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Non-occupational Asbestosis: a Potential Risk that should be Considered

Asbestosis no ocupacional: un riesgo potencial que tener en consideración

Rey Darío Raúl[1, 2]

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Correspondence address
Darío Raúl Rey
E-mail:
darioraul.rey@gmail.com

ABSTRACT

The association of occupational exposure with respiratory diseases is well-known. Non-occupational exposure has been recognized for over sixty years.
It is necessary to differentiate two types of non-occupational asbestosis:
a) Environmental (close or residential exposure).
b) Domestic or home exposure.
Proximity to a factory that uses asbestos is an important health risk.
The environmental levels of this mineral can be dangerous when the clothes worn in the workplace with exposure to asbestos are washed at home. Unaware workers take their clothes home, and their homes could have high levels of asbestos. Contaminated clothing should be left in the workplace.
Employees and workers must be educated on the occupational risks and hazards, thus minimizing the risk of developing a disease, especially one that can be prevented.

Key word: home asbestosis - environmental asbestosis

RESUMEN

Es ampliamente conocida la relación entre una ocupación laboral y las enfermedades pulmonares. La exposición no ocupacional se reconoce desde hace más de sesenta años.
Es necesario diferenciar dos tipos de exposiciones en asbestosis no ocupacional:
a) Ambiental (cercana o residencial).
b) Exposición doméstica u hogareña.
La vecindad a una fábrica, donde se utiliza amianto, representa un gran riesgo para la salud.
Los niveles del mineral en el medio ambiente pueden ser peligrosos cuando la ropa usada en trabajos con amianto se lava en el hogar. Si debido al desconocimiento llevaran su ropa a casa, los hogares de los trabajadores podrían contener altos niveles de amianto. La ropa contaminada debe permanecer en el lugar de trabajo.
Los empleadores y los trabajadores deben ser educados sobre los riesgos y los peligros de los riesgos laborales, lo que lleva a minimizar una enfermedad especialmente prevenible.

Palabras clave: asbestosis doméstica - abestosis ambiental

[1] Consultant physician in Pulmonology, Hospital Gral. de Agudos Dr. E. Tornú
[2] Director of the Bachelor's Degree in Pulmonology, UBA (Universidad de Buenos Aires).

INTRODUCTION

The association of occupational exposure with the pulmonary diseases it may cause is well-known, as well as the resulting severe health problem. The health of the worker's family may also be altered as a consequence of exposure to dangerous substances in the workplace.

Their health may be affected by toxic substances in the workplace, the community, and at home. Industrial substances taken home by the worker are getting increasingly involved as agents causing diseases in the family contacts.

The most important vehicle for taking occupational substances home are the work clothes, although there are some other personal objects that can be sources of contamination at home.

The *non-occupational, non-work-related or take-home* disease occurs when dangerous substances are transported in contaminated clothes and infect the household contacts.

Another causal factor to consider is the fact of living near premises where industrial safety and hygiene conditions are not suitably observed.

One historical review stated that in the '60s arose the first publications reporting a potential risk of disease related to asbestos in people who had lived near industrial areas or mineral extraction sites, and also among the workers' families.

In the '70s, there were reports that suggested the existence of asbestos-related diseases in the household contacts of workers with occupational asbestos exposure.

Between 1990 and 2011, additional cases of environmental exposure, both occupational and non-work-related were published. There were many other reports about workers with high or uncontrolled occupational exposure, decades ago.

Some publications show the relationship between hazardous or contaminating materials and familial diseases.[1]

SOME FACTS ABOUT ASBESTOS

In the pre-Christian era, the non-flammable, fire-resistant properties of the asbestos were already known. 100-150 years ago, it started to be used for industrial purposes; since the 1950s, it gained a strategical position. Without the proper respiratory protection, the inhalation of fibers or dust has enabled the appearance of asbestosis, irreversible pneumoconiosis with fibrogenic and carcinogenic action. Its negative prognosis is also related to this last effect as cause of mesothelioma (MTM) and bronchopulmonary cancer.

Rusia, China, Brazil and Kazakstán are great producers of this mineral. Rusia is one of the largest asbestos consumers. Since 1999, it has banned its industrialization; nevertheless, it is estimated that between 60% and 75% of the asbestos used in the world comes from this nation[2].

