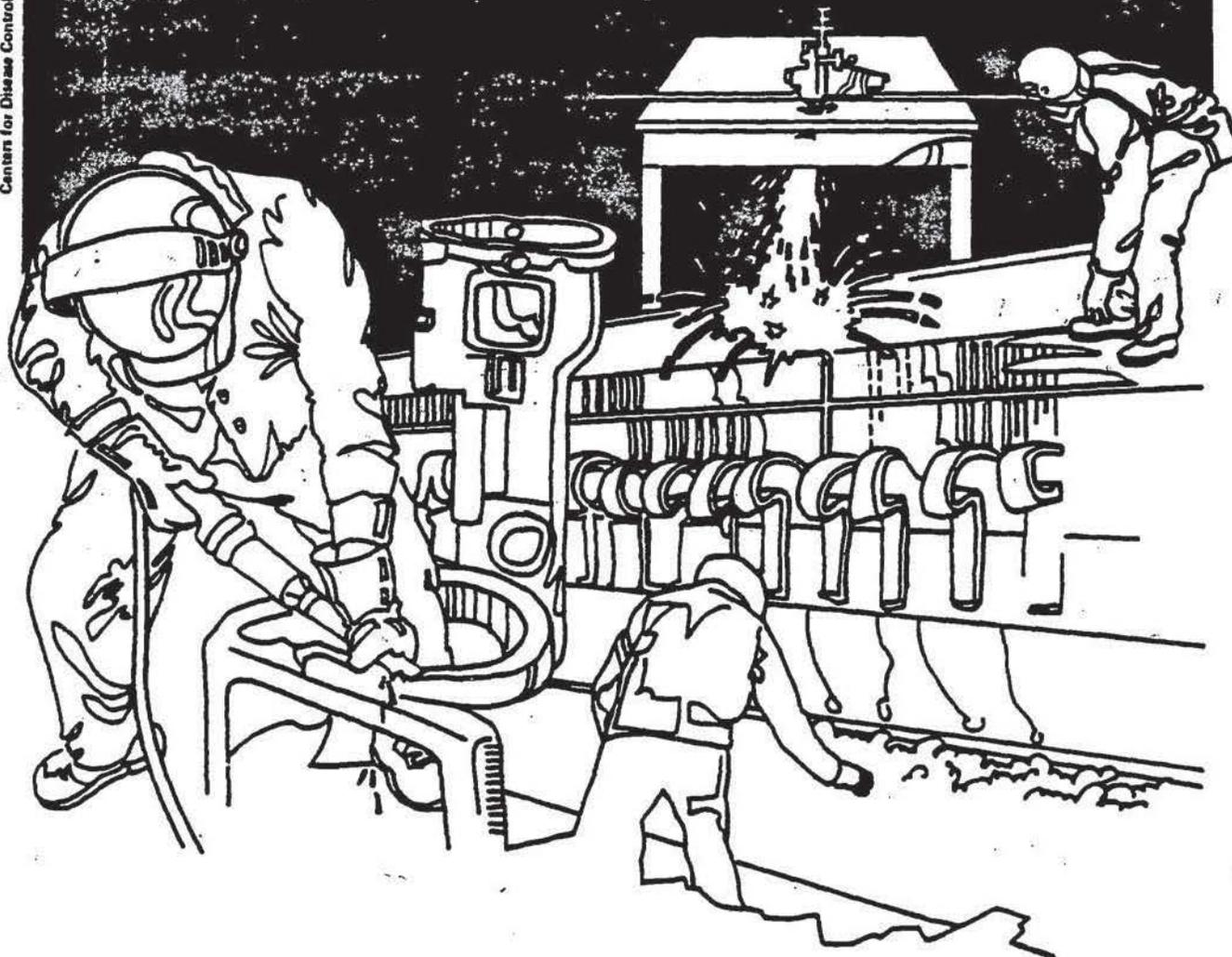


NIOSH



Health Hazard Evaluation Report

HETA 81-025-1668
OPERATIVE PLASTERERS' AND CEMENT
MASONS' INTERNATIONAL ASSOCIATION
WASHINGTON, D.C.

