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Health Effects of Asbestos Exposure among Pearl Harbor Naval Shipyard Workers

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Status Report
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ATTACHMENT 4(d)

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1. Introduction

During the period since our last report on this study, we have completed the followup on the retrospective cohort to January 1, 1974. In addition, we have begun the collection of smoking histories on the prospective cohort. Details of these activities, the results of preliminary data analyses, and our plans for the coming months are included in the present report.

2. Retrospective Study

The retrospective study is a followup study on a cohort of shipyard workers at the Pearl Harbor Naval Shipyard (PHNS), all of whom were on the personnel rolls on January 1, 1950 or were hired subsequently through 1970. Complete job histories were collected on each individual from the records of the personnel office at PHNS. Each job or trade was classified with regard to its potential for exposure to asbestos.

a. Followup for Vital Status

The vital status of each individual as of 1 January 1974 was determined by meticulous search. This included matching the cohort against the death record files of the Hawaii Department of Health, the drivers' license file of the local police department, voters' registration lists in Hawaii, the Veterans' Administration records and the Social Security Administration files in Washington. Additional checks were made by use of local Polk's city directories, inspection of newspaper obituary columns, and personal telephone contact. These efforts have yielded a followup rate of 92% to date, which is highly satisfactory for an epidemiological study of this kind.

b. Method of Analysis

Data analysis on this cohort has begun, and preliminary findings are included here. It must be noted that these results are tentative, as we intend to evaluate the data much more completely in the next several months. Since more detailed analyses may reveal findings that conflict with those presented here, this report should not be used to answer prematurely the question of past occupational hazards at PHNS.

The first analyses have utilized a life-table method, in which observed mortality is compared with expected numbers based on the age-, sex-, and race-specific mortality experience of the general population in Hawaii for calendar-periods corresponding to those covered by the study. Analyses were performed for two groups of workers at PHNS:

(1) Men with at least one year of work history in an exposed trade (exposed group); and,

(2) Men with no (or less than one year of experience in an exposed trade (non-exposed group).

Future analyses will examine the data using other criteria for exposure, such as a minimum of five years of potential exposure.

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Note: The expected numbers for the present analysis have been generated using the general population of Hawaii as controls. This is a customary procedure in occupational cohort studies where no convenient internal control group is available. The criticism of general population controls for such studies is that working populations tend to be healthier than the general population. Thus, expected numbers of deaths are higher than they ought to be, and the chance of demonstrating an increased risk for the occupational group is reduced.

Because we have distinguished two groups in terms of exposure in the present study, we have the unusual opportunity to perform direct comparisons between exposed and non-exposed workers. This analysis will still require a life-table method because of the variable entry points and observation periods in the study. Since it will take us more time to accomplish these analyses, no results of direct comparisons can be included in this report.

c. Results

Results of the present analysis are based on 9182 men on whom followup was complete and who did not work exclusively in a few selected trades (painter, rubber worker, etc.). The data presented here are based on mortality from all causes, and from lung cancer, stomach cancer and large bowel cancer. Future analyses will include non-malignant pulmonary diseases, all cancers, and other site-specific cancers.

Table 1 shows the distribution of the cohort by age and calendar year of entry. It can be seen that more than 50% of the workers entered during the first 5-year period of the study. It should be noted, however, that although persons who left employment prior to 1950 were not included in the study (the personnel office had disposed of their records), the actual cohort members could have begun their employment prior to 1950. Thus, in any computations of duration of exposure, work history information that ante-dates the onset of the unbiased period of observation is included.

Table 2 presents data based on mortality from all causes. As expected, the results for the unexposed group show risk ratios less than unity for all 5 racial groups. Since the risk ratios for the exposed group are comparably low, the data offer no evidence for any adverse effect on total mortality from asbestos exposure at PHNS.

Tables3 and 4 include data for lung cancer. Table 3 shows the race-specific risk ratios for lung cancer in both exposed and non-exposed workers. Although the overall risk ratio is higher for the exposed than for the non-exposed group, neither ratio differs significantly from unity, under the assumption of a Poisson distribution. If the risk ratio for the exposed group is adjusted upward, based on the less than unity risk for the unexposed group, the ratio becomes 1.2. This ratio is still not significantly different from unity.