In Argentina, the banning of asbestos and its derivatives is regulated and legalized since 2003. In America: Brazil, Honduras, Chile and Uruguay have banned it, too. Around the world: 58 countries have banned the use of asbestos; most are European countries.

The asbestos is classified in two groups: the **amphiboles** (its most representative examples being "brown asbestos" or amosite, and "blue asbestos" or crocidolite) and the **serpentines** (from which the chrysotile represents 90% of industrial exploitation).

Apart from the pathogenic effects already mentioned, asbestos inhalation causes many exposure-response models such as round atelectasis, calcified pleural plaques or a condition similar to pulmonary fibrosis[3-8].

PATHOGENESIS OF ASBESTOSIS

The pulmonary disease associated with asbestos is complicated and not fully understood.

The size and appearance of the fiber, its environmental concentrations, chemical composition and time of exposure may play a role both in the fibrogenesis and the carcinogenesis.

In order to establish the severity and the body's response to the inhaled fibers we should also take into account the host-related agents, his/her immune status, smoking and pulmonary depuration mechanism.

Regarding the degree of environmental concentration, time of exposure and respiratory protection, asbestos can cause different clinical variants of the disease.

In view of the above, the hazards of occupational exposure to asbestos are well-known. Also, there are some studies that showed that non-work-related (or environmental) manifestations increase the risk of MTM or lung cancer in the general population[9]. The incidence of MTM is

1.5/100,000 in men and 0.4/100,000 in women. In 2019, 3,209 cases were reported in U.S.A. From the classic study of Wagner, we are aware about the causal relationship between this type of tumor and asbestos exposure[10, 11]. According to Melaiu, the incidence of the tumor in exposed workers is between 0.5% and 18%, whereas Sekido estimates that 20%-30% of cases of MTM were never exposed to asbestos[12, 13].

Non-Occupational Asbestosis (NonOccupAsb)

Non-occupational exposure has been recognized for over 60 years. Donovan et al carried out a comprehensive review in 2012 about this topic, in which they evaluated more than two-hundred articles, and found that 65% of the patients were relatives of miners, electricians, shipyard workers or operators that make products with asbestos. They also pointed out that 98% of lung biopsies of NonOccupAsb showed amphiboles[14].

A thorough study conducted by Newhouse and Thomson in 1965 revealed that 52.6% of 83 pleural or peritoneal MTMs had history of non-work-related or domestic exposure. They emphasized the evidence of living near an asbestos factory, since 30.6% of the MTM cases lived less than 1 km from an industrial area ($p < 0.01$)[15].

In 1976, Selikoff et al researched 326 healthy household contacts, 25-30 years after the beginning of a possible asbestos contamination, and found anomalies in 35% of the chest X-rays[16].

In relation to the topic of this article, it is important to distinguish between two classes of exposure in NonOccupAsb:

a) ***Close exposure*** (or environmental or residential exposure).

b) ***Domestic exposure*** (or home exposure).

Close exposure

Even though the plaster collapses from natural processes, in the past, mortar with asbestos was used to build walls and roofs as insulation and for aesthetic purposes. So, as asbestos was used for the construction of buildings, both in the past and now there still exists the possibility of exposure to this mineral, and the affected person may not be aware of that. *The findings on calcified pleural plaques indicates possible previous asbestos exposure*. Cases of patients with MTM have been published, in which the only aspect that could be researched was the place where the individuals had lived before or where they are living now. Some examples are: office clerks, teachers and employees[17].

There is extensive bibliography on this subject. In the '70s, Artviniki and Baris studied 312 inhabitants of a town in Turkey and a control group. The results showed 22 MTMs that corresponded to a high incidence of 6.5/1,000,000/year. The research showed the presence of asbestos in building stones, fields, roads and in the lung tissue of the citizens, as opposed to zero cases in the control group[18].

We must focus on the study of the Constantopoulos group, who researched and published the results obtained in four Greek towns for twenty years. Baseline results revealed that 45.5% of the inhabitants had pleural calcifications increasing with age up to 81% in persons older than 70 years. The identification of amphiboles both in soil samples and lung biopsies was enough to consider it as the causative agent of that disease.

In 1985, seven cases of MTM were diagnosed in the population, meaning 280 times higher than expected increase (1/1,000,000/year).