PREFACE

The Hazard Evaluations and Technical Assistance Branch of NIOSH conducts field investigations of possible health hazards in the workplace. These investigations are conducted under the authority of Section 20(a)(6) of the Occupational Safety and Health Act of 1970, 29 U.S.C. 669(a)(6) which authorizes the Secretary of Health and Human Services, following a written request from any employer or authorized representative of employees, to determine whether any substance normally found in the place of employment has potentially toxic effects in such concentrations as used or found.

The Hazard Evaluations and Technical Assistance Branch also provides, upon request, medical, nursing, and industrial hygiene technical and consultative assistance (TA) to Federal, state, and local agencies; labor; industry and other groups or individuals to control occupational health hazards and to prevent related trauma and disease.

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FEBRUARY 1986
OPERATIVE PLASTERERS' AND CEMENT
MASONS' INTERNATIONAL ASSOCIATION
WASHINGTON, D.C.

NIOSH INVESTIGATORS:
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I. SUMMARY

In October 1980, the Operative Plasterers' and Cement Masons' International Association requested that the National Institute for Occupational Safety and Health (NIOSH) conduct a mortality study of the Union's members.

Utilizing the Union's Death Benefit Listing as a data base, copies of certified death certificates for all beneficiaries for the period 1974-1980 were obtained from the Union. The study population, numbering 3699, included all white males who could be identified from that Listing, and who died anywhere in the U.S., with the exception of New York City.

Using these data, NIOSH first conducted a Proportionate Mortality Ratio study (PMR), to determine whether one or more causes of death accounted for an excess proportion of deaths among the Union members during that time period. Subsequently, a Proportionate Cancer Mortality Ratio study (PCMR), was conducted.

Results of the PMR study indicated an excess proportion of deaths due to the category All Cancers Combined (PMR = 1.36, $p < 0.01$), distributed across a number of specific cancer sites.

Upon performing the PCMR, the only statistically significant excess proportion of deaths was due to Cancer of the Trachea, Bronchus, and Lung (PCMR = 1.20, $p < 0.01$).

It has been reported that many Union members, particularly plasterers, have worked with asbestos in the post- World War II years. It is believed that this exposure to asbestos accounted for at least part of the excess proportion of deaths attributed to Cancer of the Trachea, Bronchus, and Lung.

As can best be determined, current potential exposure to asbestos occurs only during renovation work which involves the removal of asbestos-containing materials (ACM). Such work should be performed employing the work practices outlined in the Environmental Protection Agency's publication, Guidance for Controlling Asbestos-Containing Materials in Buildings, EPA 560/5-85-024.

On the basis of data collected in this evaluation, it was determined that a potential health hazard existed for members of the Union, due at least in part to their work with asbestos. Any renovation work, performed henceforth, should employ work practices which prevent potential exposure to asbestos.

KEYWORDS: Lung cancer, asbestos, Proportionate Mortality Ratio, PMR, Proportionate Cancer Mortality Ratio, PCMR.

II. INTRODUCTION

In October 1980, the Operative Plasterers' and Cement Masons' International Association requested that NIOSH conduct a mortality study of the Union's members.

Utilizing the Union's Death Benefit Listing as a data base, copies of certified death certificates for all beneficiaries for the period 1974-1980 were obtained from the Union.

Using these data, NIOSH first conducted a Proportionate Mortality Ratio study (PMR), to determine whether one or more causes of death accounted for an excess proportion of deaths among the Union members during that time period. Subsequently, a Proportionate Cancer Mortality Ratio study (PCMR), was conducted.

An interim report, with preliminary results of these studies, was distributed in April 1985.

III. BACKGROUND

The Operative Plasterers' and Cement Masons' International Association is a trade union, affiliated with the AFL-CIO. The plasterers and cement masons it represents work in a wide range of projects, from highway construction, to new construction of commercial buildings and of residential buildings, to renovation work, to free-lance work.

For an individual union member, the only work history information which exists is a record of the date in which the person was first registered in the International, and the date and local union number each time he transferred locals. In most instances, the death certificate has a record of "usual occupation", generally listed as "plasterer" or "cement mason". No information exists as to what construction projects a person worked on, or what materials he worked with.