Table 4 shows the relative risks for lung cancer in this population, based on the length of the period of followup. There is a clear pattern of increasing risk in the exposed group as the period of followup lengthens. This is consistent with the reported latency period of >15 years for lung cancer.

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[illegible] followup is still not statistically significant. The non-exposed group shows no consistent pattern. Nevertheless, the risk for the <10 year group is elevated (1.45), suggesting perhaps that there may be some inaccuracy in our classification of trades with respect to asbestos exposure. Alternatively, since smoking has not been accounted for, this group could have included a relative excess of heavy smokers.

The lack of smoking data is, of course, the main weakness with these analyses, and is the primary purpose for the prospective study in which we will have such information. We are collecting these smoking histories now, and, because of the study design, there is much overlap between the retrospective and prospective cohorts. Thus, we will be able to use these data to make some observations on the smoking patterns in the retrospective cohort. Furthermore, we have collected smoking data on a representative sample of the general population of Hawaii (as part of another research project), and these data can be compared with the data from the PHNS cohort. For example, we will be able to compare the distribution by smoking category in the two populations (non-smoker, light smoker, heavy smoker, etc.) as one measure of the reasonableness of the use of general population controls in these analyses.

Tables 5 and 6, and Tables 7 and 8 present data for stomach and large bowel cancer, respectively. Some previous studies have shown an association between gastrointestinal cancers and asbestos exposure. No statistically significant associations between either of these cancers and exposure to asbestos at PHNS emerge from the present data.

d. Conclusion

These results do not show a significant risk for general mortality or for cancer in the PHNS population employed in 1950 or later. However, the latency period for cancer is long, and the mean duration of followup to date is less than 20 years. In this regard, the data for lung cancer do suggest that exposed individuals with more than 20 years of followup may have an increased risk, although the magnitude of the increase is not great. The validity of these findings will be strengthened when we have made direct comparisons between the exposed and non-exposed cohorts, and when we have analyzed the data using stricter criteria to define exposure.

3. Prospective Study

The prospective cohort study will follow a group of about 6,000 men on whom smoking histories have been collected. This will enable us to evaluate health risks in the shipyard workers in relation to their smoking status. Furthermore, it will enable us to study the relationship of smoking to asbestos exposure in the occurrence of lung cancer (a synergistic relationship has been reported). The prospective cohort consists of all living members of the retrospective cohort who also reside in Hawaii.

a. Identification of the Cohort

The cohort has been identified as part of the followup activities for the retrospective cohort. Two component groups of the prospective cohort have been

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formerly employed at PHNS. The latter group includes 3910 men, and the former about 3,000 men.

b. Collection of Smoking Data

A questionnaire form which includes smoking data and additional information about occupational exposures was included in the original proposal for this study (preliminary form) and in the last status report (final form). We began mailing out these questionnaires to former PHNS employees several month ago. We have completed two mailings at this time, with an overall response rate of about 40%. Our plan is to provide at least one more mailing, and then to follow up with personal contacts so that we can achieve a participation rate of 65% or more.

We have not yet been able to acquire this information from the current employees, since the present Command at PHNS has reservations about a portion of the questionnaire dealing with other occupational exposures (not necessarily at PHNS). When a decision has been reached on this matter, we will be able to proceed.

4. Future Plans

During the next several months, we hope to complete our analyses on the retrospective cohort. Because most of the men in this cohort are only now entering the high risk ages for cancer, it will be desirable to continue the followup on this group for re-analysis at a later date.

We hope to begin collecting smoking histories from the current employees at PHNS in the near future. When the data collection has been completed, we will initiate our followup activities on the prospective cohort. For this, we will rely heavily on the Hawaii Tumor Registry (HTR) which collects data on all incidence cases of cancer in the state. We have maintained compatibility between our files and those of the HTR, so that most of this matching can be achieved by computer. For other non-cancer illnesses, we will match our cohort against the mortality files of the Department of Health.

