

Chronic Occupational Exposure to Asbestos: More than Medical Effects?

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One hundred and twenty-nine workers chronically exposed to asbestos were interviewed regarding their perceived health status and concerns, their health behaviors, particularly their smoking behavior, and their psychologic well-being. In contrast to a non-exposed comparison group of postal workers, asbestos workers exhibited significantly elevated levels of somatic concern ($P < .03$), and significantly lower levels of mental health functioning only when experiencing high levels of stress ($P < .01$). Despite feeling significantly more susceptible to developing cancer ($P < .0001$), 34% of asbestos workers were cigarette smokers (compared to 32% of the postal group) and long-term mask usage was minimal. Asbestos workers' increased sensitivity to stress and changes in health status along with the lack of adaptation of health-promotive behaviors indicate the need for interventions to attend to the psychologic effects of increased risk status.

The effects of inhaling asbestos fibers are time- and dose-related; continued exposure leads to various severe and debilitating diseases. Of those persons with substantial exposure, predictions are that 19% will die of lung cancer, 9% of asbestosis, 9% of gastrointestinal cancer, and 8% of mesothelioma.¹

The question arises as to whether the increasing health consciousness witnessed in the last decade in the general population has also occurred among medical

risk groups, such as those who have had chronic occupational exposure. Health-promotive behaviors, particularly smoking cessation, are singularly significant for asbestos-exposed individuals. Although the mechanism of asbestos-induced carcinogenesis is unclear, asbestos fibers may act as physical transporters of other environmental carcinogens.^{2,3} Cell transformation by co-carcinogens so commonly found in the blue collar environment may be facilitated by asbestos. The asbestos worker who smokes has a risk of dying of bronchogenic carcinoma 53 times greater than that of the nonsmoking population, and 5 times greater than that of the smoking general population.⁴ Furthermore, cessation of smoking among asbestos workers has resulted in decreased risk of bronchogenic carcinoma.^{5,6}

The question also arises regarding the mental health effects of chronic occupational exposure. Although asbestos is a major occupational and public health problem, and there are many medical studies of cohorts of asbestos workers,^{1,4-10} minimal documentation is available regarding the psychologic sequelae of living with medical risk. Prior psychologic studies of actual or perceived hazardous exposures, such as at Three Mile Island,¹¹⁻¹⁵ Love Canal,^{16,17} and with Michigan farmers exposed to polybrominated biphenyls,^{18,19} reflected relatively recent exposures. Although investigators studied the chronic risk effect of *in utero* diethylstilbestrol exposure, women at risk were aware of their risk only shortly before the study.²⁰ In sum, very little is known about the psychologic reaction to the knowledge that one has been continuously exposed to a hazardous substance.

A study was designed to evaluate persons chronically exposed through their occupation to asbestos fiber and to compare them with a non-exposed group of blue collar workers with respect to (1) perceived health status, health concern, disease susceptibility, and health locus of control; (2) behavioral correlates of such exposure,

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cigarette smoking in particular; and (3) their psychologic well-being and mood states.

Methods

Study Participants

One hundred and twenty-nine asbestos workers from the New York metropolitan area, members of the International Association of Heat and Frost Insulators and Asbestos Workers, were interviewed. Criteria for inclusion were a minimum of 20 years in the asbestos insulation trade, and continuous "field" exposure into the past 5 years (to exclude those who worked exclusively in an office). The cohort studied participated in medical surveillance examinations over the last 20 years and its medical risk has been well documented.⁷

Due to the lack of standardized measures to assess the psychologic status of blue collar workers, a comparison group was utilized to serve as a "normative" standard. US Postal Service workers were chosen because as a group they had not knowingly been exposed to any hazardous substance, were demographically similar to asbestos workers, and performed manual labor. One hundred postal workers who had worked for the postal service a minimum of 20 years were entered onto study. (Six postal workers were excluded from this analysis because of a history of direct occupational asbestos exposure on jobs outside the postal service.) Recognizing the inherent work characteristic differences between the asbestos and postal groups, statistical covariates were implemented in the analyses, to control for group differences.

Asbestos worker participants were recruited from more than 600 cohort records of the Environmental Science Laboratory of The Mount Sinai School of Medicine, whereas postal workers were recruited from a pool of more than 550 potential study-eligible participants. Asbestos worker participants represent 49% and postal worker participants represent 32% of those successfully contacted who met the inclusion criteria for this study (Table 1).