Little information concerning work materials and possible exposures exists for the trade as a whole. It is known that asbestos has been used in the trade. This use was greatest during the 30 years following World War II. Asbestos was used in fireproofing materials, to be sprayed onto beams in commercial construction. Because asbestos was inexpensive, it was also widely used as a filler in many plaster formulations. No quantitative asbestos exposure data exist for those workers during that period¹.

IV. EVALUATION DESIGN and METHODS

Utilizing the Union's Death Benefit Listing as a data base, copies of certified death certificates for all beneficiaries for the period 1974-1980 were obtained from the Union. The study population included all white males who could be identified from that Listing, and who died anywhere in the U.S., with the exception of New York City. New York City deaths were excluded because: there was difficulty in obtaining a number of those death certificates; it was felt that a high percentage of those workers were first generation immigrants, and that it would be of questionable accuracy to use U.S. death rates for comparison; and there would still be a sufficiently large number of study participants remaining to allow the study to have the statistical power to detect relatively small excesses of death.

Once obtained, the death certificates were sent to a nosologist. Cause of death was classified according to the International Classification of Disease revision in effect at the time of death.

Mortality patterns were then investigated using a Proportionate Mortality Ratio study (PMR). PMR studies do not assess each cause of death independently, but rather, assume an overall death rate equal to one. They look at the proportion of deaths attributable to specific causes or groups of causes. The PMR study was done using a NIOSH computer program which used the proportions of cause specific deaths for U.S. white males for comparison. Since the proportions of deaths due to specific causes have changed over the years, and are different for young people as compared to older people, the ratios were calculated for specific five year age and five year calendar time periods.

Cause, time, and age specific proportions of deaths from the comparison group were applied to the total number of deaths in the study population, yielding the number of expected cases. The data were assumed to follow a Poisson distribution, with a mean equal to the expected number of deaths for a specific cause. A two-tailed p value less than 0.05 was required for statistical significance.

After performing the PMR study, we conducted a Proportionate Cancer Mortality Ratio study (PCMR). The procedure was the same as that described for the PMR, except that only proportions of deaths from cancer were considered. This procedure helps correct for some potential biases which are often encountered in PMR studies. Again, cause, age, and time specific proportions for U.S. white males served as comparisons.

In addition to performing the PMR and PCMR analyses on the entire study population, we divided the group by death certificate indication of

usual occupation, in an attempt to identify those subgroups who might be at highest excess risk.

We also divided the number of study participants into quartiles based upon date of first employment, in an attempt to account for changes in the formulae of materials, or changes in work practices.

Finally, we divided each of the four groups by usual occupation, and calculated PCMRs for the plasterers and for the cement masons within each of the four time periods.

V. RESULTS

A total of 3699 deaths met the study definition of white males who died between 1974 and 1980 and who were in "good standing" in the Union at the time of death. Of these, 1401 were plasterers, 1749 were cement masons, and the remaining 549 were miscellaneously classified.

Statistically significant Proportionate Mortality Ratios (PMRs) included: a deficit of Diseases of the Circulatory System (mostly heart attacks, $PMR = 0.90$, $p < 0.01$); a deficit of Diseases of the Nervous System (mostly strokes, $PMR = 0.78$, $p < 0.01$); and an excess of death due to All Cancers ($PMR = 1.36$, $p < 0.01$) (Table I).

We then looked more closely at selected categories of cancer (Table II). Those found to be at significant excess were: Cancer of the Digestive Organs and Peritoneum; Cancer of the Respiratory System; Cancer of the Brain and other Nervous System; and Cancer of Other and Unspecified Sites.

Of the Cancers of the Digestive System, the stomach accounted for 44 of the deaths, and was the only site which approached statistical significance, with a p value just above 0.05 for the PMR of 1.37.

Within the Respiratory System, 409 of the 422 deaths were Cancer of the Trachea, Bronchus, and Lung (primarily lung cancer), $p < 0.01$ for the PMR of 1.64.

Subsequently, a Proportionate Cancer Mortality Ratio study (PCMR) was performed. The excesses which were observed in the PMRs for Digestive Cancers generally, or for Stomach Cancer specifically, did not persist once their PCMRs were calculated.

Looking at the PCMRs for specific causes of cancer, we found that Cancer of the Respiratory System remained at significant excess (PCMR = 1.17, $p < 0.01$). As before, most of those cases were Cancer of the Trachea, Bronchus, and Lung (Table III).

