelioma cases in the rural areas over the next 20 years.

10. Considering the mesothelioma cases who were not born or living in the village as the cases with a high risk of occupational exposure.

11. Obtaining information for the determination of the workplaces with asbestos exposure in the light of the mesothelioma cases with possible occupational asbestos exposure.

B. Eliminating asbestos exposure in the rural areas of Turkey

1. Rehabilitating the houses and/or mounds found to have been exposed to asbestos in the villages.

2. Ensuring that the family doctors can follow-up the population under the risk of asbestos exposure for the relevant diseases.

SCOPE OF THE PLAN: ASBESTOS AND ASBESTOS EXPOSURE IN TURKEY

A. Asbestos

Asbestos is the name of six natural, fibrous minerals of silicate origin. Although they are different from each other, they are similar in terms of the main structure but with different mineralogical features [1,2]. The main common feature of these minerals is their fibrous structure. The rate of length and width of the fibrous minerals is more than three and their length is a few microns. Asbestos and similar minerals are also called "fibrous minerals" because of their fibrous structure (Figure 1) [3,4].

Asbestos is found on the ground, sometimes as large masses in the areas particularly with high volcanic activities [3,4] (Figures 2, 3).

If observed closely, it is clear that the soil was dug-up and the composition of the soil deteriorated because of extractions. The satellite image of the Tatarcık village in Mihalıççık, Eskişehir can be seen in Figure 3. A large soil cover containing a high quantity of asbestos is observed near the village. As the villagers said, this soil was transferred by the trucks to be put into the channels for the insulation of the underground pipes carrying hot water among the blocks.

We can classify the asbestos and human exposure in epidemiological terms as follows:

1. Occupational exposure (industry-based exposure)
    - Primary: Asbestos mine.
    - Secondary: Workplaces using asbestos; for example, asbestos cement and textile industries.
    - Tertiary: Environmental exposure from the working atmosphere.
        - Domestic exposure: Exposure because of the clothes brought home by those working in the abovementioned workplaces.
        - Exposure through settlement and neighborhood.
2. Environmental exposure: Exposure of the general population because of the asbestos contamination in certain materials used in habitats.
3. Asbestos exposure in the rural areas: Exposure observed in the villagers living in the rural areas.

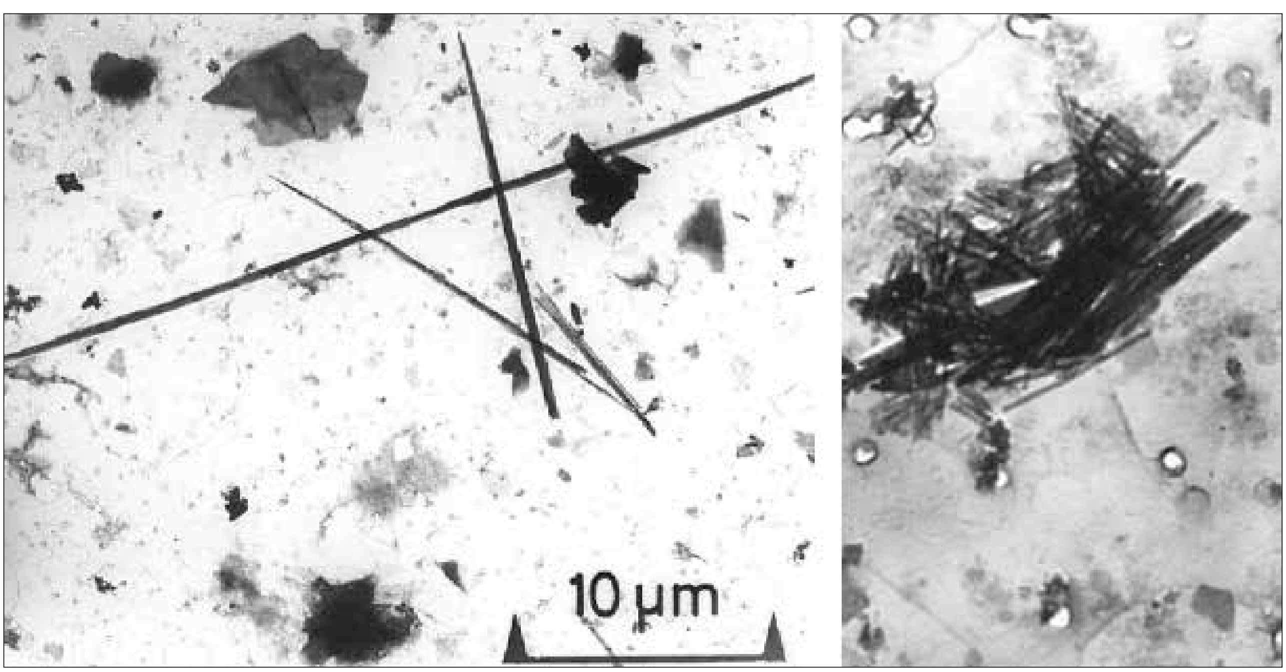

Figure 1. A tremolite type on the left; A chrysotile type asbestos fibre on the right (The archive of Dr. M. Metintaş)

Figure 2. Mounds with natural asbestos near the roads in Sivas (The archive of Dr. M. Bayram)

Figure 3. The mound with asbestos near a village in Mihalıççık, Eskişehir

B. Asbestos Exposure in the Rural Areas

Mounds that are intensively contaminated by the asbestos fibres as a result of the shaping process of the relevant geographical location in the crust may exist [3-5]. This soil was used by those living in the rural areas because of their heat and water insulation features, and its use became widespread because of the economic advantages. Because of its adoption to socio-economic life and its frequent use, this soil was also called as “white soil” in some regions and arid land and geven soil, gök soil, and çelpek, höllük, or ceren soil (names of soil types) in the other regions by the settlers; thus distinguishing them from the other soil types [5-9] (In this text, the term “white soil” will be used) (Figure 4).

Therefore, the inhalation of asbestos fibres occurs because of the asbestos in the areas where this soil exists or is used; i.e., asbestos exposure is observed [5-15].

White soil can be extracted easily with a small adze or a digging tool.

The villagers living in the places where such soil is abundant gained experience about the advantages of white soil because of its asbestos fibres and used this soil to a great extent in the whitewash plaster of their houses, heat and water insulation of the roofs, as well as the insulation of the furnaces [5,6,9].

In addition to its use, white soil may also cause asbestos exposure of the residents through natural events. For instance, the satellite image of the Tepeköy village in Emirdağ, Afyon can be seen in Figure 6. A large amount of soil mixed with asbestos can be seen on the northern main road of this village. As seen in the small picture, the settlement is just below the road. Therefore, masses of white soil dust flow towards the houses of the villages during windy weather. Thus, white soil asbestos exposure occurs because of the natural events and it also arises from the use of this soil. It is clear that such villages are still exposed to asbestos because of the natural vegetation, although the number of the houses using the white soil has considerably decreased.

The white soil extracted from its resource is mixed with water and converted into soil to be used later (Figure 7), dried under the sun (Figure 8), and stored until it is used [9].

Figure 4. Natural mounds contaminated by the asbestos in open areas, roadsides, and near the villages (The archive of Dr. M. Metintaş)

Figure 5. Extracting white soil on the roadside. Visible fibrous features of the extracted soil and asbestos fibres are seen under a microscope. (The archive of Dr. M. Metintaş)

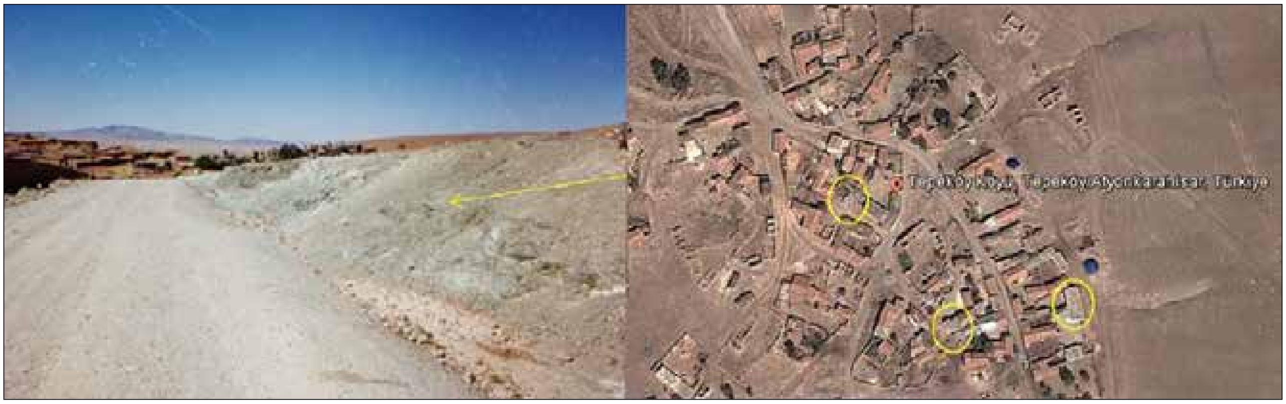

Figure 6. A village in Emirdağ, Afyon; the mound of white soil on the main road of the village access; the roofs of some houses are covered with white soil (The archive of Dr. M. Metintaş)

Figure 7. Extraction of white soil and its formation process (The archive of Dr. A.Şenyiğit)

Figure 8. The white soil is laid on the roofs for drying. It will be used when necessary. Pay attention to the roof cover. A typical example of white soil cover (The archive of Dr. A. Şenyiğit)

If the white soil is used for plaster, it is mixed with water and it turns into a fluid plastering material. This material used to be plastered on the walls of the houses with the hair of sheepskin but is now directly applied on the walls with thick brushes. Thus, both whitewash and plastering of the houses are completed (Figure 9) [5,6,9].

White soil is laid on the roofs as mounds for heat and water insulation and it is pressed and compressed with a particular stone wheel. When it rains, the wet fibres unite well and results in an appropriate atmosphere for insulation [7].

The white soil mounds contaminated by asbestos and the houses plastered with white soil on the walls and roofs can be seen in a village of the rural regions in Sivas. X-RD analysis of this soil clearly shows its asbestos minerals (Figure 10).

One of the two important features of white soil plastering is its nice smell after drying and its easy plaster on the ground it was applied on.