It was related to an asbestos-containing type of lime used to whiten the walls of the houses. Since it was less and less used, the incidence of MTM has been reduced to 33% of the expected incidence.

In 2017, the group published a new study that showed that, after having interrupted the use of lime, only two inhabitants presented minimum calcifications, and the tomographic studies of 22 young adults were negative[19-22].

Proximity to a factory that uses asbestos is an important health risk. In Northern Italy, there was a fiber cement factory between 1932 and 1993. The rate of MTM in Lombardy exposed a high impact of asbestos exposure on the incidence of the tumor among workers, their families, and people who lived in close proximity.

Between 2000 and 2016, 39 cases of MTM were found among workers' household members (4.24 expected) and 91 cases in inhabitants (7.43 estimated), in individuals who had never had occupational or non-work-related exposure. The total number of excess cases (including factory workers) was approximately 194 (17.24 expected).

Even though the premises were closed, the incidence of MTM associated with the factory is still high for the workers, their families and the neighbours[23].

In Barcelona, there was a fiber cement factory between 1907 and 1997. 1,107 cases of NonOccu-

pAsb were diagnosed between 1970 and 2006 with values of 9.5/100,000 among neighbors of the area and 35.5/100,000 among the people living near the premises. The prevalence of NonOccupAsb was 91/100,000 in inhabitants of the area and 353.4/100,000 in people living near the factory, with 8.4% for MTM and 86.5% for non-malignant masses, assuming a serious conflict for workers and the population[24].

In their interesting article, Reid et al research the deaths of an Australian female population between 1950-2004 without occupational asbestos exposure, and found 455 deaths, 30 of them from MTM. The risk of death was excessive for all types of cancer, and MTM in particular was associated with handling or washing the work clothes of the local mine workers. Thus, the former inhabitants of this population who had been exposed to asbestos at home or in their environment showed excess of mortality from cancer, including MTM[25].

We can deduce that there is strong evidence of a higher risk of MTM among subjects whose exposure is of non-occupational or domestic origin. The risk of MTM as a consequence of living near an industry that uses asbestos (deposits, mineral processing plants, mills) is certainly confirmed. NonOccupAsb explains around 20% of the MTMs in industrialized countries[26].

The magnitude of the problem can be reduced through the adequate regulation of the workplace and increased awareness amongst healthcare professionals. Controlling diseases of familial occurrence depends mostly on raising awareness among the population and the participation of the authorities.

*Find attached two personal comments regarding the **NonOccupAsb** of close exposure:*

Case 1: FP, 80 years old, non-smoker. No dyspnea. Transferred due to "abnormalities in chest CT". Numerous pleural calcifications observed in both hemithorax. *Never worked with asbestos directly, but had non-occupational exposure to the mineral for fifteen years, (administrative manager at the repair shop of the AFIP [Federal Administration of Public Revenue, for its acronym in Spanish])* (Figures 1 and 2).

Case 2 JB, 53 years old. Transferred due to "lung tumor". Non-smoker. Chest CT: round atelectasis and calcifications in diaphragmatic pleura. *Twenty years ago, he worked as office clerk in an office with insulation roofs. The roofs were destroyed after a storm, so he lived for a long time in contact with environmental pollution* (Figures 3 and 4).

