PLAINTIFF'S EXHIBIT
WRC-1432

C A M B R I D G E

TO: H.C. Duecker
F.W. Eaton
O.M. Favorito
J.W. Wolter
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DATE: April 26, 1977

FROM: H.A. Eschenbach

SUBJECT: Attached

CONFIDENTIAL

This article may be of value if people in the Enoree or Libby communities raise questions concerning health hazards associated with living in those areas. While the study just refers to "deposits" and does not indicate whether any of these deposits are mined and/or milled, the data is encouraging.

H.A. Eschenbach

HAE:bp

Attachment

exist between multiple primary malignant lesions.

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CANCER MORTALITY AND ASBESTOS DEPOSITS

THOMAS R. FEARS

Fears, T. R. (Office of Field Studies and Statistics, National Cancer Institute, 7910 Woodmont Avenue, Bethesda, MD 20014). Cancer mortality and asbestos deposits. *Am J Epidemiol* 104:523-526, 1976.

Asbestos deposits are found in many parts of the United States. In this paper the question is asked: Is there an increase in risk from cancer associated with naturally-occurring asbestos? In an attempt to control for the urban effect, geographic gradient and socioeconomic class, each county in the United States with asbestos deposits was matched for percent of area that was urban and for median years in school with two nearby counties that did not have known asbestos deposits. The study of cancer mortality rates in these matched counties provides no evidence that naturally-occurring asbestos is a great hazard to the general population of counties with asbestos depostis.

asbestos; cancer; carcinogens; environment; mortality.

Introduction

Epidemiologic studies have found that asbestos workers display an extremely high risk of dying from lung cancer. In addition, incidence of cancer of other sites, esophagus, stomach, colon and rectum, are higher than average (1). The production of tumors in animals by inhaled asbestos has been difficult to demonstrate (2) but there have been examples of experimental carcinogenesis following injection or implantation of asbestos. There is evidence that asbestos fed to animals enters the gut wall, lungs and other organs.

Asbestos in the form of chrysotile and amphibole deposits is found in many parts of the United States (3, 4). In this paper we ask: Is there an increase in risk from cancer associated with naturally-occurring asbestos deposits?

Materials and Methods

Locations of asbestos deposits in the United States are given in *Asbestos in the United States* by A. H. Chidester and A. F. Shride, published by the US Geological Survey of the Department of the Interior (5). Their text lists counties with asbestos deposits and distinguishes those deposits as to mineralogic type, name of the deposit or prospect and associated references. With this as a guide, each county was classified as to type of asbestos present—having chrysotile deposits or not, having amphibole (including anthophyllite and tremolite) or not. There were 99 counties with asbestos deposits; 54 with amphibole and 45 with chrysotile.

Information on cancer mortality has been gathered by the National Center for Health Statistics and analyzed geographically by the Epidemiology Branch of the National Cancer Institute. Age-adjusted death rates over the period 1950-1969 were obtained for counties in the contiguous forty-eight states by race, sex, and site of cancer (6). The standard for the rate calculations was the total US population in 1960.

Two asbestos deposit counties, each with amphibole, were eliminated from the study as the cancer mortality data from these counties were combined with other nearby counties.

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Throughout, only sites for which there is evidence of asbestos-caused cancer are studied. Specifically we use lung, International Classification of Diseases (ICD) 162–163; esophagus, ICD 150; stomach, ICD 151; large intestine, ICD 153; rectum, ICD 154; biliary passages and liver, ICD 155; as well as the total for the gastrointestinal tract ICD 150+151+153+154. Rates for white males and females were studied since the black populations of the study counties were, in general, small.

An initial study of the data (table 1) showed that cancer mortality rates in the asbestos deposit counties were substantially below the rates of the total US. The asbestos counties are heavily rural, which might account for the low rates.

