Asbestos knowledge and awareness level in central part of Anatolia

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ABSTRACT

Background: Asbestos-contaminated soil has been used by people for many years in the rural part of Anatolia. However, there is no program to control usage of asbestos in this region.

Objective: To determine the knowledge and awareness level about asbestos in a region where asbestos-related diseases are endemic due to environmental exposure to asbestos in the rural setting.

Methods: This study included 760 participants, recruited using non-probability sampling, who were classified into four groups according to residence and asbestos exposure type (urban, rural; asbestos-exposed, asbestos-unexposed). Asbestos knowledge and awareness was measured via the Asbestos Knowledge and Awareness Questionnaire (AKAQ). The cut-off value of questionnaire was determined by the K-means cluster analysis for sufficient and insufficient knowledge and awareness level. A multiple logistic regression analysis was performed to determine independent factors affecting sufficient knowledge and awareness of participants about asbestos.

Results: The median and mean score of the AKAQ in study group were 30 and 33.9, respectively. The urban asbestos-exposed group had a higher score than the urban asbestos-unexposed and both rural groups ($p < 0.001$). Factors affecting asbestos knowledge and awareness were education status ($p = 0.035$), asbestos exposure ($p = 0.003$) and living in the rural area ($p = 0.005$). Sufficient knowledge and awareness (score > 45) was higher among participants who had graduated from university and had asbestos exposure. Insufficient knowledge and awareness level was higher among participants living in rural areas.

Conclusion: In this region of Anatolia, knowledge and awareness level of asbestos was low among people at risk for environmental asbestos exposure. People should be aware of asbestos and its hazards by a well-designed training program and be monitored for asbestos-related diseases.

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Introduction

The carcinogenic effects of asbestos on human health are well known and exposure can occur in occupational/para-occupational settings or via the natural environment [1–8]. Currently, asbestos is banned in most industrialized countries in occupational settings because of its hazardous effect on human health [9]. Some developing countries have not banned the use of asbestos [9]. Asbestos exposure via the natural environment, particularly in rural areas, is common in some parts of the world including Turkey, Greece, Cyprus, Corsica, and New Caledonia [10–19].

Asbestos-contaminated soil has been used by people for many years in the rural part of Anatolia. Villagers in the places where asbestos-contaminated soil is abundant are familiar with the heat and water insulation features of this soil, called “white soil,” using it as whitewash-plaster

for their houses, heat and water insulation for roofs, and insulation for furnaces. At the same time, benign/malignant pleural and lung diseases such as mesothelioma, lung cancer, diffuse pleural thickening, pleural plaque and asbestosis are common in Anatolia [10–15]. Occupational asbestos exposure has not been studied and therefore there is no knowledge about its frequency in Turkey. Asbestos was not prohibited in Turkey until 2010. Although Turkish Mesothelioma Working Group have demonstrated and presented overwhelming evidence about the asbestos problem in Turkey, people continue to use the soil in the rural area [20]. The group has estimated that the rate of mesothelioma, lung cancer and benign pleural diseases would increase in the next 20 years [20].

Occupational exposure to asbestos can be controlled by banning asbestos use in workplaces in most countries. However, controlling environmental asbestos exposure

in rural areas is more difficult. To control asbestos exposure in rural areas, it is necessary that residents have knowledge and awareness of asbestos harms. We hypothesize that increased knowledge will lead to a decrease in asbestos-related diseases. Although there are studies evaluating the awareness about asbestos in occupational settings [21,22], we did not find any studies measuring knowledge and awareness of environmental asbestos exposure. The objective of this study was to determine the knowledge and awareness of asbestos in a region of Turkey where asbestos related diseases are endemic due to rural environmental exposure to asbestos.

Material and methods

The study was conducted in the city of Eskisehir in Central Anatolia, which also has a developing rural area. It is west of Ankara and in 2016 had a population of 837,050 [23]. Eighty-seven percent of the population lives in the city center and 13% lives in the rural area. Eskisehir has an area of 1,365,200 hectares (ha) of which 657,263 ha is fields and forests. In the city, many people hold office and industrial jobs. In the rural area, the main source of income is through farming and livestock breeding. Literacy rate is 95% [23]. There is one medical school in this area and the people have access to medical facilities. A recent study estimated that 9,282 people are exposed to asbestos in rural areas Eskisehir [20].