Cancer of the Brain and Other Nervous System still occurred in excess proportion, though it was no longer statistically significant.

For Cancer of the Digestive Organs and Peritoneum, there was no longer any excess proportion of deaths.

We then looked separately at the PCMRs for plasterers and for cement masons. The PCMR for Cancer of the Brain and other parts of the Nervous System, for the whole population, was 1.27, but not statistically significant. Dividing the cohort by occupation, neither the plasterers nor the cement masons had a statistically significant excess (Table IV).

Looking at cancers of the Trachea, Bronchus, and Lung, we found only plasterers still with a significant excess proportion of deaths (PCMR = 1.34, $p < 0.01$, Table V).

Figure VI illustrates the PCMRs for Cancer of the Brain and Other Parts of the Nervous System, divided now both by usual occupation, and by year of first employment in the Union. The PCMRs show no apparent relationship to occupation, though there appears to be a relationship to year of first employment. The proportion of deaths due to brain cancer seems to be greatest for those who began work in the early part of the century.

Figure VII illustrates the PCMRs for Cancer of the Trachea, Bronchus, and Lung, also divided by usual occupation, and by year of first employment in the Union. Here, the PCMR for plasterers exceeded that of cement masons for all time periods. However, the PCMRs did not show any clear relationship to year of first employment.

VI. DISCUSSION, CONCLUSIONS, and RECOMMENDATIONS

Before discussing the study's results, further explanation of the choice of study design is warranted.

The type of mortality study often preferred is a Standardized Mortality Ratio (SMR) study. The advantage of an SMR is that it examines, on a cause-by-cause basis, whether people in the study group are dying at an increased rate, compared to the general population. In order to conduct such a study, it is necessary to have available basic demographic information on all members of the group under investigation, not merely those members who have died.

Because we only had information on those members of the Union who appeared in the Union's Death Benefit Listing, we were unable to perform an SMR analysis. We, therefore, chose to perform a Proportionate Mortality Ratio (PMR) analysis. As mentioned in Section IV of this report, PMR studies do not assess each cause of death

independently, but rather, assume that the study population, overall, is dying at the same rate as the general (or comparison) population. In a PMR study, one then looks at the proportion of deaths attributable to specific causes, or groups of causes. The potential problem in a PMR study is that, when one or more cause of death accounts for a lower than expected proportion of deaths, that deficit must be matched by an equivalent excess, residing in one or more other death category. One must then question whether an apparent excess is an artifact, or whether it is real, and attributable to specific agents or factors.

To further complicate matters, in mortality studies of industrial populations, a so-called "healthy worker" effect is often observed. The "healthy worker" effect is a phenomenon whereby working populations are frequently healthier than the general population. This is because, for example, a person with a heart condition is less likely to be able to get a job as a worker in a demanding trade, like construction. Therefore, we would expect to see less deaths due to heart attacks, and possibly strokes, in a working population than we would in the general population. In this study, we found a PMR of 0.90 for Diseases of the Circulatory System, with a resultant deficit of 171 deaths in that category (Table I). However, because in a PMR study that deficit must be matched by an excess in some other category(s) of death, it is not clear whether the PMR of 1.20 for Cancer of the Digestive Organs and Peritoneum (or any of the other excesses, for that matter [Table II]), is a real excess, or if it is due partially to the deficit residing in the Diseases of the Circulatory System and/or Diseases of the Nervous System.

Since, in our PMR study, there was an apparent excess of cancer mortality, we subsequently performed a Proportionate Cancer Mortality Ratio (PCMR) analysis, as a means of verifying the excess with greater accuracy. In a PCMR analysis, one assumes the group is dying of cancer at a rate equal to the general population, and one looks specifically at the proportion of cancer deaths due to each specific cancer site (ie. cancer of the lung, brain, etc.) Since any carcinogen affects only one, or a few, body sites, one would expect that, even if there is one (or a few) cancer-causing agent(s) affecting a population, the result will be an excess of cancer at those few target organs, not an excess of cancer at every site.