In an attempt to control for the urban effect, geographic gradient and socioeconomic class, the following approach was taken: each asbestos deposit county was matched for percent of area that was urban and for median years in school with two counties that did not contain known asbestos deposits. The matched counties were in the same or an adjacent state. An analysis was then made of the differences between the cancer rates of an asbestos deposit county and the average rate of its demographically matched counties. This matching is particularly appropriate because of the epidemiologic features of cancer of the esophagus, stomach, large bowel and lung (7). Esophageal cancer mortality rates show a high degree of geographic variation and the incidence is higher in urban areas than in adjacent rural areas. Stomach cancer rates are higher among lower socioeconomic classes. Large bowel cancer rates are higher for urban than rural residents. Factors associated with increased risk of lung cancer include low socioeconomic status and urban residence.

Results

Analysis by type

The mean difference between cancer mortality rates of asbestos counties and their controls was interpreted to be the "effect" of asbestos entering into the environment on cancer mortality rates. For each of the study sites, for males and for females, for chrysotile and amphibole as well as for all study counties the asbestos effect was measured and tested using a paired t-test. Normality of the distribution of differences is important for the validity of the t-test but moderate departures have been shown to have little effect (8). Wilcoxon Rank tests for each subgroup of counties and for each study site were calculated as a precaution against distortions in probability statements because of possible deviations from normality.

Table 2 gives the average annual age adjusted (1960) cancer mortality rates for 1950–1969 among white males and females in each subgroup of the asbestos counties and in their respective matched controls. Using the t and Wilcoxon statistics, no significant differences (all $p > .10$) for asbestos county mortality rates compared with control county mortality rates were found for males or for females. No significant differences (all $p > .10$) for chrysotile or amphibole were seen.

Multiple regression

A county was classified as a county with asbestos of a given specific type if any known deposit in that county was of that type. Since some counties contained both chrysotile and amphibole the examination of the counties by type is not sufficient for understanding. A multiple regression analysis was made using a model with terms for type of deposit: (amphibole, chrysotile and both) for white male and white females for each study site. An F statistic with 3 and 93 degrees of freedom was used to test the significance of proportion of the total variation explained by the model by asbestos type. No significant increases in cancer mortality were found for any study site for either males or females. The individual regression coefficients were tested with t-tests. No coefficient in any model was significant (all $p > .05$). The constant term

TABLE 1

Cancer mortality rates 1950–1969 for various sites—asbestos counties compared to US totals (deaths per 100,000)

Sex and location	Esophagus (ICD 150)	Stomach (ICD 151)	Large intestine (ICD 153)	Rectum (ICD 154)	Total gastro-intestinal tract (ICD 150–154)	Biliary passages and liver (ICD 155)	Bronchus and lung (ICD 162–163)
White Males							
Asbestos Counties	3.14	13.25	12.68	5.69	34.76	4.21	31.86
Total U.S.	4.10	15.22	16.54	7.65	43.51	5.16	37.98
White Females							
Asbestos Counties	.97	6.95	13.25	3.96	25.13	4.65	5.38
Total U.S.	1.03	7.70	16.25	4.82	29.80	5.34	6.29

TABLE 2

Mean age-adjusted cancer mortality rates 1950–1969 by cancer site and type of asbestos deposit for white males and white females in asbestos deposit counties and matched counties (deaths per 100,000)

Counties	No.	Esophagus (ICD 150)		Stomach (ICD 151)		Large intestine (ICD 153)		Rectum (ICD 154)		Total gastro-intestinal tract (ICD 150–154)		Biliary passages and liver (ICD 155)		Bronchus and lung (ICD 162–163)	
		Male	Female	Male	Female	Male	Female	Male	Female	Male	Female	Male	Female	Male	Female
Chrysotile counties	45	3.14	.95	14.18	7.09	13.37	13.42	5.95	4.31	36.64	25.77	4.26	4.74	31.97	5.77
Control counties	95	3.07	.96	14.57	6.91	13.19	13.66	6.34	4.43	37.17	25.96	4.08	4.61	32.35	5.25
Amphibole counties	52	3.13	.96	12.77	6.83	11.58	12.54	5.20	3.69	32.68	24.02	4.19	4.75	31.10	5.14
Control counties	104	2.79	.88	13.81	6.38	12.15	12.94	5.45	3.58	34.20	23.78	4.22	4.55	32.77	5.16
All asbestos counties	97	3.14	.97	13.25	6.95	12.68	13.25	5.69	3.96	34.76	25.13	4.21	4.65	31.86	5.25
All control counties	194	2.96	.99	13.75	6.64	12.59	13.50	5.72	3.96	35.02	25.09	4.20	4.54	32.59	5.21

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was not significant (all $p > .10$) in any tests. The per cent of variation in the data explained by the model did not exceed 10 per cent for any site or sex.

