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JMEA 6268 X

10 36 02 37 70 82 76 102

PUBLISHED BY L'ASSOCIATION DES MINES D'AMIANTE DU QUÉBEC MAY/JUNE 1980 VOL. 4/NO 3

Results of the most comprehensive scientific study on the effects of asbestos dust exposure

Fourteen years of research by a multidisciplinary team of scientists

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"In cases where a substance has been shown to be carcinogenic, it is important to consider whether the possible risks to man are outweighed by the social, economic and medical benefits of the substance. Scientists must play a major role in the decision-making process by providing and interpreting the available data. However the final decision must be taken by society in the widest sense, through the intermediary of official organizations". This in brief is the conclusion of the Sub-Committee on Environmental Carcinogenisis of the National Cancer Advisory Committee (1977) of the United States regarding the guidelines for risk/benefit appraisal relative to exposure to carcinogenic substances.

14 years of research

In the perspective of such a statement, the results of a fourteen-year epidemiological study on a group of asbestos workers take on particular significance.

The results of this study have recently been published in a scientific journal. They show among other things that the risk of lung cancer among asbestos workers who are continuously exposed in the workplace to one airborne fibre per cubic centimetre is equivalent to the risk involved in smoking just a few cigarettes per week.

This important scientific research project was carried out under the direction of Professor J.C. McDonald, Director of the TUC Centenary Institute of Occupational Health at the London School of Hygiene and Tropical Medicine, assisted by his wife, Alison McDonald, Professor of Epidemiology at St. Mary's Hospital Medical School, by Douglas Liddell, Professor of Medical Statistics at McGill University, by Graham Gibbs, Director of the Institute of Occupational Health and Safety of McGill University, and by Gail Eyssen who is currently working in cancer epidemiology at the University of Toronto.



Dr Alison McDonald and Dr. J.C. McDonald.

A key work

The research was part of a program established in 1966 at McGill University, at the invitation of the Canadian Government and with encouragement from the Government of Québec, to study the health effects of work in the asbestos industry.

The entire asbestos industry of Québec contributed to the study, from company management and unions to workers and their families. In addition to government backing, McGill University and the London School of Hygiene and Tropical Medicine, the joint organizers of the project, received financial support from the Institute of

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Results of the most comprehensive scientific study...

Occupational and Environmental Health of Montréal.

The results of the first three years' work, which included the reading of 16 000 chest radiographs, comprehensive tests on a sample of workers, and studies of mortality to the end of 1969, were summarized by Dr. C. McDonald and his colleagues in 1974.

After a number of interim reports discussing various aspects of the data analysis, the final report – a summary of which has been published in the British Journal of Industrial Medicine – goes into greater depth on the issue of asbestos dust exposure than any other epidemiological survey yet carried out. Moreover Professor C. McDonald considers that he has made the optimum possible use of the data currently available on the subject. It must also be stressed that after duly analyzing the preliminary reports and the final version, the international scientific community has acknowledged the value of this study, conferring upon it a degree of credibility that makes it a key work and reference document. The Simpson Report,[1] for example, made use of this survey.

Objectives

The survey's primary aim was to define as accurately as possible the quantitative relationship between exposure to chrysotile asbestos fibre and the incidence of lung cancer.

Since lung cancer is also associated with smoking, a second objective was to attempt to separate the hazards and to determine the importance of each factor in the cause of mortality.

Additional aims of the survey were to measure the exposure-response relations for other diseases including cancers of the gastrointestinal tract and larynx, and for pneumoconiosis and other respiratory diseases.

Methodology

The members of the sample group were chosen according to the following criteria: being born between 1891 and 1920 and having been employed for at least one month in the asbestos industry. These criteria ensured the widest possible range of levels of exposure and of duration of employment. Considerable effort was deployed to trace every person in the sample. For those who had died, once copies of the death certificates had been obtained, the causes of mortality were coded according to the International Classification of Diseases.

After checks and more stringent application of the criteria for admission to the group, the study sample was reduced from the original 11 788 to 11 379 (10 939 men and 440 women).

A great deal of work went into determining the level of dust exposure for each subject, according to norms set by Drs Gibbs and Lachance. This was particularly difficult for the years prior to 1949 when there had been few measurements. Drs Gibbs and Lachance obtained their assessment of dust levels prior to 1949 by means of interviews with long-service employees and comparisons with more recent conditions.

Thus for each person the survey established the period of exposure per employment and the total of annual dust exposures (accumulated exposure); for almost all subjects it also determined smoking histories, and distinguished the following categories: non-smoker, moderate smoker or heavy smoker, the latter indicating a consumption of 26 to 50 cigarettes per day. The information was obtained by means of a questionnaire answered by the subjects themselves or by their friends or relatives.