Figure 9. Houses with white soil plastered walls and covered with white soil roofing (The archive of Dr. M. Metintaş)

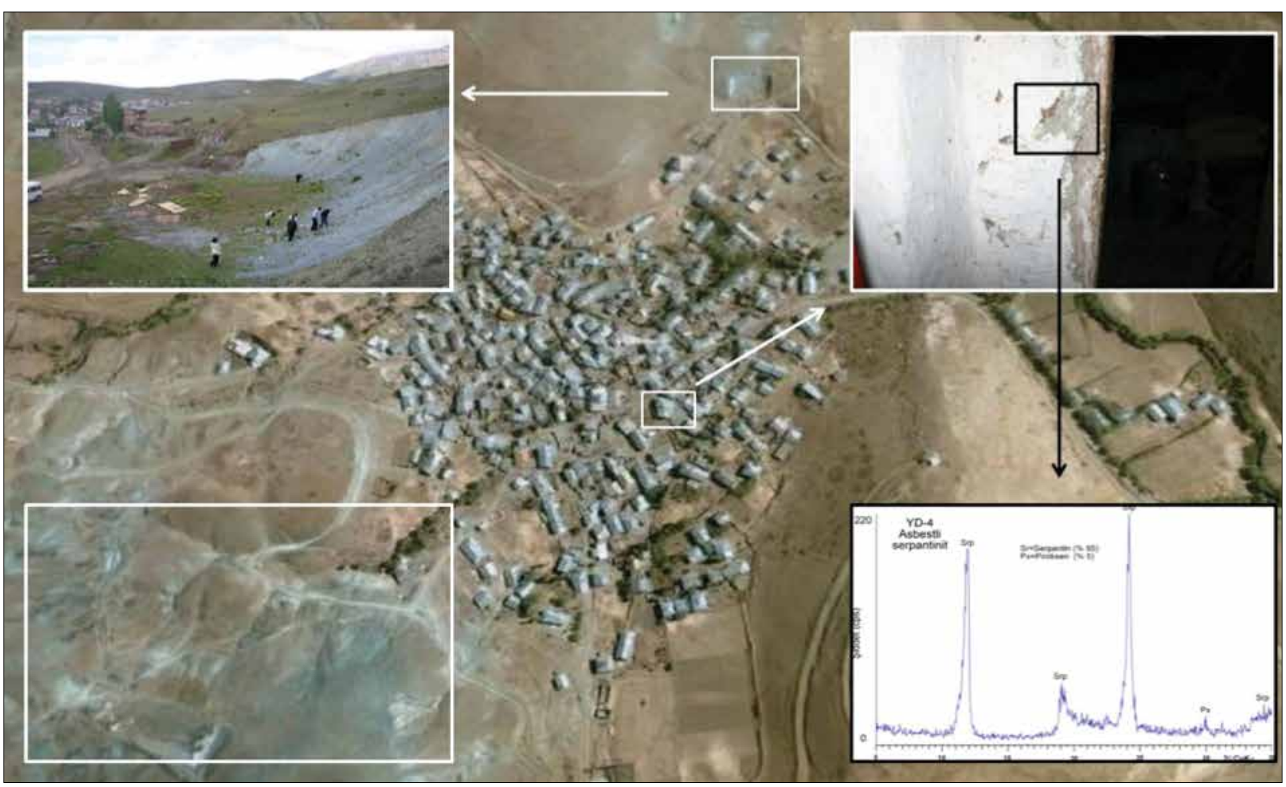

Figure 10. Satellite image of a village in Sivas using white soil intensively and the relationship between white soil and asbestos (The archive of Dr. M. Bayram)

In rural areas, asbestos fibres flow in the air because of the peeling of the plaster from the walls and other domestic issues. Therefore, the residents of the rural areas inhale the asbestos fibres. However, outside the houses, the plaster and roofing decompose and fly in the air because of the natural events; thus, the asbestos and fibre concentration increases. As a result, those living outside the houses also inhale asbestos fibres [5-9].

In the measurements under the cohort studies conducted in the rural areas, the amount of asbestos and fibres in the air was between 0.009 and 0.28 f/mL and outside the houses it was between 0.009 and 0.04 f/mL. The mean exposure level of a resident living in a rural area and exposed to asbestos for approximately 51 years was estimated to be 5.7 f/mL and his lifelong exposure level was estimated to be 0.19-14.80 fibre-year/mL [15]. According to these findings, the total exposure levels for a lifelong period in a rural area cannot be regarded as "low."

With respect to the workplace series, the exposure periods of the patients in rural areas also surprisingly differ from each other. For instance, with respect to the workplace series, the exposure with the asbestos starts when the person starts working and a worker is exposed to asbestos 8 h a day, 5 days a week, and 46-48 weeks in a year. Accordingly, the exposure period of a person who starts working when he was 20 years of age and has worked for 30 years is approximately 60,000 h, whereas the exposure period of a 50-year-old resident of a rural area is approximately 260,000 h. The reason is that the exposure which started at birth in the village continues at least for 16 h a day and for a lifelong period in the village, although the dust concentrations change [7-9,16]. Moreover, these measurements are instantaneous; therefore, the fibre measurements may be higher than the instantaneous ones when the soil dries after the rain, the herd passes by during windy weather, after the cleaning, or when the white soil is extracted and applied. As a result, the total exposure level and the amount of fibres in the lungs is almost equal to or even higher in a person who was born and was living in a rural area for 50 years than a person starting to work when he was 20 years of age and has worked for 30 years. In fact, the detailed studies verify and reveal the asbestos and fibre amount in the lungs [16].

C. Asbestos Exposure in Turkey Because of Occupational Reasons

We have no information about the results of asbestos exposure because of occupational reasons in Turkey. In Turkey, approximately 471,000 tonnes of asbestos have been imported over the last 30 years, which include 310,478 tonnes between 1983 and 1993, 60,691 tonnes between 1996 and 1997, and 100,300 tonnes between 1995 and 2005. However, the production is approximately 10% of this number. Therefore, 500,000 tonnes of asbestos were used in Turkey from 1983 to 2010 when the use of asbestos was completely banned. Those working with the products, including these amounts, would be exposed to asbestos at least for the next 30–40 years (*The Report of Specialisation Commission of the SPO, 1996, 2001, 2009-2013*). Considering these amounts of asbestos used in the industry, it is obvious that this exposure during the maintenance, repair, and disassembly of the products will lead to the emergence of the relevant diseases in the next 20 years unless efficient preventive measures are taken. In fact, as mentioned above, the number of heavy tonnage vessels which were disassembled in 2010 was 238.

D. Mesothelioma Due to the Asbestos Exposure in the Rural Areas

Because of the asbestos exposure we have mentioned in detail above, the exposure is at high levels in the rural areas and the relevant diseases, particularly mesothelioma, are almost endemic.

As detailed above, in a cohort composed of villagers who have been certainly exposed to environmental asbestos, the average annual mesothelioma incidence rate was estimated to be 114.8/100,000 for person/year men and 159.8/100,000 person/year for women. These levels are almost equal or even higher than those determined in the cohort studies, including in workers directly exposed to asbestos. Moreover, the proportional death rate found in this cohort study due to mesothelioma is 5.6% [6]. In a general population, including those exposed to asbestos in rural areas, the mesothelioma incidence rate was estimated to be 20/100,000 person/year [9]. These numbers show the level of risk the population with asbestos exposure due to environmental reasons is faced with. Such an environmental exposure is also reported in Greece, Corsica, Cyprus, Bulgaria, France, and Yugoslavia, apart from Turkey [17]. However, the rate of population with asbestos exposure is relatively low in these countries.

The increase in the risk of mesothelioma because of the asbestos exposure occurring in some regions of the rural areas is related with the total level of asbestos exposure in these regions.

The disease in the mesothelioma cases due to the occupational asbestos exposure emerges 35-40 years later than the first asbestos exposure. This period is called the "latent period" [17,18]. Because the exposure initiates from the beginning of the job, the age when the mesothelioma is diagnosed is generally between the ages of 60 and 65 years [18-21].

However, the asbestos exposure in the rural areas starts from birth. In this case, the "latent period" is the age when the disease is diagnosed. This period is between the ages of 50 and 55 years in our country [6-9]. This number is longer than the series of workplaces in terms of the "latent period," whereas it is much shorter in terms of the age when the disease is diagnosed because the "latent period" is the same as the age when the disease emerged. It is believed that the "latent period" is related with the frequency of the exposure levels [17,18].

E. Other Problems Due to the Asbestos Exposure in the Rural Areas

Lung Cancer

It is stated that the asbestos increases the risk of lung cancer separately apart from the other etiologic reasons and smoking [22-24]. The asbestos exposure in the rural areas directly increases the risk of lung cancer [25,26].

In the retrospective cohorts, including 15 villages certainly exposed to asbestos and 12 villages with no asbestos exposure, the incidence of lung cancer in the villages with asbestos exposure is determined to be 135.21/100,000 person/year for men and 47.28/100,000 person/year for women. The same rates is 60.15/100,000 and 15.06/100,000 person/year for men and women, respectively in the villages with no asbestos exposure [25]. In this study, the risk of lung cancer is 6.9 times higher in men with no asbestos exposure and who do not smoke than in men with asbestos exposure and who do not smoke; however, this rate is 40 times higher in women. In another comprehensive study, the incidence of lung cancer is found to be 1.3 times higher in the population with asbestos exposure in Hekimhan and Arguvan, Malatya than the normal population [26].

Considering the high levels of smoking in the rural areas, the common synergistic effect of asbestos exposure and smoking is significant in the development of lung cancer. The real dimension of this problem is unknown in our country. However, it is sure that this relationship has a key role in the incidence of lung cancer.

Figure 11. White soil plastered on the wall easily adheres to the existing material (The archive of Dr. A. Şenyiğit)

Benign Lung and Pleural Pathologies

Benign pleural changes in the cohorts living in rural areas where asbestos exposure is definite are more common in the populations with no asbestos exposure. Highly comprehensive studies have been conducted within this respect in Turkey. In these studies, the rate of pleural diseases caused by asbestos is determined to be between 20% and 40% [10-13,27,28]. Pleural plaque rate identified in a cohort from rural areas was determined to be 14.4%; the rate of diffuse pleural fibrosis is 10.4% and asbestosis rate is 0.4% [28]. It was asserted that the relatively low rates of asbestosis are because the instantaneous exposure level in the rural areas is lower than the one in workplaces [17,29]. Both national and international literature has limited information about the frequency of benign asbestos pleuritis and rounded atelectasis. Pleural plaque and rounded atelectasis is not a vital health problem for the lifelong period. However, benign asbestos pleuritis often results in diffuse pleural fibrosis during the recovery because it is an inflammation in pleura.

METHOD OF THE PLAN

The preparation process of the Plan was initiated when Prof. Dr. Recep Akdağ, the Former Minister of Health appointed Prof. Dr. Muzaffer Metintaş, the Director of Eskişehir Osmangazi University Lung and Pleural Cancers Research and Clinical Center (ESOGU-APKAM) as the strategic plan coordinator assigned with the preparation and management of the Turkey Asbestos Control Strategic Plan with a written instruction on September 24, 2012. It was stated that the Plan prepared by Dr. Muzaffer Metintaş and Dr. Hasan Fevzi Batırel in consultation with the faculty members and researchers of the Turkish Mesothelioma Working Group and submitted to the Ministry of Health was approved by the letter dated October 9, 2012 of the Public Health Institute of Turkey and the work would be initiated. Following this letter, the processes of the Plan was put into practice.