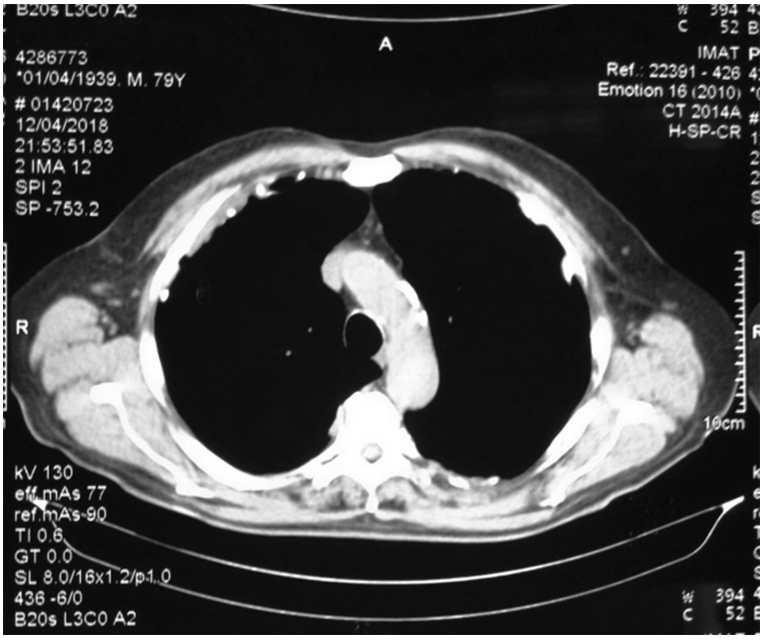

Figure 1

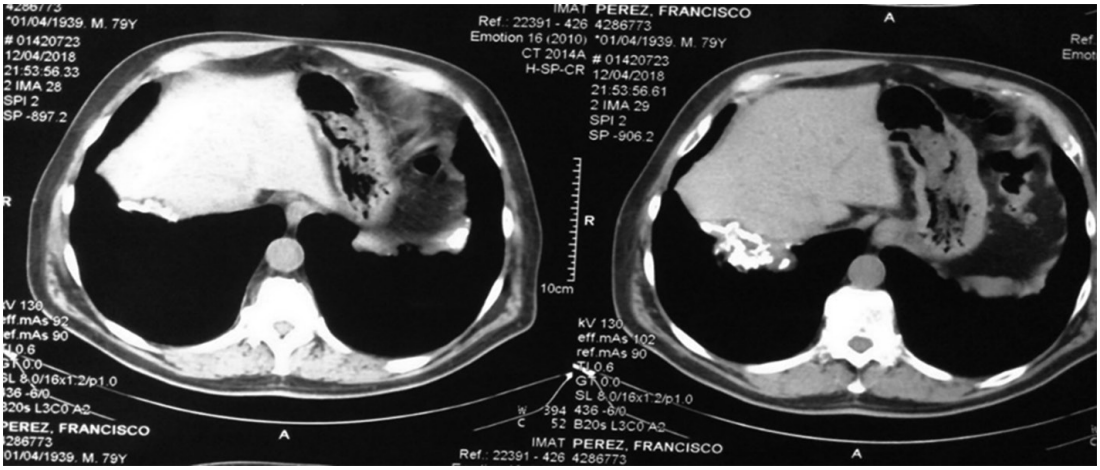

Figure 2

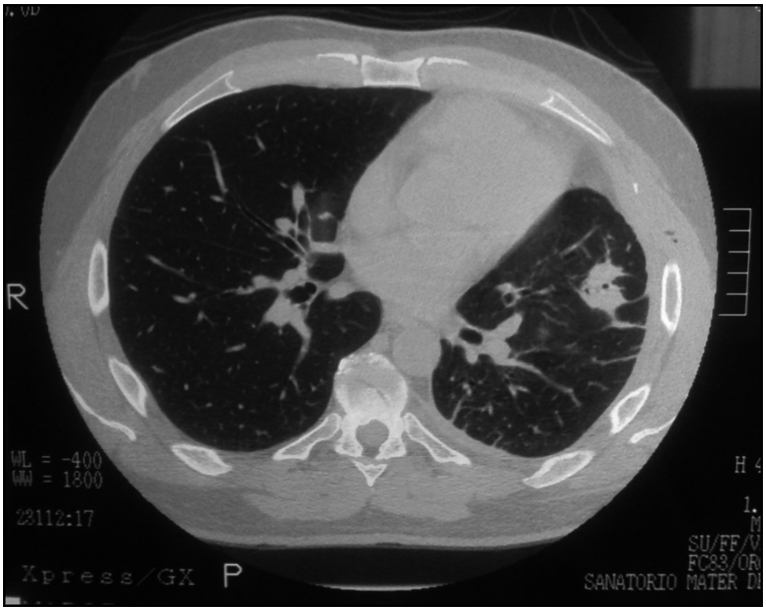

Figure 3

Domestic exposure

When someone washes the clothes used in jobs exposed to asbestos, the levels of the mineral in the home environment may account for several hundred fibers per milliliter. As a result, the homes of the workers could contain high levels of asbestos if they unknowingly take their clothes home[27].

In 1992, Dodoli et al reviewed 39,650 death certificates of Livorno (1975-1988) and 45,900 of La Spezia (1958-1988), and found 262 cases of pleural MTM. Most cases were workers of the boat building industry.