Participants

Participants were recruited via non-probability sampling. One of four patients or their relatives admitted to the Chest Diseases Department of Eskisehir Osmangazi University Medical Faculty on working days was included in the study. If the selected person had the exclusion criteria, then the next person was taken. Inclusion criteria were age over 17, first application to the department and willingness to answer questionnaires. Exclusion criteria were age under 18, unwillingness to participate, occupational asbestos exposure and cognitive disorder. Participants who answered less than 90% of the questionnaire or did not accept participation in the study were excluded. The Ethical Committee of Eskisehir Osmangazi University approved the study.

Procedure

The questionnaire was administered as paper questionnaire with or without support of the team. After agreeing to participate and providing informed consent, participants were asked to complete a two parts questionnaire. The first part included demographic questions, as age, sex, educational status, job, birth area, residence, exposure to asbestos, and knowledge of asbestos. The second part was the 19-item Asbestos Knowledge and Awareness Questionnaire (AKAQ), with one subscale.

Description of instrument

The AKAQ was developed by our study team and described in detail elsewhere [24]. Participants completed the questionnaire under supervision of the study team. Completion required approximately 25 min. The study team consisted of one epidemiology specialist, three chest physicians, a Ph.D. student and two cancer nurses. Cronbach's alpha coefficient of AKAQ was 0.951 for the entire survey. The expression was an incorrect statement for 3 items in this scale. We asked participants to answer "right" "wrong" or "do not know" for each item. Each correct answer was worth three points. Items that were incorrect statements were: "asbestos is related to bladder cancer;" "asbestos is related to melanoma;" and "asbestos is related to colon cancer." These items were encoded inversely to the other items. The answer of "wrong" for these items was the correct answer and was worth 3 points. The maximum and minimum scores were 57 and 19, respectively. The level of knowledge about asbestos was increased when the AKAQ score increased.

Analyses

The questions about birthplace and residence of the participants were coded as urban, semi-rural and rural area. An urban area had a population more than 5000; a semi-rural area had 3000–5000; and a rural area had less than 3000. Participants were classified into one of four groups according to their residence and asbestos exposure in some part of their life: the urban asbestos-unexposed group consisted of participants who were living in an urban area and had no asbestos exposure; the urban asbestos-exposed group participants were living in an urban area and had asbestos exposure; the rural asbestos-unexposed group participants were living in a rural area and had no asbestos exposure; and the rural asbestos-exposed group participants were living in a rural area and had asbestos exposure.

IBM SPSS Statistics for Windows, Version 20.0. (IBM Corp. Armonk, NY) was used for the data analysis. The demographic characteristics of the study group were reported using descriptive statistics (frequencies, proportions, means, or medians) and dispersion measures (standard deviation or min–max). The normality of the total scores was tested using the Kolmogorov–Smirnov normality test and graphs. Frequency data were analyzed using chi-square test as a univariate analysis. Therefore, the median scores were compared using Kruskal Wallis (and Bonferroni's ad hoc test) and Mann-Whitney U tests. Normative cut-off levels were computed using *k*-means cluster analysis (*k* = 2). The *K*-means clustering determined that the value of 45 was an appropriate cut-off point for sufficient and insufficient knowledge and awareness level. To determine the socio-demographic characteristics of participants who had sufficient knowledge and awareness about the issue,

Table 1. Socio-demographic characteristics of participants according to four groups.