As described in Section V of this report, the only site at statistically significant excess for the PCMR study was the category of Cancers of the Trachea, Bronchus, and Lung. With a PCMR = 1.20, this accounted for an excess of 68 deaths (Table III). The majority of this excess (46 deaths, Table V) occurred among people who worked as plasterers, according to information obtained from the death certificates.

When the cohort was divided into quartiles by year of first employment in the Union, plasterers maintained a greater excess of death due to Cancers of the Trachea, Bronchus, and Lung across all four time periods.

The limited work information which was available implicates asbestos as being the most likely source of the lung cancer excess. In the post-World War II period, asbestos was widely sprayed as a fireproofing material in commercial construction. Additionally, because it was inexpensive and because of its physical characteristics, it was often used as a filler in plastering formulations. Sometimes the asbestos was added by the manufacturers of the plaster, other times a small amount of asbestos fibers were added to each sack of Portland Cement at the job site, in order to prevent aggregate separation in the plaster². Both fireproofing and plastering are jobs which are more likely performed by plasterers than by cement masons.

Asbestos has been widely described as a carcinogen. Sites for which there is extensive evidence of carcinogenicity in humans are the lung, pleura, and peritoneum. There is less conclusive evidence that asbestos causes cancer of the larynx, large bowel, prostate, and stomach³. Mortality studies of defined populations of asbestos-manufacturing, insulating, and shipyard workers have provided the most concrete evidence concerning the association between bronchial cancer, pleural and peritoneal mesotheliomas and exposure to asbestos. Reports have come from several countries, including Britain^{4, 5}, West Germany⁶, Italy⁷, the Netherlands⁸, and the U.S.A.⁹.

While there were not comparison proportions of mortality available for cancer of the pleura or peritoneum for our study, these causes of death are extremely rare, and are almost always attributable to asbestos exposure. In our study, we found six cases of cancer of the pleura, and two cases of cancer of the peritoneum. Five people were also diagnosed as having died due to asbestosis.

The possibility that cigarette smoking caused the lung cancer excess was considered. While cigarettes certainly accounted for some of the deaths, it is unlikely that it caused the excess. There is no reason to believe that members of the Union smoked more than did the general population. A higher rate of smoking would presumably result in an increased proportion of other causes of death which have been attributed to cigarettes. However, such an excess was not found when two categories of death, which have been associated with smoking, were examined. There was a deficit of mortality due to Diseases of the Circulatory System (PMR = 0.90, $p < 0.01$). Looking at Non-Malignant Diseases of the Respiratory System, there was not a significant excess observed (PMR = 1.05, $p > 0.05$) (Table I).

A weakness of this study is the inability of the NIOSH investigators to obtain detailed individual work histories. It was also difficult to obtain substantial information about work processes and materials content for the trade as a whole. Information of this nature could potentially make it possible to delineate which sub-group of the Union (i.e., by job, location, time period, etc.) was at greatest risk of dying of lung cancer. Even without that information, certain recommendations can be made to assist current and future workers in the trade. It is known that materials currently used by plasterers and cement masons do not contain asbestos. However, for jobs which entail renovation or rehabilitation ("re-habbing"), rather than new construction, it is imperative that the old materials being removed first be assessed as to their status as asbestos-containing materials (ACM). Where the original construction occurred between World War II and the early-to-mid-1970's, there is a good chance that some ACM were used. When the presence of ACM is known or suspected, it is imperative that strict precaution be taken, and that specific work practices be followed. Given the wide range of conditions encountered, it is impractical to delineate all the scenarios with their respective recommendations. An excellent reference which provides this information is published by the U.S. Environmental Protection Agency. It is publication EPA 560/5-85-024, Guidance for Controlling Asbestos-Containing Materials in Buildings.

A final recommendation concerns cigarette smoking. Many researchers have reported that there is a greatly increased risk of lung cancer among those workers exposed to asbestos who also smoke cigarettes.¹⁰⁻¹³ Each union member, therefore, should be educated about the risks of smoking, particularly in combination with exposure to asbestos.