Regarding non-occupational asbestos exposure, thirteen cases of MTM were found in women who had washed the clothes of their relatives and six possible cases due to the installation of fire-resistant or insulation materials in the domestic environment, which allowed us to think that the cases could be more common than expected[28].

A publication of Rake et al researched the home and work history of 622 individuals with MTM and 1,420 controls. The results showed that the risk of life was the same for both genders in non-exposed individuals, but it doubled in the family contacts

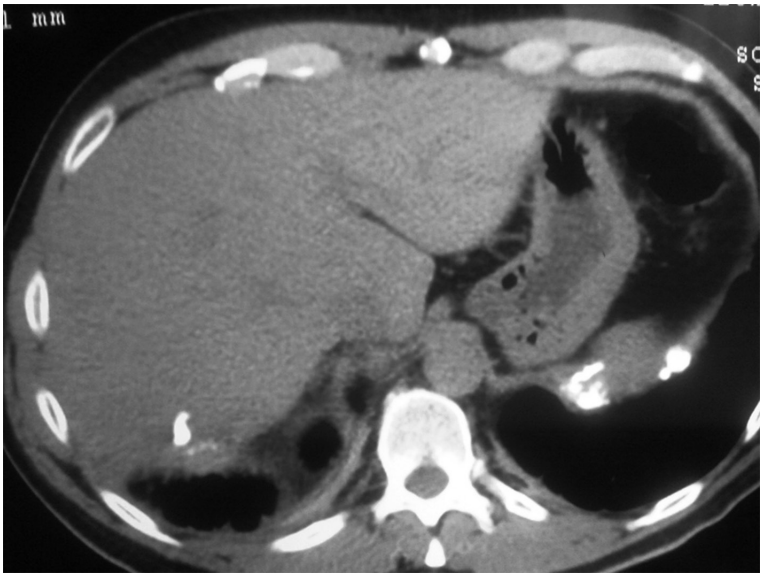

Figure 4

of workers exposed to asbestos. In 38% of women and 86% of men, it could be attributed to asbestos exposure both at home and in the workplace[29].

Italy has a MTM record, so it is possible to update and know the number of cases, its incidence, its prevalence and its relationship with the jobs and types of exposure. D'Agostin et al studied the characteristics of MTM in Veneto, which could only be attributed to the asbestos brought home by the workers, especially those who worked in shipyards. The study was carried out by means of a standardized medical-work interview and a questionnaire.

35 MTMs were attributed to home exposure (including two workers' sons). Workers' exposure to asbestos occurred mainly in the shipyards. The mean latency time was 59 years, and the spouses had a significantly shorter interval between the exposure and appearance of the disease, thus confirming that domestic concentration increases the risk of MTM in women without history of occupational exposure to asbestos[30].

In the study of Hilbert et al, asbestos workers and their families underwent a chest X-ray and answered questionnaires regarding personal hygiene and possible access to mineral exposure. The assessment of the X-rays was done in accordance with the International Labor Organization (ILO) Guides[31].

118 workers and 122 household contacts participated in the study. 53% of workers showed radiographic alterations, and this number was reduced by 2% in household contacts.

The high prevalence of pleural alterations and the pulmonary interstice in workers didn't correspond with similar changes in household contacts, and this was the result of the individual hygiene behavior of most workers.

The use and habitual washing of work clothes in the workplace, as well as having a bath before leaving the premises are important factors that could contribute to reducing possible home contamination and preventing adverse results in the worker's family[32].

Case 3 *Personal comment regarding domestic NonOccupAsb:* NC, 63 years old. Woman. Smoker, 40 packs/year, consulted because of chronic bronchitis progression. Auscultation: velcro-type crackles in the bases. Chest CT: extensive honeycombing associated with pleural calcifications. *During her childhood and adolescence, she cleaned her shoes and those of her siblings with an asbestos burlap (the burlap had been taken home by her father, an electrician working in a sugar mill)* (Figures 5 and 6).