	Urban asbestos-unexposed group (n = 298)	Urban asbestos-exposed group (n = 265)	Rural asbestos-unexposed group (n = 60)	Rural asbestos-exposed group (n = 137)	p
Age, years					<0.001
Mean (SD)	49.0 (15.6)	55.5 (13.9)	53.8 (15.9)	57.6 (13.1)	
(min–max)	(18–89)	(20–84)	(21–84)	(19–82)	
Gender, n (%)					0.16
Male	142 (47.7)	135 (50.9)	33 (55.0)	82 (59.9)	
Female	156 (52.3)	130 (49.1)	27 (45.0)	55 (40.1)	
Education, n (%)					<0.001
Illiterate	9 (3.0)	23 (8.7)	10 (16.7)	19 (13.9)	
Primary school	136 (45.6)	167 (63.0)	35 (58.3)	96 (70.1)	
High school	71 (23.8)	44 (16.6)	11 (18.3)	15 (10.9)	
University	82 (27.5)	31 (11.7)	4 (6.7)	7 (5.1)	
Occupation, n (%)					<0.001
Unemployed	116 (38.9)	124 (46.8)	27 (45.0)	58 (42.3)	
Employed	141 (47.3)	88 (33.2)	18 (30.0)	41 (29.9)	
Retired	38 (12.8)	33 (12.5)	8 (13.3)	10 (7.3)	
Farmer	3 (1.0)	20 (7.5)	7 (11.7)	28 (20.4)	

Note: SD: Standard Deviation. Bold values represents a statistically significance

the chi-square test was performed as univariate analysis. A multiple logistic regression analysis was performed to determine independent factors affecting sufficient knowledge and awareness of participants about asbestos.

Results

The study was conducted with 760 participants. Of the 760 participants: the urban asbestos-unexposed group included 39.2% of participants, the urban asbestos-exposed group consisted of 34.9%, the rural asbestos-unexposed group consisted of 7.9%, and the rural asbestos-exposed group consisted of 18.0%. Table 1 shows socio-demographic characteristics of the participants according to study groups.

The participants in the urban asbestos-unexposed group were younger, more educated and more employed than the participants in the urban asbestos-exposed and rural groups. ($p < 0.001$). There was no difference between the groups in terms of gender. Table 2 shows comparisons of the study groups regarding correct answers to the AKAQ.

There were significant differences among the groups in their correct answers to questions on the AKAQ. The urban asbestos-unexposed group scored worst on the item “white soil is used for plastering / whitewashing” than the urban asbestos-exposed and rural groups. Correct answer rates for the items “white soil includes asbestos,” “white soil is harmful” and “asbestos is used as plastering / whitewashing material” were higher in the urban asbestos-exposed group than the urban asbestos-unexposed and rural groups. However, differences among the groups for the other items derived from lower correct answer rates of both rural groups. The five items most commonly answered incorrectly were about usage of asbestos in the occupational setting (roofing material, shipbuilding, and construction material), diffuse pleural thickening and malignant mesothelioma. The items most commonly correctly answered were about usage of asbestos in various areas in the rural area (plastering/

whitewashing material), effect of asbestos on human health, need for protection from asbestos, entry way of asbestos to the body and lung cancer (Table 2). Sufficient knowledge and awareness (defined as a score > 45) about asbestos was present in 31.5% of the urban asbestos-unexposed group, 37% of the urban asbestos-exposed group, 18.3% of the rural asbestos-unexposed group and 17.5% of the rural asbestos-exposed group.

Figure 1 shows the AKAQ scores of the four groups. There was no difference between the rural asbestos-unexposed and the rural asbestos-exposed group. However, the urban asbestos-exposed group, that was living in an urban area and had asbestos exposure, had a higher score than the urban asbestos-unexposed and rural groups ($p < 0.001$). The median (min–max) and mean (SD) score of the study population were 30 (19–56) and 33.9 (11.9), respectively.

The cut-off value for the AKAQ score was 45 points, with those having a score > 45 classified as having sufficient knowledge and awareness about asbestos. Table 3 compares participants with and without sufficient knowledge levels based on their socio-demographic characteristics.

In univariate analysis, sufficient knowledge and awareness was not associated with gender and age. Approximately 48.2% of participants were born in rural areas, with 14.1% still living in rural areas. Participants born and living in urban areas had higher sufficient knowledge and awareness than those who were born in rural areas and living in semi-rural and rural areas ($p < 0.001$ and $p = 0.002$). Sufficient knowledge and awareness level of the participants who graduated from a university ($p < 0.001$), were employed and were retired ($p < 0.001$) were higher than those who got education under 12 years, were farmer and unemployed. Participants with previous exposure to asbestos had a higher sufficient knowledge and awareness level than participants not exposed to asbestos ($p = 0.05$). Table 4 shows the multiple logistic regression model of variables affecting sufficient knowledge and awareness level.