Discussion

While the results of this study are negative, the interpretation is not easily made. Problems which complicate the interpretation are: the lack of exposure information; the use of populations as the unit of study; migration within the US; other sources of asbestos; and the presence of epidemiologic features other than asbestos which could modify cancer mortality.

No measurements of asbestos exposure to individuals have been taken by us in the study or in control counties. We assumed that if there were asbestos deposits present, then there would be an elevated exposure. If in fact the presence of asbestos deposits does not lead to elevated exposure to asbestos, then no excess mortality should be seen.

We have used as our unit of study the population of counties with asbestos deposits and concerned ourselves with population mortality rates. There are many problems in making inferences about the risks to an individual in a county. For example, the general exposure of the population in the study counties can be very small, but a few individuals can have increased exposure, in which case the population hazard need not reflect individual hazard. The elevated individual hazard would in this case not necessarily be detected.

Finally, other factors of etiological significance have not been included in this study. It is possible that adjustment for these factors might allow the detection of asbestos' effect but sufficiently detailed information on smoking, alcohol, food, air, water, etc., are not available.

This study provides no evidence that naturally occurring asbestos deposits provide a great risk to the general population of counties with asbestos deposits.

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SEX, BIRTH ORDER, AND MATERNAL AGE CHARACTERISTICS OF INFANTS WITH CONGENITAL HEART DEFECTS

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Rothman, K. J. and Fyler, D. C. (Department of Epidemiology, Harvard School of Public Health, Boston, MA 02115). Sex, birth order and maternal age characteristics of infants with congenital heart defects. *Am J Epidemiol* 104:527-534, 1976.

The records of the New England Regional Infant Cardiac Program, a service program covering all of New England, provide a useful source of information about the characteristics of children born with congenital heart defects. Data were analyzed on more than 2000 children born in New England who were diagnosed with a congenital heart defect before the first birthday. Children with arterio-venous fistula, aortic stenosis, transposition of the great arteries or hypoplastic left ventricle were predominantly male; children with persistent ductus arteriosus and endocardial cushion defect were predominantly female. Positive trends in risk with increasing birth order were present for pulmonic stenosis and transposition of the great arteries, and a negative trend was seen for persistent ductus arteriosus. What evidence there was for associations with maternal age was greatly reduced after controlling for confounding by birth order.

aortic diseases; aortic valve stenosis; arterio-venous fistula; heart defects, congenital

The New England Regional Infant Cardiac Program (NERICP) is a service program designed to provide medical care for all infants with serious congenital heart disease born in New England (1). The population coverage and centralized record-keeping provide the equivalent of a regional registry of congenital heart disease. In a previous report (2) we used these data to describe the associations of congenital heart defects with season and with population density. In this paper we present the sex, birth order and maternal age characteristics of infants with congenital heart defects.

Subjects and Methods

Enrollment of patients into the NERICP began July 1, 1968, and 2336 children under one year of age born in New England with serious cardiac defects were enrolled by June 30, 1974. When the program

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Abbreviations: NERICP, New England Regional Infant Cardiac Program; TGA, transposition of the great arteries.

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The authors express their gratitude to the many individuals whose cooperative efforts make NERICP successful. Participating centers in NERICP are the pediatric divisions of the following hospitals: Hartford Hospital and St. Francis Hospital, Hartford; Yale-New Haven Hospital, New Haven; Maine Medical Center, Portland; Boston City Hospital, Boston Floating Hospital for Infants and Children, Children's Hospital Medical Center, Massachusetts General Hospital, Boston; Dartmouth-Hitchcock Medical Center, Hanover; Rhode Island Hospital-Brown University, Providence; Medical Center Hospital of Vermont (Mary Fletcher Unit), Burlington.

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