RADIOGRAPHIC ABNORMALITIES IN VERMONT GRANITE WORKERS EXPOSED TO LOW LEVELS OF QUARTZ

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ABSTRACT

Whether exposure to levels of granite dust below the current OSHA limits leads to radiographic abnormalities after a lifetime of exposure has not been settled. In 1953, we carried out an X-ray survey of the Vermont granite industry. Quarry and stone shed workers who had been exposed to the low dust levels prevailing in the Industry since 1940 were offered chest X-rays. Films were read by three "B" readers, and were considered abnormal if 2 or 3 of the readers assigned a profusion score of 1/0 or greater. 976 workers out of a total of approximately 1400 participated. 65 (6.9%) of the films were judged abnormal, but the profusion scores were low, only 4 of the films being assigned scores of 6/1 or greater. Only 7 (0.7%) had "pqr" or rounded opacities as the major abnormality. The remaining 61 had irregular opacities, largely lower lobe in location, which are of doubtful significance, but may be related to smoking and aging. In addition, total dust concentrations were measured using personal samplers; dust levels were similar to previous measurements. Mean concentrations were 601 ± 365 micrograms/cuhic meter. Using previously estimated values for percentage quartz of 10%, the mean quartz concentration was below the current OSHA standard of 100 micrograms/cubic meter, although 11% of the samples were above this value. If exposure levels have remained approximately the same over the past 45 years, we conclude that current dust controls, which conform to OSHA standards, have essentially eliminated silicosis.

BACKGROUND

Studies of workers' health in the Vermont granite industry have provided a great deal of information on the health effects of quartz dust inhalation since 1969, when the first comprehensive study of the industry was published.[4] Based on a high incidence of silicotuberculosis, control measures which reduced granite dust levels below 10 million parts per cubic foot (mppcf) were accomplished between 1935 and 1940. At that time, the Vermont Division of Industrial Hygiene (DIH) began annual radiographic surveys to assess the effect of dust reduction on the prevalence of silicosis. Subsequent studies showed that as workers with established silicosis retired or left the industry because of illness, and as new workers were hired, the percentage of the work force with radiographic abnormalities declined.[1,3] In 1964, it was stated that no new cases of silicosis had been detected in workers exposed only to the lower dust levels prevailing after 1940.

In 1974, a study analyzing the results of the DIH radiographic survey of 1970–1 suggested that radiographic abnormalities were present in approximately 30% of the workforce.[7] Most of these were of low grades of profusion and comprised both irregular and rounded shadows. However, 67 films (5% of the total) were assigned profusion scores of 6 or 3, which was believed to be consistent with definite silicosis.

Three possible criticisms might he made of this study. First, the films were interpreted only by a single non-certified reader. Second, workers who were exposed only to the low dust levels prevailing after 1940 were not analyzed as a separate group. It was therefore not possible to know whether levels less than 10 mppcf had eliminated silicosis, or were, on the contrary responsible for some of the radiographic abnormalities. Finally, a certain percentage of the films were interpreted as showing opacities in workers with zero dust years of exposure.

The present study attempts to clarify the issue whether the dust levels present in the industry since 1940 have caused radiographic abnormalities, and if so, of what type and extent. We present the results of an industry-wide radiographic survey done in 1953, which includes only workers exposed to granite dust after the institution of dust controls in 1935. Results of dust sampling for total respirable dust will also be mentioned briefly.

METHODS

All workers employed in 1953, including quarry and stone shed workers, were offered 14×17 chest radiographs taken in a mobile van provided by the Appalachian Laboratory for Occupational Safety and Health (ALOSH). Work histories were recorded or updated on all participants, including oc-

cupational category, the shed where employed, duration of employment and smoking histories. Forced spirometries were also carried out. The chest radiographs were interpreted by three "B" readers using the ILO format (1980). The definition of an abnormal film was that either 2 or 3 of the readers assigned a profusion scores of 1/0 or greater, either of the rounded (pqr) or irregular (stu) type. One worker with definite silicosis was excluded because his major work experience occurred in Canada. Gravimetric dust sampling of respirable size particles were collected using personal breathing zone samplers at flow rates of 6 liters/minute.