Table 2. Comparison of four groups regarding correct answers to items of the Asbestos Knowledge and Awareness Questionnaire.

Question, n (%)	Urban asbestos-unexposed group (n = 298)	Urban asbestos-exposed group (n = 265)	Rural asbestos-unexposed group (n = 60)	Rural asbestos-exposed group (n = 137)	p
White soil is used for plastering/whitewashing	140 (47.0)	225 (84.9)	36 (60.0)	114 (83.2)	<0.001
White soil includes asbestos	43 (14.4)	63 (23.8)	7 (11.7)	20 (14.6)	0.002
White soil is harmful	149 (50.0)	156 (58.9)	24 (40.0)	60 (43.8)	<0.001
White soil is related to asbestos	70 (23.5)	74 (27.9)	9 (15.0)	16 (11.7)	0.002
White soil is a solid material	108 (36.2)	103 (38.9)	14 (23.3)	38 (27.7)	0.020
Asbestos is used various areas	87 (29.2)	85 (32.1)	7 (11.7)	16 (11.7)	<0.001
Asbestos is harmful on human health	157 (52.7)	136 (51.3)	20 (33.3)	41 (29.9)	<0.001
Asbestos enters the body by the inhalation	130 (43.6)	121 (45.7)	14 (23.3)	41 (29.9)	<0.001
Asbestos is used as plastering/whitewashing material	94 (31.5)	110 (41.5)	10 (16.7)	32 (23.4)	<0.001
Asbestos is used as roofing material	49 (16.4)	39 (14.7)	3 (5.0)	9 (6.6)	0.006
Asbestos is used for shipbuilding	47 (15.8)	45 (17.0)	4 (6.7)	10 (7.3)	0.013
Asbestos is used as construction material	51 (17.1)	48 (18.1)	5 (8.3)	11 (8.0)	0.049
Asbestos is related to bladder cancer	129 (43.3)	123 (46.4)	13 (21.7)	35 (25.5)	<0.001
Asbestos is related to melanoma	102 (34.2)	105 (39.6)	12 (20.9)	32 (23.4)	<0.001
Asbestos is related to lung cancer	130 (43.6)	125 (47.2)	13 (21.7)	35 (25.5)	<0.001
Asbestos is related to diffuse pleural thickening	60 (20.1)	67 (25.3)	4 (6.7)	15 (10.9)	<0.001
Asbestos is related to malignant mesothelioma	73 (24.5)	86 (32.5)	4 (6.7)	14 (10.2)	<0.001
Asbestos is related to colon cancer	126 (42.3)	112 (42.3)	12 (20.0)	35 (25.5)	<0.001
It is required to avoid of asbestos	156 (52.3)	147 (55.5)	16 (26.7)	43 (31.4)	<0.001

Note: Bold values represents a statistically significance

Figure 1. Asbestos Knowledge and Awareness Questionnaire score of the study groups.

Notes: The median (interquartile range) AKAQ score of the study groups: urban asbestos-unexposed group: 31 (21.7 – 46); urban asbestos-exposed group: 38 (24 – 47); rural asbestos-unexposed group: 24 (21.3 – 34.5); rural asbestos-exposed group: 25 (23 – 41). AKAQ: Asbestos Knowledge and Awareness Questionnaire.

The independent positive factors affecting the sufficient knowledge and awareness level of asbestos in the multiple regression analysis were education status ($p = 0.035$) and asbestos exposure ($p = 0.003$) while negative factor was living in a rural area ($p = 0.005$).

Discussion

This study evaluated the knowledge and awareness of asbestos in the central part of Anatolia, where there is environmental asbestos exposure in the rural areas.