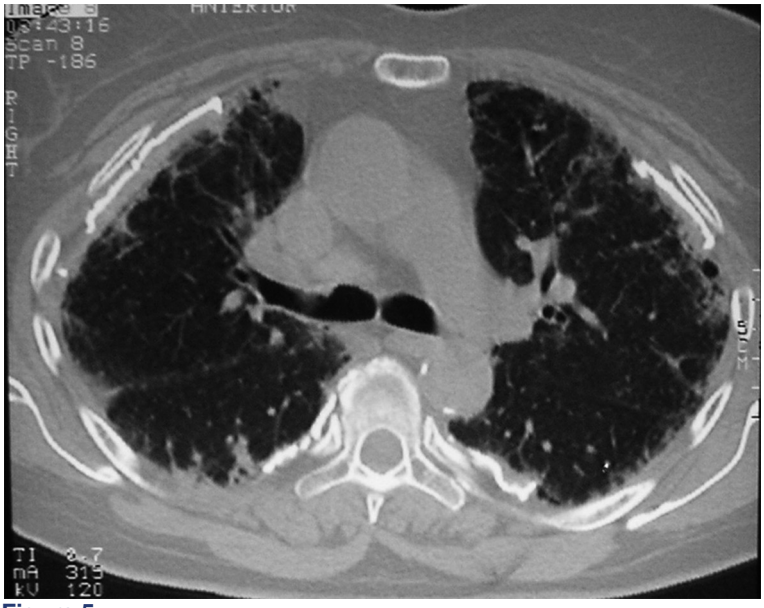

Figure 5

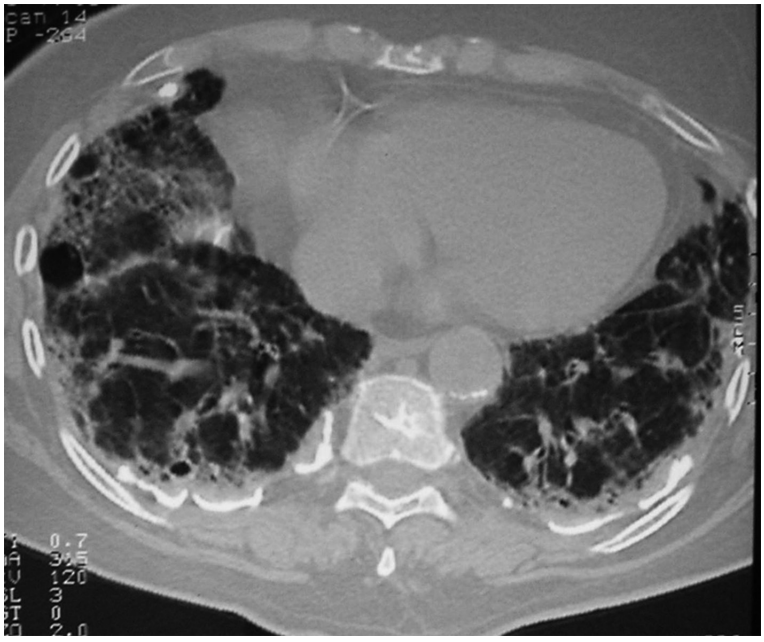

Figure 6

PREVENTION

It is extremely important to ensure that contaminated clothes remain in the workplace. The IOSHA (Industrial Occupational Safety and Health Administration) regulations require among other things, that employers provide the workers with work clothes, proper environmental ventilation, showers and dressing rooms.

Occupational physicians and health and safety professionals have a significant role in the detection and prevention of occupational or environmental diseases. The anamnesis related to the type of work, environmental characteristics and the way in which the task is performed, knowledge of the risks and taking them home are all elements of prime importance for identifying occupational and non-occupational diseases.

It is also important to know about previous tasks, since they may be related to the current disease.

Demolitions can release fibers containing dispersed asbestos. Perkins et al published a study about air monitoring in buildings to be demolished to check the presence of asbestos. They also controlled the personnel involved and the air of the area around the sites. In general, there weren't asbestos fibers, and real exposure to this element was frequently below the limit of detection. The buildings were washed with fire hose water during demolition, requiring great amounts of liquid; undoubtedly, this contributed to the results obtained[33].

Nicholson et al evaluated asbestos concentrations in damaged buildings, in the surroundings of those buildings, and in the homes of workers who worked with asbestos. Of the 89 air samples, 43 exceeded 50 ng/m^3, showing the need of promoting corrective measures or proper surveillance[34].

Occupational exposure is extremely important. State or provincial organizations, occupational physicians or industrial hygiene and safety engineers or technicians who intervene in the workplace can be consulted to know the degree of occupational exposure and limits allowed by law.