Figure 12. The asbestos exposure in the house because of the plaster in the interior walls and outside because of the plaster in the exterior walls (The archive of Dr. A. Şenyiğit, Dr. M. Metintaş)

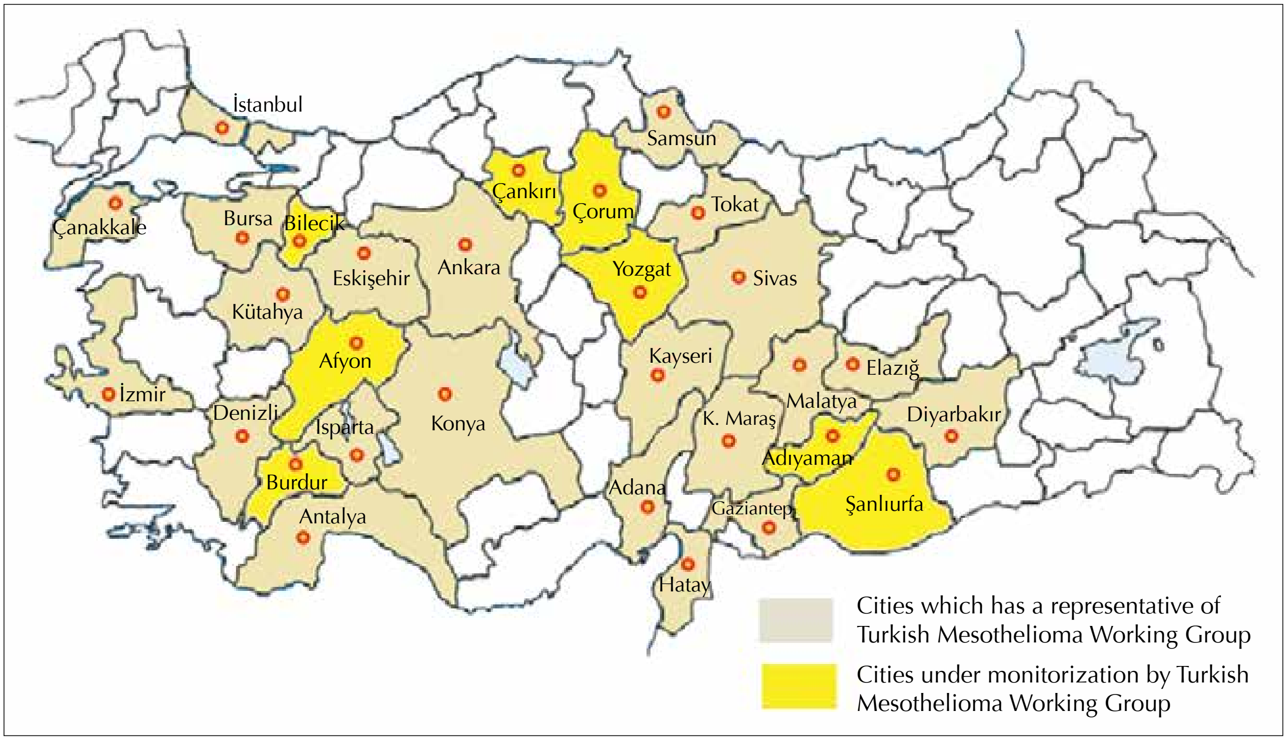

Figure 13. The provinces which the Mesothelioma Working Group of Turkey organizes in

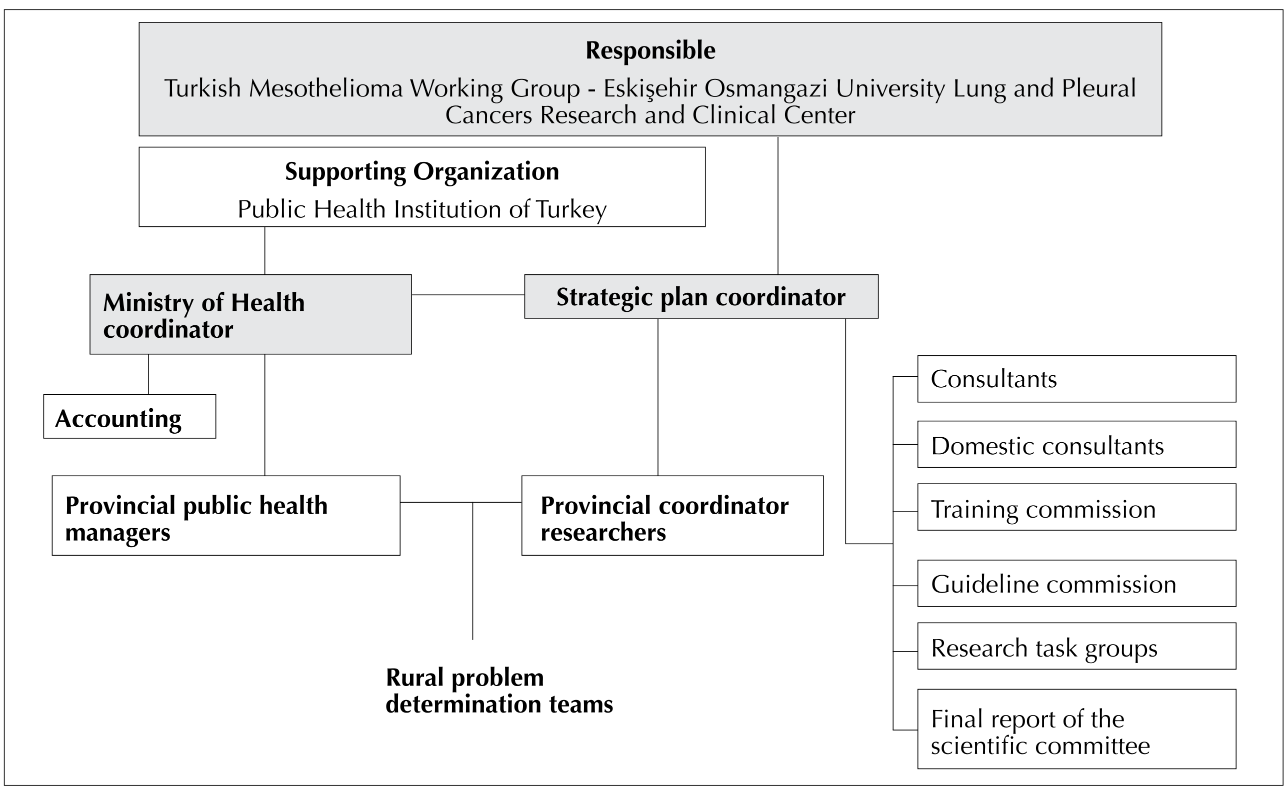

Figure 14. Organizational chart for the planning studies

Thirty-eight faculty members, including 19 professors, 16 associate professors, three assistant professors, two specialist physicians, two mineralogist professors, and four foreign consultant scientists who are members of the Turkish Mesothelioma Working Group, who work in 22 provinces were found to have the highest number of cases according to the relevant previous publications and eight control provinces in the neighborhood took part in the Plan. Asbestos Control Strategic Plan (Figure 13). The researchers are members of the Turkish Mesothelioma Working Group in 24 universities, four teaching hospitals, and two occupational diseases hospitals.

Organization

Three organizational structures took part in the organization of the Plan. The preparation, coordination, result analysis,

Figure 15. Discussion on the preparation of the Plan implementation method by the Plan researchers on November 3, 2012

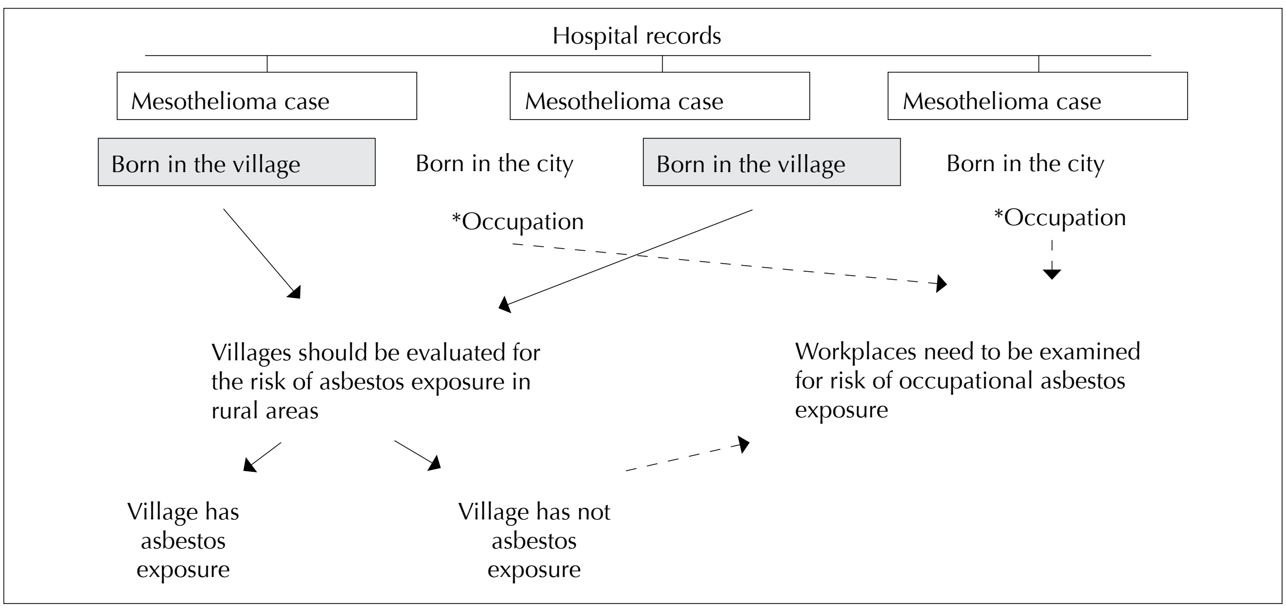

Figure 16. Method to follow for the determination of the villages which will be examined for the existence of asbestos exposure risk

and interpretation of the strategic plan as well as the wording of the Plan were conducted by ESOGU-APKAM. The scientific preparation and the coordination of local training and scientific studies as well as the local activities were conducted by the members of the Turkish Mesothelioma Working Group. Technical services and financing of the Plan studies and local practices in the provinces as well as reimbursing mineralogy analysis of the soil samples were realized by the Public Health Institute of Turkey. The coordination of the Plan was ensured by the Department of Cancer within the Public Health Institute of Turkey. The organizational chart of the Plan is as follows (Figure 14).

In the organization of the Plan, faculty members and researchers who are the members of the Mesothelioma Working Group of Turkey acted as the "provincial coordinators" in the provinces of the universities. The Mesothelioma Working Group of Turkey included faculty members from 22 provinces where mesothelioma cases are more prominent than the other provinces. The Group also followed up eight such provinces. The provincial directors of public health in these provinces formed the "provincial co-coordinator" group to manage the technical work under the coordination of the Department of Cancer in the Public Health Institute of Turkey, which is the coordinator of the Ministry of Health.

Method for the Determination of the Asbestos Problem in the Rural Areas of Turkey

To discuss and finalize the method developed for the Plan, a "Plan development" meeting was held in Ankara under the authority of the Public Health Institution of Turkey on November 3, 2012. The members of the Mesothelioma

Figure 17. Photos from the training of mukhtars and councillors in the villages

Working Group of Turkey formed by the faculty members from 30 provinces who served in the Plan work as well as the provincial directors of public health in these provinces or their authorized assistants and the officials from the Public Health Institution of Turkey participated in the meeting. The implementation method of the Turkey Asbestos Control Strategic Plan was finalized in the meeting (Figure 15).

In this study, "from case to the field method" has been used (Figure 16). In other words, the birth and living places of the cases with mesothelioma diagnosed between 2008 and 2012 to detect regions/areas exposed to asbestos in Turkey were determined; villages under the risk of being exposed to asbestos were identified. Soil samples were collected from these villages and these samples were subject to mineral analysis.

Identification of Mesothelioma Cases

In hospitals from 30 provinces where mesothelioma cases are determined to be diagnosed mostly, the patients diagnosed with "mesothelioma" under the code of C45 between 2008 and 2012 (for 5 years) were identified with approbation. All the data was sent to ESOGU-APKAM in a CD by the Department of Cancer in the Public Health Institute of Turkey.