Both groups were exclusively male and were similar demographically with regard to marital status, level of education, number of years in the trade, and physical health status (as measured by the Karnofsky Patient Performance Scale)²¹ (Table 2). Asbestos workers were, however, significantly younger, had a significantly lower Hollingshead socioeconomic status score (A.B. Hollingshead, unpublished data), and also differed in race and religion. These group demographic differences did not relate either statistically or clinically to the outcome measures.

Assessment Measures

Standardized measures with published reliability and validity were administered. To evaluate perceived health status and concern, two scales of the Current and Past Psychopathology Scales (CAPPS) were used, the

TABLE 1
Sample Recruitment

	Asbestos Workers	Postal Workers
Those successfully contacted who met eligibility criteria for study	262	308
Declined participation	76 (29%)	151 (49%)
Interview not scheduled by end of study	57 (22%)	57 (19%)
Participated	129 (49%)	100 (32%)

TABLE 2
Demographics

	Asbestos Workers	Postal Workers	P
Age	51.1	55.9	<.0001
Hollingshead SES score	31.1	33.2	<.01
Years in trade	27.7	27.9	NS*
Karnofsky physical health status rating (100 = maximum)	88.4	88.4	NS
Sex (% male)	100	100	NS
Race (% white)	100	91	<.01
Religion (% Catholic)	78	48	<.0001
Married, %	91	88	NS
Education level, %			NS
>High school	22	16	
>9th grade	49	53	
<9th grade	29	31	

* NS, not significant.

Current and Past Somatic Concern Scales (C-SC, P-SC).²² The Multidimensional Health Locus of Control Scale evaluated perceptions of internal and external control of health,²³ and questions evaluating perceived health status and disease susceptibility were also asked.²⁴ Present and past health behaviors were assessed, particularly smoking behavior,²⁵ alcohol consumption,²² usage of masks, and physician visits. Two other scales of the CAPPS were administered, the Current and Past Depression and Anxiety Scales (C-DA, P-DA), as well as CAPPS-derived present and past global distress scores, to assess overall level of psychological distress. The Global Assessment Scale (GAS) was also used to determine overall level of mental health functioning.²⁶ In addition to these measures, the Sixteen Personality Factor Questionnaire (16PF)²⁷ was used as a measure of between-group trait comparability, and the Recent Life Changes Questionnaire (RLCQ)²⁸ was given to compare group differences in level of stress prior to the evaluation of present distress. A specially devised project questionnaire evaluated the specific parameters of this study: demographics, occupational and exposure histories, adoption of health-promotive behaviors, and acquisition of risk information.

Reliability and Participant Refuser Studies

Because some instruments used were interviewer-rated measures, inter-rater reliability was determined for the two interviewers. To control for bias, an independent rater "blind" to the overall and specific study

objectives assigned ratings to audiotaped interviews. The resultant intra-class correlation coefficients were indicative of reliable ratings with a minimization of rater subjectivity.

A participant-refuser comparison was undertaken with the asbestos worker study participants to evaluate the presence of volunteer bias. Comparability of the study participants to the first 61 study refusers on five variables available from existing medical cohort data showed no significant differences regarding age, smoking history, age started to smoke, cigarettes smoked per day, and year started in the insulation trade.

Statistical Analyses

The analytic premise for this study was to evaluate differences in perceived health status and concern, health behaviors and awareness, and overall level of psychological distress between the experimental group (the asbestos workers) and the comparison group (the postal workers). To ascertain that any obtained group difference was due to the presence or absence of chronic hazardous exposure, it was important to control for possible sources of group differences in present psychologic status other than asbestos exposure. Analysis of covariance was used with three criteria used for selecting the appropriate covariates: (1) Clinical relevance between the covariate variables and the outcome measures, such that the covariates could theoretically influence the outcome measures. For example, between group trait factors evaluated through the 16PF, such as neuroticism or anxiety, could influence between group differences in current mood state levels of depression and anxiety. (2) A significant correlational relationship to the dependent outcome psychologic status variables. (3) A significant difference between the groups on the variable.