5. Air Sampling for Asbestos

During recent ripout operations at the shipyard, air measurements for asbestos were made in the direct vicinity of the work, as well as upwind and downwind from the ship. No detectible levels of asbestos were found. Thus, there does not appear to be any risk from exposure to asbestos at the shipyard at the present time.

6. Summary of Activities

This study is progressing satisfactorily. We are now actively analyzing the data from the retrospective cohort and hope to complete these analyses over the next several months. The prospective cohort has been established, and smoking histories are being collected from the group of former employees at the present time. We hope to acquire the smoking histories from the current employees in the near future.

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Table 1

Distribution of Cohort by Age and Calendar Year of Entry

Age Group	Year of Entry 1950-54	1955-59	1960-64	1965-69	1970-74	Total
15-19	64	82	216	424	1	787
20-24	577	246	445	836	20	2074
25-29	1195	188	206	372	18	1979
30-34	1005	83	92	168	4	1352
35-39	737	41	86	142	3	1009
40-44	557	23	86	187	6	859
45-49	367	24	61	140	3	595
50-54	187	17	30	86	3	323
55-59	102	5	13	46	2	168
60-64	14	3	4	8	1	30
65-69	1	0	2	3	0	6
Total	4756	712	1241	2412	61	9182

Table 2

Observed and Expected Deaths from All Causes
by Exposure Category and Race

Exposure Category		Race					
		Caucasian	Japanese	Chinese	Filipino	Hawaiian	Total
EXPOSED	Observed deaths	192	14	35	47	93	381
	Expected deaths	293.71	31.63	68.41	89.31	167.35	650.41
	Risk Ratio	0.65	0.44	0.51	0.53	0.56	0.59
	N	(1561)	(904)	(709)	(712)	(894)	(4780)
NON-EXPOSED	Observed deaths	148	16	44	23	64	295
	Expected deaths	186.41	29.46	57.67	44.75	82.08	400.37
	Risk Ratio	0.79	0.54	0.76	0.51	0.79	0.74
	N	(1419)	(920)	(634)	(441)	(597)	(4011)

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Table 3

Observed and Expected Deaths from Lung Cancer by Exposure Category and Race

Exposure Category		Race					
		Caucasian	Japanese	Chinese	Filipino	Hawaiian	Total
EXPOSED	Observed	20	0	2	0	13	35
	Expected	15.09	1.09	3.40	2.48	11.82	33.88
	Risk Ratio	1.33	0.0	0.59	0.0	1.10	1.03
	N	(1561)	(904)	(709)	(712)	(894)	(4780)
NON-EXPOSED	Observed	8	0	1	1	7	17
	Expected	9.49	1.03	2.65	1.21	5.26	19.64
	Risk Ratio	0.84	0.0	0.38	0.83	1.33	0.87
	N	(1419)	(920)	(634)	(441)	(597)	(4011)

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Table 6

Observed and Expected Deaths from Stomach Cancer by Duration of Followup

Exposure Category	No. of years of followup	Observed Deaths	Expected Deaths	Risk Ratio
Exposed	<10	2	4.6	0.43
	10-19	5	7.1	0.70
	≥20	2	3.2	0.63
Non-exposed	<10	2	3.4	0.59
	10-19	1	4.1	0.24
	≥20	4	1.8	2.22

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Table 7

Observed and Expected Deaths from Large Bowel Cancer by Exposure Category and Race

Exposure Category		Race					
		Caucasian	Japanese	Chinese	Filipino	Hawaiian	Total
EXPOSED	Observed	3	1	1	2	1	8
	Expected	5.51	0.82	2.28	1.77	1.75	12.13
	Risk Ratio	0.54	1.22	0.44	1.13	0.57	0.66
	N	(1561)	(904)	(709)	(712)	(894)	(4780)
NON-EXPOSED	Observed	4	0	2	1	0	7
	Expected	3.43	.77	1.89	0.87	0.81	7.77
	Risk Ratio	1.17	0.0	1.06	1.15	0.0	0.90
	N	(1419)	(920)	(634)	(441)	(597)	(4011)