The information about the determined patients was uploaded in an Excel file specifically prepared by ESOGU-APKAM based on their names, ages, genders, diagnosis dates, birth places, villages, districts, provinces, provinces where they are diagnosed with mesothelioma, and their addresses. During this process, the number of the registered mesothelioma patients under the code of C45 was requested from the Social Security Institution of Turkey according to the diagnosis records for the period between 2008 and 2012.

After consolidating and compiling all records of mesothelioma cases with C45 code under a single file, the repeated records and the others with wrong identification numbers or names, whose diagnosis date is unknown or lacking in information about the age, birth place, and origin were excluded. The cases were checked in the Central Register System (MERNIS) one by one according to their identity, name, age, birth place, register, and address information with their identity numbers by the authorized health personnel. The records which are not verified or consisting of incompatible information were excluded. Later, the deceased cases were identified; their death dates and ages were determined over the automation system of the hospitals with identity numbers and these were verified by their registers. Following the identification of all dead cases, the mean and median survival times were identified according to their diagnosis dates.

The number of cases found was compared with the number of cases obtained from the Social Security Institution in terms of years and provinces.

All the records of mesothelioma cases were transferred into the Statistical Package for the Social Sciences (SPSS) version 15.0 program from the Excel file for statistical analysis and were analyzed based on the objectives of the Plan.

The Determination of the Villages

After obtaining the final records of the cases with mesothelioma, the cases born in villages/rural areas were determined. The villages where these cases were born were identified as "villages required to be examined for asbestos exposure risk."

"Villages required to be examined for asbestos exposure risk" were classified based on provinces. Later, the lists of prov-

Figure 18. Training brochures distributed in the villages

Figure 19. Training of the personnel who will collect samples from the villages

inces were sent to the provincial coordinating researchers and to the provincial directorates of public health. The provincial coordinating researchers and the officials from the provincial directorates of public health combined the local and central information and initiated the work to determine the villages to be visited and to collect samples.

Within the scope of the work mentioned above, the provincial coordinators and the officials from the provincial directorates of public health contacted the offices of mukhtars in the "villages required to be examined for asbestos exposure risk." The mukhtars and councilors of the villages were invited to the province and received local training on the "asbestos exposure in the rural areas-villages, its results, and Plan work." The training was conducted by the provincial coordinators with the same program in all parts of Turkey between March and August 2013.

Training practices were applied in a hall selected locally for every province with the participation of all mukhtars and councilors of the selected villages. In the first stage, the training was conducted via a conference; the discussion with the help of a common slide series was prepared by the provincial coordinators. Moreover, the benefits of the Plan work for the villages were also explained. The questions of the mukhtars were answered.

At the end of the meeting, previously prepared posters and brochures mentioning "asbestos exposure in the villages and its risks" were handed out (Figure 18).

Following the training, a clear, easy, and standard questionnaire about the asbestos exposure was administered to the mukhtars.

The provincial coordinators and officials from the provincial directorates of public health evaluated the training of mukhtars, interview and questionnaire results, as well as the village information obtained from the central administration and determined the "villages required to be examined for asbestos exposure risk" based on their provinces. Following the identification of the villages, the officials of the provincial directorate of public health went to these villages to collect samples.

Taking Soil Samples from the Villages

Applied training of the technical staff

Because the method of the Plan is based on taking samples from the soil likely to include asbestos in the villages found to be under the risk of asbestos exposure and mineral analysis of these samples, it was important to appropriately take samples from the walls and roofs of the houses and the mound and to list and deliver them to the analysis centers. Therefore, at the beginning of the Plan work, the technical personnel to collect soil samples in the rural areas should be trained to "recognize the risky soil mixed with asbestos." The officials from the provincial directorates of public health who will visit the rural areas participated in the applied training held in Ankara on November 10, 2012, with the clinicians, epidemiologists, and mineralogists.

After the training, the guide for recognizing the soil mixed with asbestos and taking samples in the rural areas (Figure 20), which the technical personnel can use, while working in the rural areas was prepared, distributed to the technical personnel as a leaflet, and uploaded on the website *www.turkiyemezotelyoma.org*. The guide mainly included visual information about the description of the soil mixed with asbestos; its differences; and how to collect samples from houses, roofing, or mounds.

Figure 20. Guide

Practices in the rural areas

The trained teams of the provincial directorate of public health visited the villages considered to be examined for asbestos exposure risk to collect soil samples. The teams collected samples from the soil, the walls of the houses, roofs, and other areas under the risk of asbestos exposure with the help of the mukhtar and the villagers (Figure 22).

These samples were recorded in the pre-prepared and distributed reports, packaged, and sent to the address of ESOGU-APKAM to be submitted to the project coordinator Dr. Muzaffer Metintaş.

Mineral Analysis of the Soil Samples

The soil samples delivered to ESOGU-APKAM were coded according to their provinces, districts, villages, areas, and individual houses. Later, the soil samples were examined for its fibrous mineral structures by light microscopy. The fibrous minerals were regarded as the structures with the width and length rate of 1:3. Those found to have fibrous minerals were regarded as risky soil samples and were coded according to their provincial, district, and village addresses and were sent to the TUBITAK Marmara Research Centre Material Institute for mineral analysis with XRD by cargo.

The existence of the asbestos in the samples was examined at the TUBITAK Marmara Research Centre Material Institute based on the sub-types of asbestos. The samples found to contain asbestos and fibre mixture were listed in codes and were reported, including the formulation of asbestos and fibre type. The reports were sent to Dr. Muzaffer Metintaş in

Figure 21. The domain that the technical personnel can use over the website

Figure 22. Collecting samples from houses and mounds. The samples collected were delivered to ESOGU-APKAM by cargo

ESOGU-APKAM in the form of pdf lists and to the Public Health Institute of Turkey as printouts. The results of the TUBITAK Marmara Research Centre Material Institute and of ESOGU-APKAM were compared and in some incompatible cases, the samples were requested to be re-analyzed.

The examined soil samples and their XRD patterns were backed up and stored to be maintained for 3 years.

The Determination of Villages with Asbestos Exposure

Following the evaluation of the analysis results, the coded soil samples were classified based on provinces, districts, villages, areas, and names of the owners of the houses. Thus, the villages, areas, and houses with asbestos exposure were identified.

Following the confirmation of the villages with asbestos exposure, the records of mesothelioma cases were examined again and the villages with more than one mesothelioma case were listed again. Among these villages, those which were not visited by the officials of the provincial directorates of public health due to the statements of the mukhtars and the information in the questionnaires or although visited, the officials did not collect samples because there are no houses plastered with the soil likely to include asbestos due to the reports were determined. These villages were also listed as the ones required to be visited and to collect samples with respect to asbestos exposure.

Estimation of the Population Exposed to Asbestos in Turkey in 2013

The populations of the villages with asbestos exposure for 2012-2013 were determined based on the names of villages, districts, and provinces on the official websites *www.yerel-net.org.tr* and *www.nufusu.com*, including the data of the TUIK.

Evaluation of the Occupational Asbestos Exposure Risk

Because there are insufficient records in Turkey with respect to the occupational environment, it is not fully possible to determine the occupational asbestos exposure. The Plan work does not aim to detect the occupational asbestos exposure risk; however, it establishes the first basis for the work aiming to determine this risk. Accordingly, mesothelioma patients with high occupational asbestos exposure risk include those who were diagnosed with mesothelioma between 2008 and 2012 but who were not born in villages and/or living in villages and those who were born in the villages of provinces where there is no asbestos exposure. When analyzing the case distribution of the Plan work, the cases that were not born in villages were categorized as cases with high occupational asbestos exposure risk. These cases should be examined based on occupation and workplace, and the existence of the occupational asbestos exposure should be analyzed based on the obtained data.

Based on the 2008-2012 Data, the Population Exposed to Asbestos in Rural Areas in Turkey and the Measurement of the Risk of Occurrence of Mesothelioma, Lung Cancer, and Benign Pleural Diseases Because of Asbestos Exposure

During the Plan work, the "population exposed to asbestos in our country" was divided into two groups. The first group is the "population including the existing mesothelioma cases and exposed to asbestos in rural areas for a sufficient period of time to develop the risk." The second group is the "population living in villages where the asbestos exposure remains and continues to be exposed to asbestos because of living in these villages."

Mesothelioma, lung cancer, and benign lung and pleural diseases were measured for both populations.

Findings utilized in the estimation

1. Mesothelioma risk for the population that is not exposed to asbestos is reported to be 2.2-4/1,000,000 person/year [30-33]. However, the risk for the workers who are directly exposed to asbestos is reported to be 19-122.4/100,000 person/year [2,17,32].

2. In Turkey, in a cohort composed of villagers who are above 30 years of age and who have been certainly exposed to asbestos in rural areas, the average annual mesothelioma incidence rate was estimated to be 114.8/100,000 person/year for men and 159.8/100,000 person/year for women [6].

3. In a general population including those exposed to asbestos in rural areas in Turkey, the mesothelioma incidence rate was determined to be 20/100,000 person/year [9].

4. Number of mesothelioma cases with definite diagnosis in Turkey in the year 2000 by the Mesothelioma National Council established in 2000 by the Ministry of Health was declared to be 506 [34]. It was also stated that there is a relation between the asbestos exposure and the villages of 415 cases out of the abovementioned 506 cases.

5. In Turkey, among the villagers who are above 20 years of age and who have been definitely exposed to asbestos in rural areas, the lung cancer incidence risk is estimated to be 135.21/100,000 person/year for men and 47.28/100,000 for women [25]. For the villagers who live in the same region but who are not exposed to asbestos, the aforementioned incidence rates were estimated to be 60.2/100,000 and 15/100,000 person/year, respectively.

6. In Turkey, benign pleural changes were determined to be more common in cohorts living in the rural areas where the asbestos exposure is definite than in populations with no asbestos exposure, corresponding to a range between 10% and 25% [10-13,27,28]. Among the people living in the rural areas, specified pleural plaque prevalence, diffuse pleural fibrosis prevalence, and asbestosis prevalence was determined to be 14.4%, 10.4%, and 0.4%, respectively [28].

7. We have almost no information regarding the quantitative data on workplace asbestos exposure to enable an overall assessment for Turkey. As of December 2010, asbestos production and usage has been fully prohibited in Turkey. However, a significant number of people working in various fields are still exposed to previously used asbestos, and it should be admitted that this exposure will last for a certain period of time.

Estimates

1. Depending on the number of mesothelioma cases with rural area origin among all mesothelioma cases observed between 2008 and 2012, "the population exposed to asbestos in rural areas for a risky period of time" can be estimated by utilizing the abovementioned incidence rates for mesothelioma. In other words, the annual total count of male and female mesothelioma cases with asbestos exposure in rural areas will correspond to the population exposed to asbestos in rural areas in the same region by male and female incidences. Accordingly, the population exposed to asbestos was estimated for men with the formula: "Male population exposed to asbestos is EM x 100,000/I," where "I" is the mesothelioma incidence rate in rural areas and "EM" is the annual number of male mesothelioma cases determined in the rural areas. Female population exposed to asbestos was also estimated with the same formula. Thereafter, by consolidating both of these populations, the "population exposed to asbestos in rural areas for a risky period of time," some of which comprise mesothelioma cases in 2013 were estimated.