Approximately 40% of participants lived in an urban area and had asbestos exposure during their lifetime, while 18% of participants lived in rural areas with current asbestos exposure. Turkey is one of the countries where environmental asbestos exposure continues to be a concern [10–15,20,25]. The Turkish Mesothelioma Working Group identified 5,617 patients diagnosed with mesothelioma between 2008 and 2012 in Turkey. The same group reported that asbestos exposure is occurring in 379 villages (158,068 people). They also found that an estimated 571,464 rural and previously rural residents were exposed to asbestos [20]. Those rural residents represented the characteristics of the urban asbestos-exposed group. They probably have the same knowledge and awareness level about asbestos. This situation suggests that environmental asbestos exposure is an important public health problem in Turkey.

Naturally occurring asbestos is mostly used as a mixture in plastering or whitewashing. Approximately half of the urban asbestos-unexposed group (47%) answered this item correctly. This is unsurprising because asbestos is commonly used in the rural areas, as it is cheap, practical and esthetically pleasing. We found that people were less able to correctly answer questions that emphasized the relationship between asbestos and white soil. The items most frequently answered incorrect was about the usage of asbestos, such as roofing material, construction material like in industrialized countries. Results were not compared with other studies as we could not identify similar studies.

Approximately half of the participants stated that asbestos, or white soil, was harmful and that asbestos should be avoided. Environmental exposure in rural settings is

Table 3. Comparison of participants who had sufficient and insufficient knowledge and awareness level regarding socio-demographic characteristics.

	Participants who have insufficient knowledge level, <i>n</i> (%)	Participants who have sufficient knowledge level, <i>n</i> (%)	<i>p</i>
Age groups			0.240
>29	43 (68.3)	20 (31.7)	
30–39	47 (61.8)	29 (38.2)	
40–49	108 (71.1)	44 (28.9)	
50–59	125 (67.6)	60 (32.4)	
60–69	124 (71.3)	50 (28.7)	
≥70	86 (78.2)	24 (21.8)	
Gender			0.535
Male	271 (69.1)	121 (30.9)	
Female	262 (71.2)	106 (28.8)	
Residence			<0.001
Urban	348 (64.7)	190 (35.3)	
Semi-rural	94 (81.7)	21 (18.3)	
Rural	91 (85.8)	15 (14.2)	
Birth area			0.002
Urban	152 (62.3)	92 (37.7)	
Semi-rural	104 (69.3)	46 (30.7)	
Rural	277 (75.7)	89 (24.3)	
Education			<0.001
Illiterate	52 (85.2)	9 (14.8)	
Primary school	339 (78.1)	95 (21.9)	
High school	88 (62.4)	53 (37.6)	
University	54 (43.5)	70 (56.5)	
Occupation			<0.001
Unemployed	248 (76.3)	77 (23.7)	
Employed	190 (66.0)	98 (34.0)	
Retired	49 (55.1)	40 (44.9)	
Farmer	46 (79.3)	12 (20.7)	
Asbestos exposure			0.05
No	317 (72.9)	118 (27.1)	
Yes	216 (66.5)	109 (33.5)	

Note: Bold values represents a statistically significance

Table 4. Variables affecting sufficient knowledge and awareness level of the study population by logistic regression.

Variables	OR	95% CI	<i>p</i>
Age	1.138	0.989 to 1.309	0.071
Gender	1.314	0.869 to 1.988	0.195
Education	1.293	1.018 to 1.642	0.035
Birth area	0.826	0.664 to 1.027	0.086
Residence	0.658	0.490 to 0.883	0.005
Asbestos exposure	1.748	1.209 to 2.527	0.003

Note: OR: Odds Ratio; CI: Confidence Interval. Bold values represents a statistically significance

different from occupational exposures in terms of age at first exposure and continuity/duration of exposure. Environmental asbestos exposure is lower than occupational exposure, but can start at birth and can be continuous until death [10–15,25]. However, this low dose exposure in the rural setting is high enough to cause asbestos-related diseases similar to those in the occupational setting because of the cumulative exposure dose [25]. Additionally, indoor or outdoor airborne fiber levels can increase during sweeping, windy weather, car circulation, etc. [26].