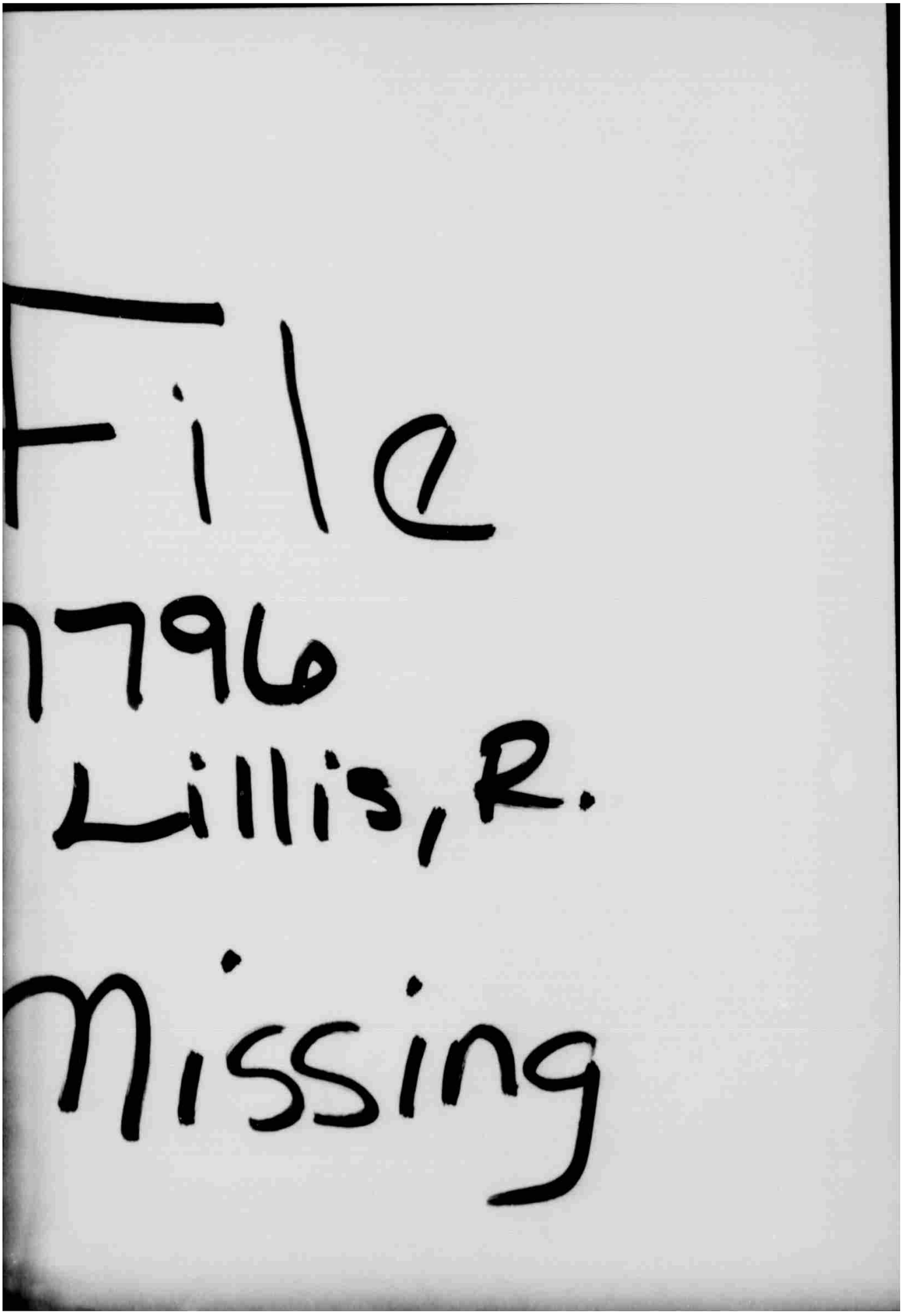
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Table 8

Observed and Expected Deaths from Large Bowel Cancer by Duration of Followup

Exposure Category	No. of years of followup	Observed Deaths	Expected Deaths	Risk Ratio
Exposed	<10	1	2.6	0.38
	10-19	4	5.9	0.68
	≥20	2	3.2	0.63
Non-exposed	<10	0	2.3	0.0
	10-19	5	3.6	1.39
	≥20	3	1.7	1.76

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