2. Data published by the Mesothelioma National Council established in 2000 by the Ministry of Health was compared with our data and assessments were made [34].

3. "Population living in villages where there is still an asbestos exposure and those continuing to be exposed to asbestos because of living in these villages" was determined as the total population of the villages exposed to asbestos.

4. Among the "population exposed to asbestos in rural areas for a risky period of time" estimated for Turkey, the number of people to have mesothelioma, lung cancer, and benign lung and pleural disease in the next 20 years was estimated in accordance with the abovementioned incidence and prevalence rates. Same estimations were made for "the population that is determined to have asbestos exposure currently in rural areas."

5. To estimate the number of mesothelioma cases to occur between 2013 and 2033 among both the populations, the method detailed below was followed:

    i. Among the population exposed to asbestos, the number of people exposed to asbestos was identified based on age, considering the births, deaths, and migrations in the next 20 years. Because births and migrations would not cause any changes, they were not taken into account in the estimation of "population exposed to asbestos in rural areas for a risky period of time." However, births and migrations were considered in estimating the population that will continue to be exposed to asbestos in 2013.

ii. Based on the data of the TUIK [35], rough birth and mortality rates up to 2033 were utilized. Births and deaths in the selected populations were estimated based on the number of births and deaths expected from the projected population in each year.

iii. Projected volume of migration was obtained based on the projected population for each year, with a decrease of the figure (21.8%) calculated by the proportion of migration to provinces from villages and to villages from villages in 2000, to the population in 2000. The percentage of men and women among the projected population for the 2013–2033 period was taken as 50% and 50%, respectively. The proportion of the men is 49.9% in the latest projection in the year of 2025 in TUIK. The number of men and women in our selected population was determined based on these ratios.

iv. Based on the mesothelioma rate (abovementioned) in men and women in the villages in the rural areas of Eskisehir, where asbestos exposure was determined quantitatively, the number of individuals above 30 years of age was determined and mesothelioma cases for that year were estimated.

6. Lung cancer risk for each population was also estimated. Therefore, based on the lung cancer rate (abovementioned) in men and women in the villages of Turkey, where asbestos exposure was determined quantitatively, the figure obtained depending on the lung cancer rate in villages not exposed to asbestos was deduced from the figure obtained depending on the lung cancer rate in villages exposed to asbestos, and the number of lung cancer cases associated with asbestos was estimated in a manner similar to mesothelioma.

7. Benign lung and pleural diseases in populations exposed to asbestos were estimated based on the abovementioned prevalence.

i. In estimating the benign number of diseases among the "population exposed to asbestos in rural areas for a risky period of time," the prevalence of the diseases were utilized directly.

ii. In estimating the population that will continue to be exposed to asbestos after 2013, estimations were made over the projected population in 2033 by adding 20 to 2013 because the benign disease needs nearly 20 years to develop.

iii. In estimating the number of people with respiratory insufficiency as a result of continuous asbestos exposure, co-existence of chronic obstructive pulmonary disease (COPD) that may be observed in these cases was considered. The smoking rate in adults was estimated to be 31.3% [36], and COPD prevalence among the smoking population was projected to be around 26.3%. These rates were utilized in the estimations to determine the co-existence of COPD [36].

FINANCING OF THE PLAN WORK

The Plan meetings, which were held on November 3 and November 10, 2012, publication and distribution of training brochures, and XRD analysis of soil samples by the TUBITAK Marmara Research Centre were financed by the Public Health Institute of Turkey. Researchers of the Plan came together in the meetings held by the Turkish Thoracic Society and the Turkish Respiratory Research Society. The website of the Plan, preliminary analysis of the samples, and communication facilities were financed by the Eskişehir Osmangazi University. The coordinators and researchers of the Plan were not paid.

RESULTS OF THE PLAN

Number of Mesothelioma Cases

According to the hospital records in 30 provinces determined for the identification of patients diagnosed with mesothelioma, the number of mesothelioma cases listed in the hospital records with C45 code between 2008 and 2012 (5 years) was 7,787. These cases were compiled in a single file, analyzed individually in terms of data accuracy and data sufficiency by scanning the population and death registers (MERNIS), and compared with the number of cases provided by the Social Security Institution. Accordingly, the number of cases based on sound admissible data was determined to be 5,617 (Table 1).

The distribution of mesothelioma cases based on gender and age is given in Table 2. Considering the number of cases, the men/women ratio in Turkey was estimated to be 1.36.

Out of 5,617 cases diagnosed between 2008 and 2012 in Turkey, 3,445 (62.2%) cases were determined to have died by July 2014. Distribution of the patients, dead or alive, based on gender is given in Table 3.

Table 1. Number of mesothelioma cases with C45 code between 2008 and 2012

Year	Male	Female	Total
2008	570	422	992
2009	658	455	1.113
2010	606	498	1.104
2011	686	501	1.187
2012	721	500	1.221
Total	3.241	2.376	5.617

Table 2. Distribution of mesothelioma cases based on gender and age and those diagnosed between 2008 and 2012 in Turkey

Gender	Number	Mean age (years)	Standard deviation	Minimum	Maximum	Median age (years)
Male	3.241	62.0	13.1	20	96	62
Female	2.376	61.3	13.7	21	95	62
Total	5.617	61.7	13.4	20	96	62

Table 3. Distribution of the mesothelioma cases, dead or alive, based on gender by July 2014

Gender	Alive	Dead	Total
Male	1.144 35.3%	2.097 64.7%	3.241 100%
Female	978 41.2%	1.398 58.8%	2.376 100%
Total	2.122	3.495	5.617

Table 4. Distribution of dead and alive mesothelioma cases based on age

Status	Number	Mean age (years)	Standard deviation	Minimum	Maximum	Median age (years)
Alive	2.122	58.4	13.71	24	95	59
Dead	3.495	63.7	12.76	20	96	64
Total	5.617	61.7	13.37	20	96	62

Mortality rate among men is higher than that of women (X^2=20.05; p<0.001). The distribution of cases based on mean and median ages of dead or living patients is given in Table 4. The mean age of dead patients was determined to be longer than that of living patients (t=14.63; p<0.001).

When the life time of dead cases at the date of diagnosis was examined, the mean survival of the cases was estimated to be 11.44±021 (95% GA 11.04-11.85) months, while the median survival was estimated to be 8 (95% GA 7.60–8.40) months.

When 5,617 cases diagnosed between 2008 and 2012 in Turkey were examined based on their distribution according to the province of birth and the province where the patient was diagnosed, it was observed that the most common provinces of birth among the cases were Diyarbakır, Elazığ, Eskişehir, Tokat, Sivas, Kütahya, and Yozgat, and the most common provinces where the patient is diagnosed were İstanbul, Ankara, Diyarbakır, Eskişehir, Elazığ, Adana, Antalya, Bursa, and Gaziantep.

Among 5,617 mesothelioma cases, when the cases born in rural areas/villages and have lived in villages are addressed separately, it was identified that 3,738 of the cases had lived in villages/rural areas, whereas 1,879 (33.5%) had not (Table 5).

The number of men and women with rural area history was different. The ratio of men among the cases who did not live in rural areas was significantly high (X^2=3,973; p<0.05).

Distribution of mesothelioma cases with or without rural area history according to the ages is given in Table 6. The mean age was higher among those without rural area history (t=4.48; p<0.001).

Villages Where There is Asbestos Exposure

When the place of birth of cases from 30 provinces where mesothelioma cases were determined was examined, 1,571 villages in 62 provinces were identified. Following an analysis of possible "asbestos exposure risk" of these villages, as explained above in the methods section, it was decided to collect soil samples from 1,236 villages in a total of 58 provinces. Although some of the cases were born in the villages of the other four provinces, it was agreed based on risk analyses that these villages were not worth analyzing for asbestos exposure risk.

Table 5. Distribution of mesothelioma cases based on their rural area history according to gender

	Living in rural area		
Gender	Yes	No	Total
Male	2.122 65.5%	1.119 34.5%	3.241
Female	1.616 68.0%	760 32.0%	2.376
Total	3.738 66.5%	1.879 33.5%	5.617

Table 6. Distribution of mesothelioma cases with or without rural area history

Living in rural area	Number	Mean age (years)	Standard deviation
Yes	3.738	62.29	13.2
No	1.879	60.59	13.7

As a result of the work conducted by the teams from provincial directorates of public health in 1,236 villages of 58 provinces, 2,447 soil samples were collected from the interior and exterior walls of the houses, risky roofing, and soil mounds in 1,081 villages of these 58 provinces. It was deemed unnecessary to take samples from 218 villages based on the statements of the mukhtars and/or on-the-spot controls.

Soil samples were subjected to preliminary analysis for mineral fibre existence at the Eskişehir Osmangazi University Medical Faculty Lung and Pleural Cancers Research and Clinical Center. Out of the 2,447 samples, 1,251 were considered to have fibrous minerals and were sent to the TUBITAK Marmara Research Centre for XRD analysis.

As a result of the XRD analysis of these 1,251 samples, 514 soil samples were determined to have *chrysotile, tremolite,* or asbestos fibres including both. When the registers were checked, it was observed that these 514 soil samples were collected from 379 villages in 41 provinces out of 58. Therefore, asbestos exposure was stated to continue in a total of 379 villages out of 1,088 from which soil samples were collected to be examined for asbestos exposure risk.

When the distribution of 379 villages with asbestos exposure was examined, it was observed that the number of provinces that have five or more villages where asbestos exposure is still prevalent was 15 (Figure 23).