Asbestos is known to cause benign/malignant pleural and lung diseases, such as malignant mesothelioma, lung cancer, diffuse pleural thickening, pleural plaque and asbestosis. Each of these diseases are preventable and/or are detectable at an early and more treatable stage. In a cohort composed of rural and previously rural residents who exposed to asbestos in a rural part of Eskisehir, the annual mesothelioma incidence rates were

114.8/100,000 for men and 159.8/100,000 for women [10]. Moreover, the proportional mortality of mesothelioma was 5.6% in previous cohort study [10]. However, we found that the item about the relationship between asbestos and mesothelioma was answered incorrectly by 76.7% of participants. The asbestos exposure in the rural area directly increases the risk of lung cancer [12]. In the retrospective cohorts, including 15 asbestos-exposed villages and 12 asbestos-unexposed villages, the incidence of lung cancer in the asbestos-exposed villages was 135.21/100,000 for men and 47.28/100,000 for women. The same rates were 60.15/100,000 and 15.06/100,000, respectively, in the asbestos-unexposed villages [12]. The risk of lung cancer was 6.9 times higher in asbestos-exposed and nonsmoker men than asbestos-unexposed and nonsmoker men; however, this risk ratio was 40 times higher in women. The item about the relationship between asbestos and lung cancer had a higher score among items about asbestos-related diseases. Almost half of the participants (47.2%) stated this relationship in the urban asbestos-exposed group. Benign pleural changes were more common in the population exposed to asbestos than the population not exposed to asbestos in the rural area in our previous study [15]. The rates of pleural plaques, diffuse pleural fibrosis and asbestosis were 14.4, 10.4 and 0.4%, respectively, in a cohort from rural areas of Eskisehir [15]. Similar to the item about mesothelioma, people did not know that asbestos was related to diffuse pleural thickening.

The questionnaire was analyzed for reliability and validity by the study team before used in this study. Additionally, difficulty and discrimination indices were calculated for each item in the earlier study [24]. It is important to present the accuracy of the measurement subject by answers received from this questionnaire. The differences in age, education, and occupation among the four study groups were a reflection of their residence (urban vs. rural) and were expected. Sufficient knowledge and awareness was higher for in the participants who had one or more of the following characteristics: reside in urban area, born in urban area, university educated, employed, retired, and/or exposed to asbestos as compared to those living semi-rural and rural areas, born in rural areas, having less than 12 years of education, employed as a farmer, unemployed and/or unexposed to asbestos in this study. However, multiple logistic regression analysis showed that the independent factors affecting knowledge and awareness level of asbestos were educational status, asbestos exposure and living area. University educated and asbestos exposed participants had a higher odds value than those who did not graduate from a university and were not exposed to asbestos. However, rural resident had a lower odds value than urban resident.

There was similar exposure type in Metsovo, Greece to our study. People were using tremolite – contaminated soil for the whitewashing of their houses. The incidence of mesothelioma in this region decreased from 3.7/10,000 person – years between 1980 and 1984 to 1.4/10,000 person – years between 1985 and 1994. The most important reason for this drop was decrease using of the tremolite – contaminated soil called Luto by population from 92% in 1950 to 18% in 1980 [27].

There is a huge and continuing problem, as demonstrated above, with asbestos in the rural areas of Turkey. Unfortunately, most of the people living in this area are not aware of this problem. To take control of environmental asbestos exposure, people should know that asbestos-contaminated material is used environmentally, asbestos contaminated material is harmful, asbestos is a type of fiber and enters the body by inhalation and causes health problems, especially malignant diseases.

Conclusion

Our study showed that more than half of the participants were affected by asbestos poisoning in some part of their life, and probably some of them were still exposed to asbestos. Although approximately 30 years has passed since the first scientific report about the hazards of environmental asbestos exposure on the respiratory system in this region, the knowledge and awareness level of asbestos was low, as observed by a sampling of this population. The implementation of effective strategies to take control of asbestos exposure remains an important task in rural parts of Turkey, where asbestos is still used. To incorporate effective and sustainable strategic initiatives,

several requirements should be performed by health and environment authorities and government. These include the acquisition of a funding source, a well-designed training program via meetings given by authorities, on the internet, television, radio, in special publications and the development of a follow-up program. Thus, people can be aware of asbestos and its hazards, a training program to advice people how to manage and repair properly their houses covered by asbestos can be set up.

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Disclosure statement

The authors declare that there is no any conflict of interest for this study.

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