Statistical calculations were performed using the Statistical Analysis System software package on an IBM computer system. Descriptive statistics, correlation coefficients, and frequency tables were calculated. The "REG" procedure was used for the analysis of covariance to determine between group differences regarding perceived health status and concern and overall levels of psychologic distress. However, the basic assumptions of analysis of covariance could not be satisfied for the GAS, C-DA, and P-DA scores because of resultant significant interactional effects. Results for these scales are therefore evaluated with respect to predicted scores given the extreme minimum and maximum covariate values. The coefficients of the regression equations were derived from a stepwise regression among the covariates.

Results

Perceived Health Status and Concern

Asbestos workers were aware of their risk status, having learned of the dangers of asbestos, on the aver-

age, 18 years prior to the interview. More specific risk information, such as the synergistic relationship between smoking and asbestos, was acquired, on the average, 3 years later. Only 4% of the asbestos workers never learned of this synergistic relationship. Postal workers, on the other hand, learned of the dangers of asbestos, on the average, 6 years prior to the interview and 97% never learned about the smoking/asbestos interaction.

The two groups did not differ in their level of physical health status. Similarly, asbestos workers did not perceive their health status differently than did postal workers. When asked to rate their present health status on a five-point scale ranging from "very poor" (rating = 1) to "very good" (rating = 5), asbestos workers and postal workers averaged mean ratings of 4.14 and 3.96, respectively.

Perceived health status appeared to reflect accurately the actual physical health status: perceived health status ratings correlated positively and significantly with the Karnofsky ratings of actual physical health status for both asbestos workers ($r = .83, P < .002$) and postal workers ($r = .24, P < .02$). The correlations between physical health status (actual and perceived), and somatic concern, depression/anxiety, psychological distress, and current mental health functioning are described (Table 3). Although the actual correlation coefficients are of a low order (.40 and lower), they were statistically significant for the asbestos workers, but not for the postal workers in three out of four correlations between physical health status and psychological outcome measures, and in all four of the correlations between perceived health status and psychological outcome measures. This is indicative of a much stronger relationship between health (actual and perceived) and psychologic status for the asbestos workers than for the postal workers.

An analysis of covariance performed on the Current Somatic Concern Scale of the CAPPs, after adjusting for the significant covariates of neuroticism (as measured by the 16PF) and past year stressful life events (as measured by the RLCQ), showed that asbestos workers were significantly more concerned about their current health than postal workers were and exhibited greater somatic expression of this concern ($P < .03$). There were, however, no statistically significant differences between groups on past concern about health and its somatic expression after adjusting for the relevant covariates, nor on the subscales of the Multidimensional Health Locus of Control Scale.

When asked to rate their chances for getting cancer and coronary heart disease, asbestos workers believed they were significantly more likely to develop cancer than did postal workers ($\chi^2 = 30.54, P < .0001$). Fifty-nine percent of asbestos workers believed their chances were likely for developing cancer compared to 26% of postal workers. Asbestos workers also believed themselves to be significantly more likely to develop cancer than coronary heart disease, whereas postal workers did not share this increased susceptibility to cancer ($\chi^2 = 20.90, P < .001$).

TABLE 3
Correlations between Health Status and Psychological Outcome Measures
(Pearson Correlation Coefficients)*

	Actual Physical Health Status (Karnofsky)		Perceived Physical Health Status	
	Asbestos Workers	Postal Workers	Asbestos Workers	Postal Workers
Current depression/anxiety (C-DA)	-.22†	-.08	-.27†	-.03
Current somatic concern (C-SC)	-.40‡	-.15	-.24‡	-.18
Present distress (CAPPS)	-.25†	-.08	-.28‡	-.11
Global mental health (GAS)	.14	.24§	.29‡	.03

* Direction of measures are as follows: Karnofsky: 0 to 100, 100 = best rating of physical health; Perceived: 1 to 5, 5 = best rating of physical health; C-DA, C-SC, and CAPPS: 1 to 6, 6 = most psychopathology; GAS: 0 to 100, 100 = best rating of mental health.

† $P < .01$.

‡ $P < .001$.

§ $P < .05$.

Health Behaviors

Despite the fact that smoking cessation is the single most effective health-promotive behavior that asbestos workers can adopt, there were no significant differences in smoking prevalence or amount smoked between the groups (Table 4). Thirty-four percent of asbestos workers were presently smoking, and another 44% of asbestos workers had smoked in the past.

Asbestos workers were rated as having significantly higher levels of current and past alcohol abuse on the CAPPS and also reported being drunk more frequently than postal workers. Although not significantly different, 17% of asbestos workers reported a history of alcohol dependence, compared with 12% of postal workers.