Through primary care both the employer and the worker can be educated on the risks they face and also the para-occupational etiology hazards, with the purpose of minimizing a specially preventable disease.

Conflict of interest

Authors declare there isn't any conflict of interest in relation to this publication.

REFERENCES

1. Knishkowy B, Baker E. Transmission of Occupational Disease to Family Contacts Am J of Ind Med. 1986; 9: 543-50. https://doi.org/10.1002/ajim.4700090606
2. Rey D. Asbestosis: un problema del siglo XX que persiste en el siglo XXI. Rev Am Med Resp. 2019; 4: 253-4.
3. Klebe S, Leigh J, Henderson DW, Nurminen M. Asbestos, Smoking and Lung Cancer: An Update. Int J Environ Res Public Health. 2019; 17: 258. https://doi.org/10.3390/ijerph17010258
4. Gulati M, Redlich C. Asbestosis and environmental causes of usual interstitial pneumonia. Curr Opin Pulm Med. 2015; 21: 193-200. https://doi.org/10.1097/MCP.0000000000000144
5. American Thoracic Society. Diagnosis and initial management of nonmalignant diseases related to asbestos. Am J Respir Crit Care Med 2004; 170: 691-715. https://doi.org/10.1164/rccm.200310-1436ST
6. Enticknap J, Smither W. Peritoneal tumours in asbestosis. Brit J Ind Med. 1964; 21:20-31. https://doi.org/10.1136/oem.21.1.20
7. Rey D. Atelectasia redonda: un signo para conocer y comprender. Rev Am Med Resp. 2021; 3: 313-20.
8. Diego-Roza C, Cruz-Carmona J, Fernández-Álvarez R y col. Recomendaciones sobre el diagnóstico y manejo de la enfermedad pleural y pulmonar por asbesto. Arch Bronconeumol. 2017; 53: 437-42. https://doi.org/10.1016/j.arbres.2016.12.014
9. Marsh G, Riordan A, Keeton K y col. Non-occupational exposure to asbestos and risk of pleural mesothelioma: review and meta-analysis Occup Environ Med 2017; 0: 1-9.
10. Cummings K, Becich M, Blackley D y col.- Workshop summary: Potential usefulness and feasibility of a US National Mesothelioma Registry Am J Ind Med. 2020; 63: 105-14. https://doi.org/10.1002/ajim.23062
11. Wagner J, Sleggs C, Marchand P. Diffuse Pleural Mesothelioma and Asbestos Exposure in the Northwestern Cape Province Brit J Ind Med. 1960; 17: 260-71. https://doi.org/10.1136/oem.17.4.260
12. Melaiu O, Gemignani F, Landi S. The genetic susceptibility in the development of malignant pleural mesothelioma J Thor Dis. 2018; 10: S246-52. https://doi.org/10.21037/jtd.2017.10.41
13. Sekido Y. Molecular pathogenesis of malignant mesothelioma Carcinogenesis 2013; 34: 1413-9. https://doi.org/10.1093/carcin/bgt166
14. Donovan E, Donovan B, McKinley M y col. Evaluation of take home (para-occupational) exposure to asbestos and disease: a review of the literature. Crit Rev in Toxicol. 2012; 42: 703-31. https://doi.org/10.3109/10408444.2012.709821
15. Newhouse M, Thompson H. Mesothelioma of pleura and peritoneum following exposure to asbestos in the London area. Brit J Industr Med. 1965; 22: 261-9. https://doi.org/10.1136/oem.22.4.261
16. Anderson H, Lilis R, Daum S y col. Household-contact asbestos neoplastic risk. Ann NY Acad Sci 1976; 271: 312-26. https://doi.org/10.1111/j.1749-6632.1976.tb23127.x
17. Levin S, Selikoff I. Radiological abnormalities and asbestos exposure among custodians of the New York City Board of Education. Ann N Y Acad Sci. 1991; 643: 530-9. https://doi.org/10.1111/j.1749-6632.1991.tb24504.x
18. Artvinli M, Baris Y. Malignant mesotheliomas in a small village in the Anatolian region of Turkey: an epidemiologic study. J Nat Cancer Inst. 1979; 63: 17-22.
19. Constantopoulos S, Goudevenos J, Saratzis N y col. Metsovo Lung: Pleural Calcification and Restrictive Lung Function in Northwestern Greece. Environmental Exposure to Mineral Fiber as Etiology. EnvironRes. 1985; 38: 319-31. https://doi.org/10.1016/0013-9351(85)90096-9
20. Constantopoulos S, Malavou-Mitsi V, Goudevenos J y col.- High Incidence of Malignant Pleural Mesothelioma in Neighbouring Villages of Northwestern Greece. Respiration 1987; 51: 266-71. https://doi.org/10.1159/000195212
21. Manda-Stachouli C, Dalavanga Y, Daskalopoulos G y col. Decreasing Prevalence of Pleural Calcifications Among Metsovites With Nonoccupational Asbestos Exposure. Chest 2004; 126: 617-21. https://doi.org/10.1378/chest.126.2.617
22. Gogalia A, Ntzanib E, Manda-Stachoulia C y col.Evidence Suggesting the End of Universal Domestic Asbestos Expo-