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VIII. AUTHORSHIP AND ACKNOWLEDGEMENTS

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IX. DISTRIBUTION AND AVAILABILITY OF REPORT

Copies of this report are currently available upon request from NIOSH, Division of Standards Development and Technology Transfer, Publications Dissemination Section, 4676 Columbia Parkway, Cincinnati, Ohio 45226. After 90 days, the report will be available through the National Technical Information Service (NTIS), 5285 Port Royal, Springfield, Virginia 22161. Information regarding its availability through NTIS can be obtained from NIOSH Publications Office at the Cincinnati address. Copies of this report have been sent to:

1. Operative Plasterers' and Cement Masons' International Assoc.
2. Workers' Institute for Safety and Health
3. NIOSH, Region III
4. OSHA, Region III

For the purpose of informing affected employees, copies of this report should be distributed as widely as possible by the International, to all local unions.

TABLE I

PMRs for SELECTED DEATH CATEGORIES

<u>DEATH</u> <u>CATEGORY</u>	<u>OBSERVED</u> <u>DEATHS</u>	<u>EXPECTED</u> <u>DEATHS</u>	<u>PMR</u>
ALL CANCERS	1036	760	1.36**
NON-MALIGNANT DISEASES OF:			
NERVOUS SYSTEM	247	317	0.78**
CIRCULATORY SYSTEM	1570	1741	0.90**
RESPIRATORY SYSTEM	293	278	1.05
DIGESTIVE SYSTEM	115	98	1.17
ACCIDENTS	113	137	0.82*
ALL OTHER & NON-SPECIFIED			
DISEASES	325	368	0.88*

* p <0.05

**p <0.01

TABLE II

PMRs FOR SELECTED CATEGORIES OF CANCERS (CA)

CAUSE OF <u>DEATH</u>	OBSERVED <u>DEATHS</u>	EXPECTED <u>DEATHS</u>	<u>PMR</u>
ALL CANCERS	1036	760	1.36**
CA of DIGESTIVE ORGANS & PERITONEUM	251	208	1.20**
STOMACH	44	32	1.37
OTHER	207	176	1.18*
CA of RESPIRATORY SYSTEM	422	261	1.61**
TRACHEA, BRONCHUS, and LUNG	409	248	1.64**
OTHER	13	13	1.00
CA of MALE GENITAL ORGANS	89	80	1.10
CA OF URINARY ORGANS	46	45	1.01
CA of BRAIN and OTHER NERVOUS SYSTEM	29	16	1.76**
A of LYMPHATIC and HAEMATOPOIETIC TISSUE	80	65	1.23
CA of OTHER and UNSPECIFIED SITES	119	85	1.40**

* p <0.05

**p <0.01

TABLE III

PCMRs for SELECTED CATEGORIES of CANCERS (CA)

CAUSE OF <u>DEATH</u>	OBSERVED <u>DEATHS</u>	EXPECTED <u>DEATHS</u>	<u>PCMR</u>
CA of DIGESTIVE ORGANS & PERITONEUM	251	282	0.88
STOMACH	44	44	1.01
OTHER	207	238	0.87
CA of RESPIRATORY SYSTEM	422	358	1.17**
TRACHEA, BRONCHUS, and LUNG	409	341	1.20**
OTHER	13	17	0.76
CA of MALE GENITAL ORGANS	89	107	0.82
CA of URINARY ORGANS	46	61	0.74*
CA of BRAIN and OTHER NERVOUS SYSTEM	29	23	1.27
CA of LYMPHATIC and HAEMATOPOIETIC TISSUE	80	88	0.90
CA of OTHER and UNSPECIFIED SITES	119	117	1.02

* p <0.05

** p <0.01

Table IV

PCMRs for SELECTED CATEGORIES of CANCERS (CA)

PLASTERERS vs CEMENT MASONS

CA of BRAIN and OTHER PARTS of NERVOUS SYSTEM

<u>OCCUPATION</u>	<u>OBSERVED</u> <u>DEATHS</u>	<u>EXPECTED</u> <u>DEATHS</u>	<u>PCMR</u>
PLASTERERS	12	8	1.49
CEMENT MASONS	13	12	1.09

* p < 0.05

** p < 0.01

Table V

PCMRs for SELECTED CATEGORIES of CANCERS (CA)

PLASTERERS vs CEMENT MASONS

CA of TRACHEA, BRONCHUS, and LUNG

<u>OCCUPATION</u>	<u>OBSERVED</u> <u>DEATHS</u>	<u>EXPECTED</u> <u>DEATHS</u>	<u>PCMR</u>
PLASTERERS	177	131	1.34 **
CEMENT MASONS	192	167	1.15