The median percentage of time masks were used at work over all the years was 10%. While on the job, only 8% of asbestos workers wore masks for more than 50% of the time. Although asbestos workers went to an average of 4.4 medical surveillance examinations since acquisition of risk information, 44% of the asbestos group, however, never went to their primary care physician for regular physical examinations (without symptoms) after learning of increased risk.

Overall Level of Psychological Distress

As noted above, significant covariate interactional effects for the GAS, C-DA, and P-DA scales necessitated evaluating predicted scores for these dependent variables given minimum and maximum covariate values. When stress (as reported on the RLCQ) assumed a maximal value, asbestos workers had a significantly lower level of mental health functioning (GAS) than postal workers did. Under conditions of maximum neuroticism (16PF), postal workers had a significantly lower level of mental health functioning than asbestos

TABLE 4
Health Behaviors

	Asbestos Workers	Postal Workers	P
Cigarette smoking			
Present, %	34	32	NS*
Past, %	44	40	NS
Never, %	22	28	NS
Pack years (mean)	36	33	NS
Alcohol abuse			
Current (CAPPS rating)†	1.38	1.19	<.03
Past (CAPPS rating)†	2.02	1.70	<.05
Drunk frequency‡	4.75	5.79	<.0001
History of alcohol dependence, %	17	12	NS
Other			
Time used masks (median), %	10	—	—
Never went to primary care physician for physical, %	44	49	NS

* NS, not significant.

† 1 = none, 6 = extreme.

‡ 1 = once a week, 6 = never.

workers did (Table 5). This significant interaction effect between the covariates and the dependent variable also occurred when current and past depression/anxiety was evaluated. Under maximal conditions of trait anxiety (16PF), asbestos workers had significantly more psychopathology on the C-DA scale of the CAPPS than postal workers did. Analysis of covariance with the P-DA scale of the CAPPS revealed that postal workers exhibited significantly elevated scores except under the condition of maximum trait anxiety where asbestos workers had significantly higher levels of past depression and anxiety than postal workers did.

The groups, however, did not differ in present and past distress global scores derived from the CAPPS. Similarly, there were no significant differences in incidence of treatment for psychopathology. Only 11% of asbestos workers and 19% of postal workers had ever visited a mental health professional.

Discussion

Several important findings and implications emerge from this study. Asbestos workers exhibited an elevated level of current somatic concern relative to the comparison group. Although their actual health status and their perception of their health status did not differ from those of the postal workers, their increased somatic concern may be reflective of their (correctly) perceived increased susceptibility to cancer. This health concern appeared to be firmly related to actual physical health status, such that deteriorating health led to increasing somatic concern, increasing levels of mood state disturbance, and deteriorating mental health functioning. The fact that this correlational relationship occurred only within the medical risk group may indicate that living with the "time bomb" of chronic asbestos exposure leads to a heightened sensitivity to changes in

TABLE 5
Significant Interactional Effects of Analyses of Covariance*

Covariate Levels	Neuroticism	Life Events	Anxiety	Predicted Scores		SE	P <
				Asbestos Workers	Postal Workers		
Global assessment scale	Min	Min		84.43	83.31	0.51	.05
	Min	Max		70.03	83.31	3.69	.01
	Max	Min		74.67	68.47	2.81	.05
	Max	Max		60.27	68.47	2.94	.01
Past depression/anxiety score	Min		Min	1.16	1.23	0.02	.001
	Min		Max	1.99	1.23	0.30	.02
	Max		Min	1.08	2.13	0.33	.01
	Max		Max	1.91	2.13	0.10	.05
Current depression/anxiety score	Min	Min	Min	1.06	1.07	0.02	NS†
	Min	Min	Max	1.85	1.07	0.28	.01
	Min	Max	Min	1.54	1.55	0.02	NS
	Min	Max	Max	2.33	1.55	0.28	.01
	Max	Min	Min	0.85	1.56	0.31	.05
	Max	Min	Max	1.64	1.56	0.21	NS
	Max	Max	Min	1.33	2.04	0.31	.05
	Max	Max	Max	2.12	2.04	0.21	NS

* Regression equations are given. "Group" values are 1 for asbestos workers, 0 for postal workers. GAS score = $86.57 - 1.81(\text{neuroticism}) + 0.62(\text{neuroticism})(\text{group}) - 0.03(\text{life events})(\text{group})$; past depression/anxiety score = $1.03 - 0.12(\text{neuroticism})(\text{group}) + 0.11(\text{neuroticism}) + 0.10(\text{anxiety})(\text{group})$; current depression/anxiety score = $0.96 + 0.06(\text{neuroticism}) + 0.001(\text{life events}) + 0.095(\text{anxiety})(\text{group}) - 0.085(\text{neuroticism})(\text{group})$.