sure in Metsovo, NW Greece. Respiration 2017; 94: 510-7. https://doi.org/10.1159/000480151
23. Consonnia D, De Matteis S, Dallari B y col. Impact of an asbestos cement factory on mesothelioma incidence in a community in Italy. Environ Res
24. Tarrés J, Abós-Herrándiz R, Albertı C y col. Enfermedad por amianto en una población próxima a una fábrica de fibrocemento. Arch Bronconeumol. 2009; 45: 429-34. https://doi.org/10.1016/j.arbres.2009.04.007
25. Reid A, Heyworth J, de Klerk N, Musk A. The mortality of women exposed environmentally and domestically to blue asbestos at Wittenoom, Western Australia. Occup Environ Med. 2008; 65: 743-9. https://doi.org/10.1136/oem.2007.035782
26. Goldberg M, Lucea D. The health impact of non occupational exposure to asbestos: what do we know? Eur J Cancer Prev. 2009; 18: 489-503. https://doi.org/10.1097/CEJ.0b013e32832f9bee
27. Browne K. Asbestos-related mesothelioma: Epidemiological evidence for asbestos as a promoter. Arch Environ Health 1983; 38: 261-6. https://doi.org/10.1080/00039896.1983.10544004
28. Dodoli D, Del Nevo M, Fiumalbi C y col. Environmental Household Exposures to Asbestos and Occurrence of Pleural Mesothelioma. - Am J Ind Med 1992; 21: 681-7. https://doi.org/10.1002/ajim.4700210508
29. Rake C, Gilham CHatch J. Occupational, domestic and environmental mesothelioma risks in the British population: a case-control study. Br J Cancer. 2009; 100: 1175-83. https://doi.org/10.1038/sj.bjc.6604879
30. D'Agostin F, de Micheli P, Negro C. Pleural mesothelioma in household members of asbestos-exposed workers in Friuli Venezia Giulia, Italy. Int J Occup Med Environ Health 2017; 30: 419-31. https://doi.org/10.13075/ijomeh.1896.00890
31. Muszyńska-Graca M, Dabkowska B, Brewczyński PZ. Wytyczne stosowania Miedzynarodowej Klasyfikacji Radiogramów Pylic Płuc Miedzynarodowego Biura Pracy (ILO) - istotne zmiany w obecnie obowiazujacej edycji [Guidelines for the use of the International Classification of Radiographs of Pneumoconioses of the International Labour Office (ILO): Substantial changes in the currrent edition]. Med Pr. 2016; 67: 833-7. https://doi.org/10.13075/mp.5893.00493
32. Hilbert T, Franzblau A, Dunning K y col.- Asbestos-Related Radiographic Findings Among Household Contacts of Workers Exposed to Libby Vermiculite Impact of Workers' Personal Hygiene Practices J Occup Environ Med 2013; 55: 1300-4. https://doi.org/10.1097/JOM.0b013e31829fcf1a
33. Perkins R, Hargesheimer J, Fourie W. Asbestos Release from Whole-Building Demolition of Buildings with Asbestos-Containing Material. J Occup Environm Hyg. 2007; 4: 889-4. https://doi.org/10.1080/15459620701691023
34. Nicholson W, Rohl A, Weisman I, Selikoff I.- Environmental asbestos concentrations in the United States. IARC Sci Publ 1980; 30: 823-7.