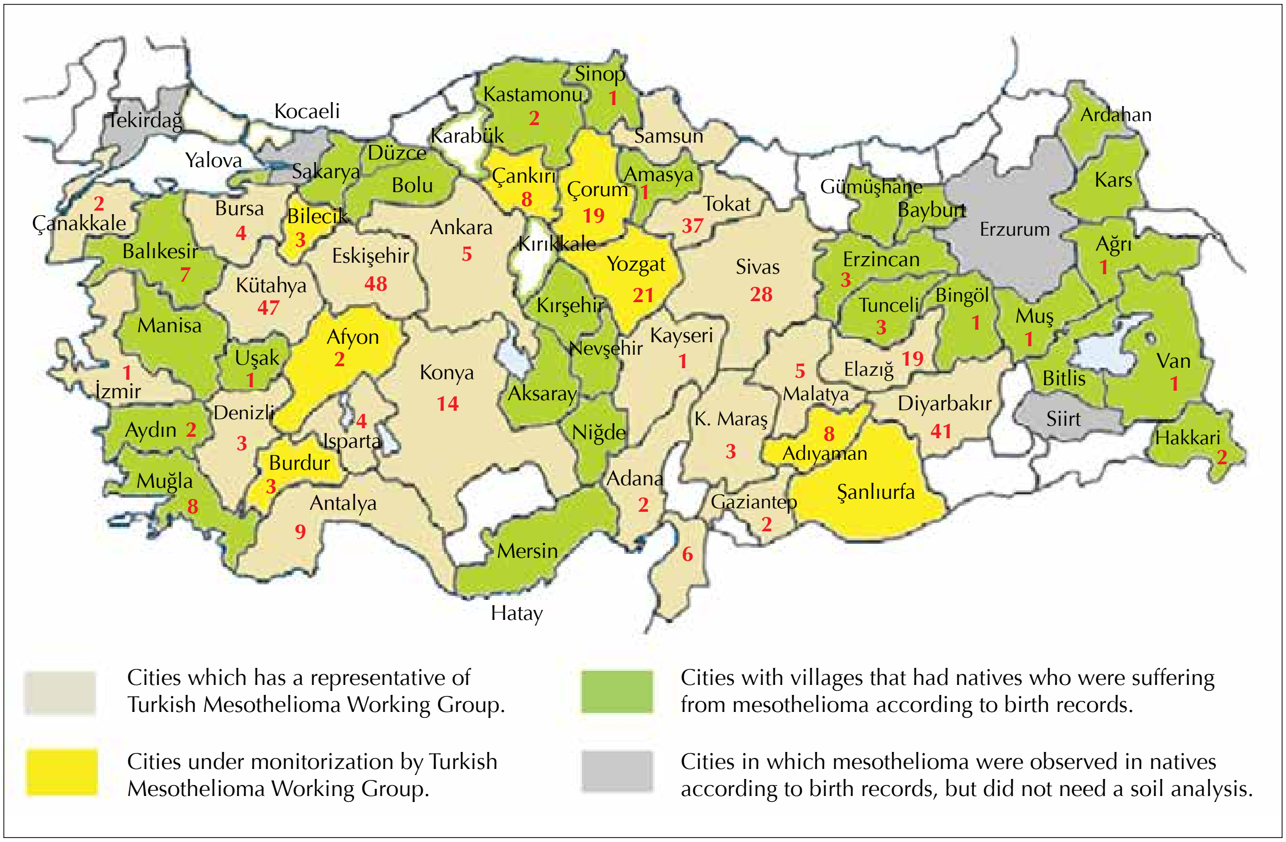

Figure 23. Number of villages where asbestos exposure is definite is attached to the provinces from which soil samples were collected to be examined for asbestos exposure risk (*Soil samples were not collected from provinces marked with grey. Those areas in which there is no figure shows the provinces of the villages* where asbestos exposure was not detected)

Other Villages Requiring Soil Samples to be Taken and Mineral Analysis to be Made

When 218 villages that were not addressed by the teams from the provincial directorates of public health for various reasons were examined for mesothelioma cases, it was determined that 120 of them were the place of birth or residence of three or more mesothelioma cases for a certain period of time. It is considered necessary to re-visit these villages to collect soil samples.

Population Exposed to Asbestos in Rural Areas in 2013

The total number of people living in 379 villages/rural areas where asbestos exposure was detected was 158,068. The distribution of the villages by provinces is given in Figure 24.

In 24 of the provinces shown in the figure, the population exposed to asbestos was more than 1,000 and it was more than 5,000 in 11 provinces. These 11 provinces were Diyarbakır, Tokat, Kütahya, Sivas, Konya, Yozgat, Eskişehir, Muğla, Malatya, Çorum, and Elazığ.

When the towns whose population is above 1,000 was excluded from 379 village/rural area units determined to have asbestos exposure currently, the number of cases living in villages with low population and therefore have a high risk of asbestos exposure was determined to be 98,453 (Figure 25).

Among the provinces shown in Figure 25, 17 had villages with a population above 1,000 and seven had villages with a population above 5,000. These seven provinces were Diyarbakır, Kütahya, Tokat, Eskişehir, Yozgat, Çorum, and Elazığ.

PROJECTIONS DUE TO THE RESULTS OF THE PLAN

THE NUMBER OF MESOTHELIOMA, LUNG CANCER, AND BENIGN LUNG AND PLEURAL DISEASES RESULTING FROM ASBESTOS EXPOSURE IN RURAL AREAS IS EXPECTED TO BE ENCOUNTERED BETWEEN 2013 AND 2033 IN TURKEY

Mesothelioma

A. Expected number of mesothelioma cases in 2013 among the population exposed to asbestos

1. Under the framework of the Plan work, the number of mesothelioma cases determined for Turkey for the period between 2008 and 2012 was 5,617. Of these cases, 3,738 were specified to have been exposed to asbestos in rural areas (66.5%).

2. Out of 3,738 mesothelioma cases exposed to asbestos in rural areas, 2,122 were men and 1,616 were women. The annual average number of cases resulting from asbestos exposure in rural areas was 424 (2,122:5) for men and 323 (1,616:5) for women.

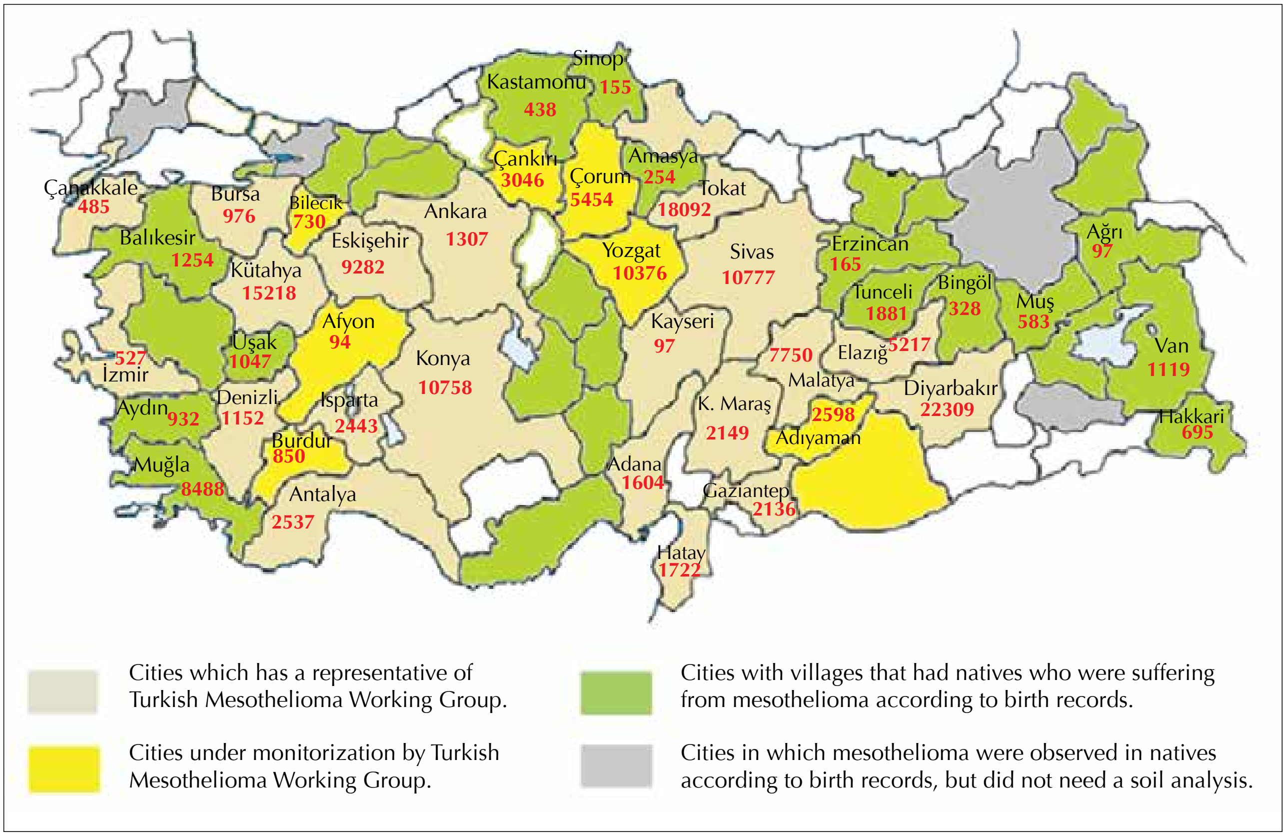

Figure 24. Distribution of the population exposed to asbestos in the provinces of the villages with asbestos exposure

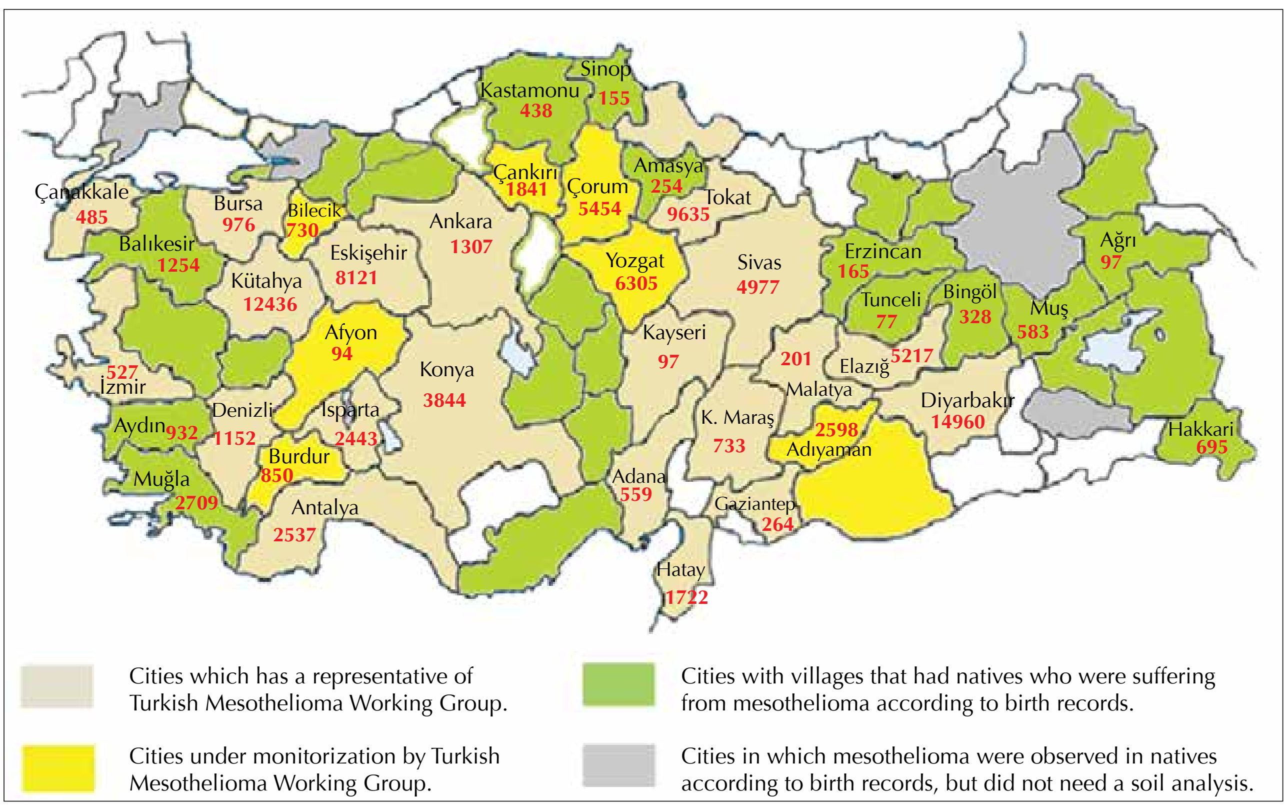

Figure 25. Distribution of population exposed to asbestos only in villages when towns are excluded