† NS, not significant.

physical health status. In addition, the elevated level of current somatic concern exhibited by the exposed group did not occur with past somatic concern. This may reflect the augmented increase in medical risk that occurs after 20 years of exposure,¹ a point in time when the long-term cumulative asbestos dosage can set the time bomb off.

Although the threat of cancer was consciously acknowledged at a cognitive level, it was not reflected in the behavioral arena. Despite being well informed of their risk and feeling significantly more susceptible to developing cancer, health-promotive behaviors such as smoking cessation, long-term use of masks, and physician visits were not appreciably affected. Nearly one out of three asbestos workers continuing to smoke is a particularly disturbing finding, considering the current epidemiologic data that suggests that smoking cessation is an even more effective health-promotive behavior than leaving the trade. Although cessation of asbestos exposure prevents an increase in cumulative asbestos dosage, there is no evidence that an asbestos worker who leaves the trade actually reverses his risk of lung cancer, as does the asbestos worker who stops smoking.^{5,6} Smoking, for an asbestos worker, indeed adds insult to injury. The findings of increased prevalence of alcoholism among asbestos workers is also of concern, considering the potential carcinogenicity of alcohol abuse and also in light of a recent report²⁹ that alcoholism may increase the incidence of pulmonary disease by enhancing the effects of asbestos. Asbestos workers, therefore, require psychosocial interventions to promote health behaviors which can reduce and even reverse their risk; few segments of the population could benefit more from such an intervention.

Although overall levels of psychological distress and use of mental health services did not strikingly differ-

entiate the occupationally exposed workers from a non-exposed work force, certain mediating influences were striking. When stressful life events were maximized, asbestos workers had a significantly lower level of mental health functioning. Living with the time bomb of chronic asbestos exposure may therefore contribute to an over-reactivity to stress, as evidenced by the relationship between stressful life events and mental health for the exposed group, but not for the comparison group. The cumulative effects of chronic awareness of risk status may be to overtax the asbestos worker such that his "threshold of endurance"³⁰ to daily stress is lowered. A recent study of the long-term psychologic effects of diethylstilbestrol exposure has similarly found an increased vulnerability to stress among diethylstilbestrol mothers.³¹

The lack of present and past excess psychologic distress and the absence of group differences regarding perceived control of health on the part of the exposed group is surprising. This may be explained, however, by reports of use of denial as a coping strategy when faced with a long-term stress or trauma.³² Denial may, therefore, be a common coping mechanism to chronic occupational exposures. Although it may serve the function of reducing psychologic distress, it apparently also has the maladaptive function of minimizing optimal adaptation of health-promotive behaviors. Li et al³³ similarly found that, although shipyard workers were well aware of the health risks of smoking, their behavior reflected denial of that risk. For exposed workers, perceived or actual deterioration of physical health status may interfere with the denial process, resulting in increasing levels of psychologic distress.

The increasingly prevalent worker "right to know" movement is an important first step in the necessary dissemination of risk information. Further research

must be conducted to supplant traditional educational campaigns with more specifically designed interventions. Research on the efficacy of altering Type A behavior in men at increased cardiovascular risk has demonstrated the importance of the specificity of the intervention.³⁴ Structured interventions such as smoking cessation classes or on-the-job behavioral intervention strategies, as found in workplace health promotion programs, are essential. Stress management techniques may be particularly helpful for chronically exposed workers to help minimize their increased vulnerability to daily stress.

Long-term asbestos workers are concerned about their health, feel very vulnerable to cancer, and exhibit distress reactions as a result of specific mediating influences, such as daily stress levels or personality traits. Living with the time bomb of chronic asbestos exposure leads to a greater reactivity to stress and a heightened sensitivity to changes in physical health status. The effects of long-term asbestos exposure are, therefore, not exclusively medical. The constant threat of cancer vulnerability exacts its psychological toll as well.

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