Conclusions

One of the conclusions of the study shows that mortality increases with exposure in the cases of asbestosis, lung cancer, cancer of colon and rectum, respiratory tuberculosis and other respiratory diseases. The trend is most clear-cut in asbestosis and lung cancer.

Here the authors emphasize the importance of having examined subjects exposed to a wide range of dust concentrations in order to determine the increase in risk with the increase in exposure. In fact, even using a sample of workers who were exposed continuously over a period of 20 years to 20f/cc., it would have been difficult to establish an increase in risk.

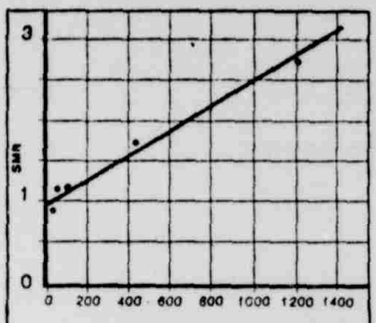
Thus it would seem that, if it is almost impossible to discern an increase in risk at an exposure rate of 20f/cc., a level which has not been found for many years, it is all the more so at 2f/cc., i.e. at the present standard for dust levels in the asbestos industry.

Exposure and smoking

For each category of smoker the risk of lung cancer increases with the level of exposure, thus strengthening the argument that for lung cancer the

Deaths from lung cancer in relation to dust exposure and smoking habit

Smoking habit	Accumulated dust exposure to age 45 in millions of fibres per cubic foot/year.							
	Less than 30		From 30 to 300		more than 300		total	
	Deaths	SMR[2]	Deaths	SMR	Deaths	SMR	Deaths	SMR
Non-smoker	5	0.18	6	0.36	8	1.24	19	0.38
Moderate smoker	73	1.14	64	1.35	52	2.31	189	1.41
Heavy smoker	13	2.12	11	2.39	10	4.50	34	2.63
All smoking habits	91	0.93	81	1.18	70	2.25	242	1.23



This graph showing the relation between the standardized mortality ratio due to lung cancer and accumulated dust exposure to age 45 has been weighted using a graphical computation technique. The horizontal line represents accumulated dust exposure to age 45 in millions of fibres per cubic foot/year; the vertical line represents the standardized mortality ratio due to lung cancer.

dose-response relation is linear (see table). The effect of smoking is particularly harmful with heavy smokers whose standardized mortality ratio[2] is 4 times higher than that of non-smokers at the highest exposure level.

In recent years, after a number of shorter research projects, less comprehensive than the present one, the industry had already seen fit to make workers aware of the dangers involved in smoking associated with exposure to asbestos. Not only do the published results justify such action, they may also give rise to stricter legislation on smoking in the workplace.

The fact that the dose-response relation for dust exposure and lung cancer is linear is of major importance for the determining of acceptable risk.

Critical analysis

There are obviously a great many factors which can influence a study of this kind: the risk of error exists, and every criticism must be closely examined. But the fact remains that this study is as solid and valid as the figures on which it is based.

Some doubts have been expressed as to the value of the relation established between exposure and smoking. The data in this survey do not invalidate the argument that asbestos exposure in itself increases the risk of cancer even for non-smokers. But they do confirm the results of several other research projects which conclude that smoking increases, and even multiplies, the risk of lung cancer.

Quantification

According to Dr. C. McDonald's report, the risk run by asbestos workers before the implementation of dust controls in the mines and mills, i.e. in conditions which no longer exist, was equivalent to that involved in smoking heavily; today's asbestos workers, continuously exposed to 1f/cc., run a risk equivalent to smoking just a few cigarettes per week.

The establishing of a relation between risk in the workplace, considered to be "imposed", and the risk of smoking, considered to be a "free choice", should throw new light on the issue of acceptable risk which the industry may ask man to accept in view of the benefits which it provides.

This study was conducted without a break for fourteen years and aimed to determine the quantitative relations between mortality and workplace exposure in the Québec chrysotile asbestos industry. The analytical methods used were varied and precise; the results obtained remained constant. It may be assumed that the purpose of the study was achieved.

By using these environment quality measurements, the mortality risk associated with work at different dust levels can now be assessed with some confidence. The precision of this risk assessment should now make it possible to determine an acceptable dust level and to take the appropriate social and political decisions.

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(1) Final report of the Advisory Committee on Asbestos, published in 1979 in Great Britain. The Committee, presided by Mr. Simpson, was established in 1976 to review the risks to health arising from exposure to asbestos or products containing asbestos.

(2) SMR: Standardized Mortality Ratio, i.e. the ratio between the actual mortality rate of the study sample and the expected mortality rate, the latter being based on the actual mortality rate of the population as a whole.