3. In a cohort composed of villagers whose asbestos exposure in rural areas was definite, when the mesothelioma incidence rate was taken as 114.8/100,000 for men and 159.8/100,000 person/year for women [6], the projected population exposed to asbestos that would include 424 cases for men was estimated to be 369,337, and the projected population exposed to asbestos that would include 323 cases for women was estimated to be 202,127. The

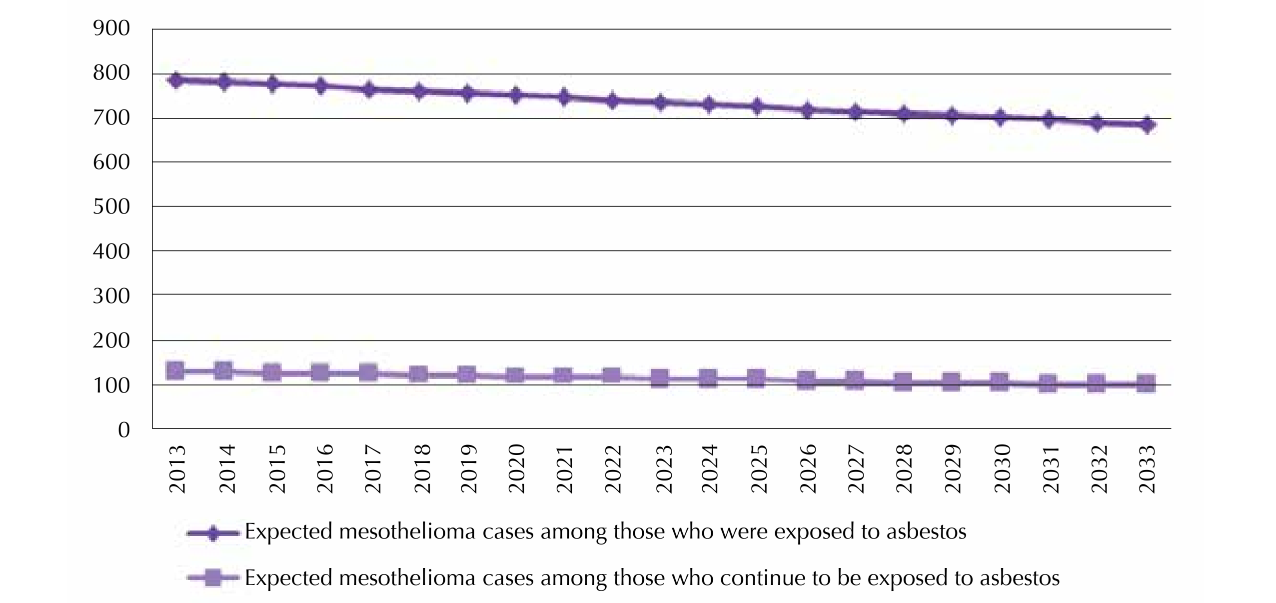

Figure 26. Mesothelioma incidence expected among those who were exposed to asbestos before 2013 and those who will continue to be exposed to asbestos after 2013

Table 7. Distribution based on years of the mesothelioma cases to be observed between 2013 and 2033 among the population exposed to asbestos for a risky period of time before 2013

Years	Crude death rate (0%)	Population who had been exposed to asbestos	Number of expected mesothelioma cases
2013	6	571460	785
2014	6	568031	780
2015	6	564623	775
2016	6	561235	771
2017	6	557868	766
2018	7	554521	761
2019	7	551194	757
2020	7	547335	751
2021	7	543504	746
2022	7	539699	741
2023	7	535921	736
2024	7	532170	731
2025	7	528445	726
2026	7	524746	720
2027	7	521072	715
2028	7	517425	710
2029	7	513803	705
2030	7	510206	701
2031	7	506635	696
2032	7	503088	691
2033	7	499567	686
Total			15.450

total population exposed to asbestos was estimated to be 571,460.

4. The number of mesothelioma cases with definite diagnosis in Turkey in the year 2000 by the Mesothelioma National Council established in 2000 by the Ministry of Health was estimated to be 506 [34]. Moreover, the relation between asbestos exposure and the villages of 415 cases was stated to be detected. Based on the fact that these 415 cases were exposed to asbestos in rural areas, when the incidence rate of the population with similar exposure was taken as a benchmark [6], the number of population that such cases are expected to be observed in was 370,695 in the year 2000. This figure complies with our above given estimation of 571,460 in 2013.

5. The number of mesothelioma cases possible to emerge in the next 20 years among the living people who were exposed to asbestos for a risky period of time was estimated for the mentioned population including 571,460 people. In addition, the number of mesothelioma cases to be observed between 2013 and 2033 among this population was estimated to be 15,450 (Table 7, Figure 26).

B. The number of expected mesothelioma cases among the population to be exposed to asbestos after 2013

1. As a result of the Plan work, it was found out that the number of villages with asbestos exposure was 379 in 2013. Based on the 2012 and 2013 data of TUIK, the populations living in these villages continue to be exposed to asbestos and were estimated to be 158,068.

2. Among this population composed of 158,068 people who will continue to be exposed to asbestos, the number of mesothelioma cases to be observed between 2013 and 2033 was estimated to be 2,511 (Table 8, Figure 26).

Table 8. Distribution based on years of the expected mesothelioma cases among a population composed of 158,068 people who will continue to be exposed to asbestos if the asbestos exposure continues in rural areas between 2013 and 2033*

Years	Crude dead rate (0%)	Crude birth rate (0%)	Migration rate (0%)	Population that will continue to be exposed after 2013	Population with continued exposure (>30 years of age)	Number of expected mesothelioma cases
2013	6	17	22	158.068	94.840	130
2014	6	17	22	156.329	93.798	129
2015	6	17	22	154.610	92.766	127
2016	6	16	22	152.909	91.745	126
2017	6	16	22	151.074	90.644	125
2018	6	16	22	149.261	89.557	123
2019	7	16	22	147.470	88.482	122
2020	7	16	22	145.553	87.332	120
2021	7	15	22	143.661	86.196	118
2022	7	15	22	141.649	84.990	117
2023	7	15	22	139.666	83.800	115
2024	7	15	22	137.711	82.627	114
2025	7	15	22	135.783	81.470	112
2026	7	14	22	133.882	80.329	110
2027	7	14	22	131.874	79.124	109
2028	7	14	22	129.896	77.937	107
2029	7	14	22	127.947	76.768	105
2030	7	14	22	126.028	75.617	104
2031	7	14	22	124.138	74.483	102
2032	7	14	22	122.276	73.365	101
2033	7	14	22	120.442	72.265	99
Total						2.511

*Crude birth rate, migration rate shown in this table and the reason of sampling a population above 30 years of age who was exposed to asbestos were explained in the relevant part under the "method" title of the Plan

Lung Cancer

The number of lung cancer cases in Turkey expected to be observed between 2013 and 2033 among a population composed of 571,460 people exposed to asbestos in rural areas for a risky period of time was estimated to be 5,737, whereas the number of lung cancer cases to be observed as a result of asbestos exposure among 158,068 people who will continue to be exposed to asbestos after 2013 was estimated to be 1,322.

The proportion of expected mesothelioma cases to expected lung cancer cases was 2.69, and this figure was in compliance with the figure projected for populations exposed to asbestos in the related international literature [37].

Benign Lung and Pleural Diseases

In a population composed of 571,460 people exposed to asbestos in rural areas for a risky period of time in terms of the related diseases in Turkey, the expected pleural plaque prevalence over a ratio of 14.4% was determined to be 82,290, diffuse pleural fibrosis prevalence over a ratio of 10.4% was determined to be 59,431, and asbestosis prevalence over a ratio of 0.4% was determined to be 2,286 people [28].

The exposure period sufficient for the development of each of these three pathologies among 158,068 people who are still exposed to asbestos in rural areas may be taken approximately as 20 years [6]. Accordingly, the figure of 2013 which was 15,068 people exposed to asbestos was adjusted to 2033, and the obtained figure comprising 120,442 people will form the baseline group in the estimation of benign disease. For this population, the expected number of people with pleural plaque would be 17,344 over 14.4%, the expected number of people with diffuse pleural fibrosis would be nearly 12,526 over 10.4%, and the expected number of people with asbestosis would be 482 over 0.4%. Among the population of 13,008 (12,526 + 482), 1,071 respiratory insufficiency cases would be expected.

INTERPRETATION OF THE PLAN RESULTS: THEIR EVALUATION IN TERMS OF VALIDITY AND CONSTRAINTS

Asbestos exposure in rural areas and the resulting mesothelioma and other relevant diseases were addressed in terms of their risk for the concerned region in the regional studies carried up by now; and accordingly, it is remarkable that these constitute important health problems in some regions of Turkey. Although the frequency of mesothelioma and other related diseases among the residents of the region have been investigated in these studies, reliable records and information on the current and future risk of mesothelioma and other related diseases have not been established for Turkey in a way to enable making overall assessments or developing sound health policies.

With respect to occupational asbestos exposure, there is almost no information for Turkey, except the limited number of field studies.

Similar to every scientific study, the Plan work has some unavoidable constraints because of the data reliability of the studied population. Through scientific methods, these constraints and their effects on the results are tried to be minimized, and the related figures are given to be considered in the interpretation of the results.

Assessments made in line with the information on the results of the Turkey Asbestos Control Strategic Plan by considering the constraints are as follows:

Number of Mesothelioma Cases in Turkey in the Last 5 Years
The number of mesothelioma cases determined for Turkey for the period between 2008 and 2012 was 5,617. This figure was obtained by accumulating the data in the mentioned period registered with the C45-mesothelioma code in the hospitals of the provinces where mesothelioma is mostly observed in Turkey. Therefore, at the first phase, the validity of the mentioned figure can be accepted as disputable because of the justifiable reasons as the registers are not always based on histopathological diagnosis results and required precision is not always ensured in clinical-radiological diagnosis. The treatment is not duly followed up because mesothelioma does not have effective treatment options.

Despite all these, we consider that the 5,617 cases obtained at the end of the Project is the most realistic one and represents the possible lower limit. All the data were checked in the registers and validated intensely. All the data from Turkey was compiled in a single file and was then examined in itself in terms of identity numbers, names, ages, genders, diagnosis dates, birth places, addresses, and their provinces. The other cases were checked in the Central Population Administration System (MERNIS) records and the validated ones were taken. The ones leading to contradicting information or not confirmed were excluded. The remaining cases were checked by identity numbers in the hospital automation monitoring system for deaths. Death dates of the deceased ones were specified. At the end, the number of cases was 7,787 at the first phase but then it decreased to 5,617 at the final phase.

The ratio of cases who died during the study period was 62.2%; this ratio was in compliance with the mesothelioma survival time of the cases diagnosed in a consecutive 5-year period [38]. Thus, the median survival time for the dead cases was 8 months. This information also complied with the information on mesothelioma prognosis [38,39].

Among the 5,617 cases determined during the Plan work, 3,738 were determined to have lived in rural areas/villages where there is asbestos exposure. Accordingly, the annual average number of cases that were born or lived in rural areas/villages was 757. This figure was stated as 415 in the year 2000 in the study of the Ministry of Health [34]. Considering the mesothelioma latent period, increased access to health services in the past 10 years, increase in the diagnosis and treatment facilities, and increased advantage of digital records, it is remarkable that both figures obtained in 2000 and 2014 are almost in compliance.