RESULTS

972 workers out of a total work force of approximately 1400 were x-rayed. Of those workers not having X-rays, 102 were absent on the day of the survey and the remainder (326 or 23% of the work-force) refused. Only 28 (2.88%) of those x-rayed were interpreted by 2 or 3 of the three readers as showing abnormalities consistent with pneumoconiosis. In only 7 films did all 3 readers agree that an abnormality was present. 21 of the 28 films judged abnormal had as the primary abnormality an irregular or stu type of opacity; this was true of the secondary readings as well. Only 7 (0.7% of the total cohort) showed rounded opacities (pqr) of the type typically seen in early silicosis. The grades of profusion were extremely low, only four films being judged as have profusion scores of 2/1 or higher and these films showed irregular (stu) types of opacities. The location of the stu changes, even at low grades of profusion, tended to be in the lower lung zones. No large opacities or egg shell calcifications were observed.

Comparison of the workers with abnormal radiographs compared to the remainder of the workforce showed that the former were older on average (53.6 yrs vs. 41.5 yrs.), and spent longer in granite (30.9 yrs vs. 17.5 yrs.), had smoked longer (27.9 yrs. vs. 19.2 yrs.), and more heavily (32.3 yrs. vs 26.99 yrs.) P values for the first three variables show significant differences at the .001 level. Several of the workers with abnormal films had notably low exposures to dust: one was a lumper for 6 years, and for the remainder of his 37 years had been a draftsman with little exposure. Another had worked exclusively in an office as a draftsman without any exposure.

Average dust concentrations of 417 samples was 601 ± 368 micrograms/cubic meter, which is similar to values observed by previous workers.[5]

DISCUSSION

These results indicate that radiographic abnormalities consistent with silicosis have occurred at a very low level (0.7% of cohort) at quartz exposures which are in conformance with the current OSHA limit of 100 micrograms/cubic meter.,This is particularly surprising inasmuch as approximately 10% of the samples, using the 10% quartz value of previous workers, were over 100 micrograms/cubic meter. Further, the changes observed tend to be a very low grades of profusion. The predominant type of opacities judged to be present were of the stu or irregular type, seen in 21 of the 28 workers judged to have abnormal films. The significance of these changes is uncertain, but may be associated with peribronchial fibrosis associated with pathological changes of chronic bronchitis which has been described in older, heavily smoking patients.[6]

In summary, this study provides an overview of the prevalence and type of radiographic abnormalities which have developed in Vermont granite workers over a 45 year period of observation, when dust controls were effectively maintained. This essential elimination of radiographic silicosis has occurred at quartz levels which are in conformance with current OSHA standard.

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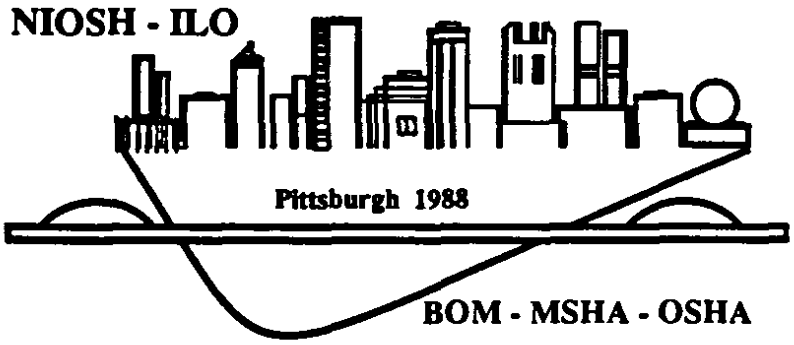

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