Consequently, it is considered that the number of mesothelioma cases specified for Turkey was estimated to be 5,617 between 2008 and 2012 and the distribution of cases by years should be taken as the most realistic figure and that it is reasonable to utilize these figures in scientific studies and in developing health policies in the related field.

Villages and Areas in Turkey are Determined to Have Asbestos Exposure
As a result of the Plan work, it has been determined that asbestos exposure remains in 379 villages. For the determination of these villages, the method “from case to the source” was utilized.

Based on 3,738 cases born in villages/lived in rural areas, determined among the mesothelioma case records, the number of “villages required to be examined for asbestos exposure risk” was identified totally to be 1,236 villages in 58 provinces. As a result of the local studies, teams from the provincial directorate of public health decided to collect soil samples from 1,018 of these villages. Trained provincial public health personnel collected a total of 2,447 soil samples from the interior or exterior walls of the houses, risky roofings, and soil mounds in villages. Of these 2,447 samples, 1,251 were found risky in terms of “mineral fibre existence” and were subjected to XRD analysis in the TUBITAK Marmara Research Centre, Materials Institute. Accordingly, 379 villages were determined to have asbestos fibre, namely the asbestos exposure (the ratio of 1,018 villages from which samples are collected to the number of villages determined to have asbestos exposure is 37.2%). Asbestos exposure was identified in 37.2% of the villages from which samples are collected and this shows that a wide margin was actually studied to not leave out any village where there is asbestos exposure.

The number of villages determined to have asbestos exposure is possibly below the actual number of villages where there is asbestos exposure because, as mentioned before, samples were only collected from 1,018 out of 1,236 villages by excluding 218 villages based on the statements of the mukhtars. When the number of mesothelioma cases in these 218 villages was examined, it was observed that there was more than one case within 5 years in 120 villages. Therefore, these villages should definitely be re-visited and samples should be collected for mineral analysis. We believe that after examining the samples from these villages, the number of villages where there is asbestos exposure would nearly increase by 40 and reach up to 430.

Asbestos exposure in 379 villages where the exposure was determined is definite because the soil sample analysis of these villages was performed by XRD analysis at a very qualified centre. The specificity of this method in identifying the searched mineral is very high, i.e., almost full. Therefore, when asbestos fibre is identified in a sample, the result is "definitely" accurate. However, when the searched fibre is not identified, the suspected sample was re-analyzed. At this point, the sensitivity of the test will not decrease the number of villages determined to have asbestos exposure but may lead to an increase in this regard. Analyzed samples and XRD patterns of the samples are maintained.

Elimination of Asbestos Exposure in Rural Areas in Turkey

As a result of the Plan work, it is possible to fully eliminate the asbestos exposure in rural areas in Turkey. Asbestos exposure was determined nearly in 2,000 houses or sources in 379 villages. As mentioned in detail under the related title, rehabilitation and elimination of these sources may be achieved within 2–3 months and with a very low cost.

Risky Population Exposed to Asbestos in Rural Areas in Turkey

Population of the 379 villages determined to have asbestos exposure, as explained above, was estimated to be 158,068 based on the TUIK data. However, the population of some of these villages was above 1,000. When areas with high population are excluded, the population was estimated to be 98,453. It is an expected characteristic that in areas with low population, the asbestos exposure risk is quite high because of the house population density.

Consequently, it should be acknowledged that at least 158,068 people in Turkey are under the risk of asbestos exposure and at least 98,453 people are exposed to asbestos at a serious level. These figures are also below the actual figures. As explained above, among 120 villages from which samples were not taken but where mesothelioma cases were observed, it is possible that new villages and thus a new list of people may be added to the population.

The period of stay, i.e., whether they live in the village for the whole year or only for some months of the year, of the registered population in the villages where there is asbestos exposure are not quite known. Therefore, it is not possible to determine the cumulative asbestos exposure doses of these people individually. However, periodical stay will only affect the volume of risk and will not eliminate the existence of the risk. As is known, mesothelioma and lung cancer risk is higher when the cumulative dose for asbestos fibre exposure is high; however, there is no reliable threshold exposure dose for the emergence of the disease. Risk is also possible in low doses [17,29,38]. Accordingly, regardless of the period of stay, living in the concerned villages is enough to be under risk.

Expected Number of Mesothelioma, Lung Cancer, and Benign Pleural Disease Cases Resulting from Asbestos Exposure in the Next 20 Years

Depending on the mesothelioma and lung cancer incidences resulting from asbestos exposure identified in the rural areas, the number of mesothelioma and lung cancer cases expected to be observed in the next 20 years as a result of the asbestos exposure was estimated among the population determined during the Plan work. During the estimations, the population exposed to asbestos was divided into two groups. The first group composed of the population, including those with mesothelioma; thus, this group is exposed to asbestos for a risky period of time. The second group is composed of the population in the villages where asbestos exposure is still prevalent; therefore, this population is and will be exposed to asbestos. If the asbestos exposure is eliminated nowadays, the cases projected for the second group may be preserved largely. However, because the first group was already subject to the risk, the projected number of mesothelioma, lung cancer, and other related diseases will be observed.

The abovementioned estimates are future expectations depending on projection methods. They do not display observed cases but aim to determine the possible projected and approximate cases and to pioneer the development of health and social policies accordingly. As a matter of fact, the actual figures may be below or above the projected figures for the next 20 years. It is necessary to take measures depending on these expectations and to eliminate the problem. Moreover, if measures are taken, projected figures will not become true in practice. Essentially, the estimations were made depending on the actual figures. Likewise, the number of cases observed was below the projected figures for the future and the difference was justified with the serious measures [37].

Occupational Asbestos Exposure

As a result of the Plan work, among the cases diagnosed with mesothelioma between 2008 and 2012, the ones that were not born/living in rural areas were considered to be under the risk of occupational exposure. The reason of this is that nearly 80% of the mesothelioma cases have an asbestos exposure history. Therefore, most of them, namely approximately 80% of the mesothelioma cases that were not born in villages determined during the Plan work had to have occupational exposure. Because it is considered that if these cases were not exposed to asbestos in rural areas, they must have been exposed in the occupational environment. As given in detail in the "results" section, 1,879 of the cases had not lived in rural areas. Therefore, the work places of these cases may be specified to have a high risk of occupational asbestos exposure. These workplaces should be identified based on the number of people and should be examined in detail by the experts with respect to current or previous asbestos exposure. Certainly, all the workplaces of the cases would not be determined to have asbestos exposure. However, identification of the workplaces of these cases will considerably enable the determination of the workplaces with asbestos exposure in Turkey and accordingly will break new ground in terms of efforts on occupational diseases and occupational health and safety.

Consequently, based on reliable data regarding the occupational health, it is clear that the results obtained in the Plan work form a basis comprehensive enough to make assessments for the first time for Turkey.

MEASURES PROPOSED AS A RESULT OF THE PLAN

Asbestos exposure in rural areas/villages may be prevented with five different measures depending on the type of exposure. These measures may be realized within a short duration by the participation of the personnel from the provincial directorates of public health and also from the provincial directorate of environment.

1. Plastering and whitewash on the walls of the houses made by using soil with asbestos may be covered with a thick "latex paint."
2. Roofs (housetops) covered with soil with asbestos may be covered with plastic roofing materials. This cover may be removed later when the houses are abandoned.
3. Ground covers with asbestos mixed soil within or near the village may be covered with suitable arable ground covers and trees may be planted. Soil mounds are generally approximately 1–20 m^2; therefore, covering practice will not necessitate much work. A few wider areas may be covered by planting trees or bushes or by encircling the mound with a fence to prevent entry.
4. Abandoned and deserted houses may be duly demolished and converted to lands. Wastes may be discharged to proper points and then may be covered.
5. When there is asbestos mixed soil at the roadside of the entry and exit points of the village, this soil may also be covered and trees may be planted.
6. During the Plan work, announcements were not made in the villages regarding the roads covered with soil with asbestos. However, if such kind of a soil contamination is detected (although rare), the roads may be required to be renovated as "stabilized" or "asphalt" roads.
7. Abolishing or moving the village is an extremely unnecessary practice. It is a heavy burden for the state. Thus, two villages have not been moved for 10 years yet. Consequently, if it has been planned to terminate erionite exposure in these two villages, this will not be achieved and unfortunately, the erionite exposure will continue for 10 years. However, solutions may have been developed for these two villages and exposure may have been prevented. The reasons for not moving the village may be justified as follows:
   - i. The number of houses plastered/covered with asbestos is limited (3–5 houses per village on an average).
   - ii. Mounds present in the villages cover small areas.
   - iii. Asbestos contamination on the village roads has not been announced; this may be observed in a few villages and these may be covered easily.
   - iv. Recently built settlements are far from fields (cultivation/plantation areas).
   - v. Size of the houses does not meet the living requirements of the villagers.
   - vi. High prices are required from the villagers for the new houses.

Control of the Solution Practices Following the Implementation of the Project

Following the rehabilitation work in villages, "accuracy of solution practices" may be supervised by the provincial directorate of public health and coordinators of the Mesothelioma Working Group of Turkey. Supervision may be conducted as follows:

1. Mukhtar surveys,
2. Confirmation through the phone with the owner of the rehabilitated unit, and
3. On-the-spot control of the units selected randomly at each province.

EXPECTED ADVANTAGES OF THE TURKEY ASBESTOS CONTROL STRATEGIC PLAN

Advantages to be obtained as a result of the Plan work in terms of the public health services in our country have been listed below. When these points are considered together, the Plan will form one of the most important "public health" projects of Turkey:

- When the proposals made following the Plan work are applied, asbestos exposure in the rural areas in Turkey will be eliminated, possible volume of asbestos exposure in the industry will be determined, and a practical detection program will be ensured.
- When the solution practices are applied in accordance with the results of the Plan, a total of 3,833 cancer cases, including 2,511 mesothelioma, 1,322 lung cancer cases as well as 17,344 pleural plaque, 12,526 diffuse pleural fibrosis, 482 asbestosis, and 1,071 respiratory insufficiency cases, would have been prevented largely.
- In line with the results of the Plan, 5,737 lung cancer cases and 15,450 mesothelioma cases expected to develop as a result of the past asbestos exposure will be

able to be diagnosed and treated at an early phase. If an effective training program is ensured, the number of patients suffering from respiratory insufficiency among 59,431 diffuse pleural fibrosis cases to be observed following the decrease in the number of smokers will be able to be decreased at a great extent.

- When the possible cost of a total of 3,833 cancer cases aimed to be prevented as a result of the Plan work is taken as TRY 10,800 [40], the direct cost of these cases, which is TRY 41,396,400 (indirect cost is TRY 124,189,200), would have been avoided. This avoided amount does not include the cost of benign diseases and also the decrease in the costs to be ensured by early diagnosis.

- The project is one of the most important "public health" projects of Turkey.

- At the end of the project, the problem of asbestos exposure in the rural areas in our country, places with asbestos exposure, number of distribution of people exposed to asbestos, exposure types, risks with respect to diseases, incidence rates, and costs would be determined in a way to provide a projection for the future.

- As the population exposed to asbestos will be determined, very specific cohorts in terms of both measures and research work would be established. Therefore, a number of scientific researches may be conducted.

- At the end of the project, useful guidelines for long-term use such as "Asbestos Exposure Safety Guide" and "Occupational Asbestos Exposure Safety Guide" would be implemented.

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