* p <0.05

** p <0.01

FIGURE VI

CANCER of the BRAIN and OTHER PARTS of NERVOUS SYSTEM

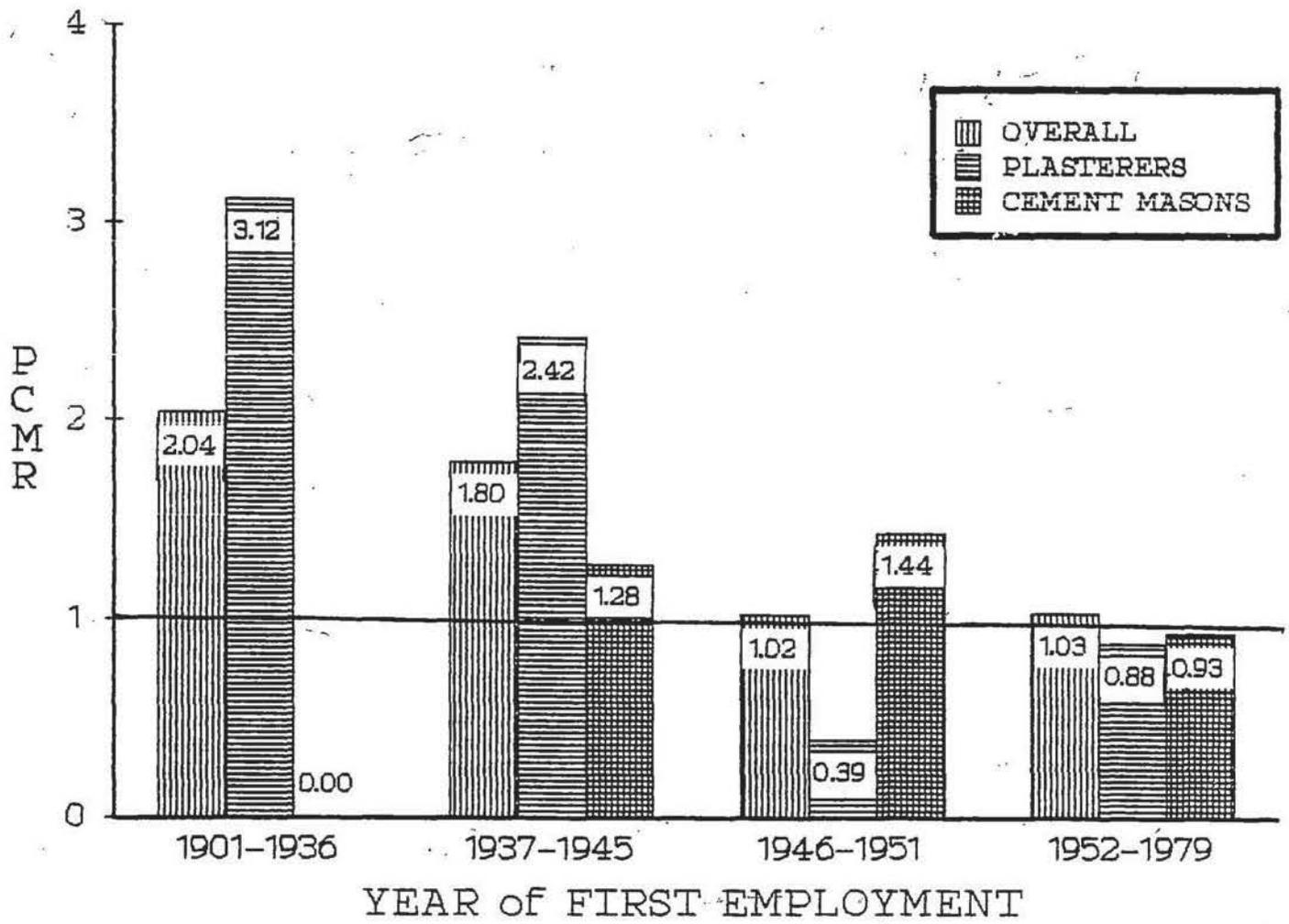
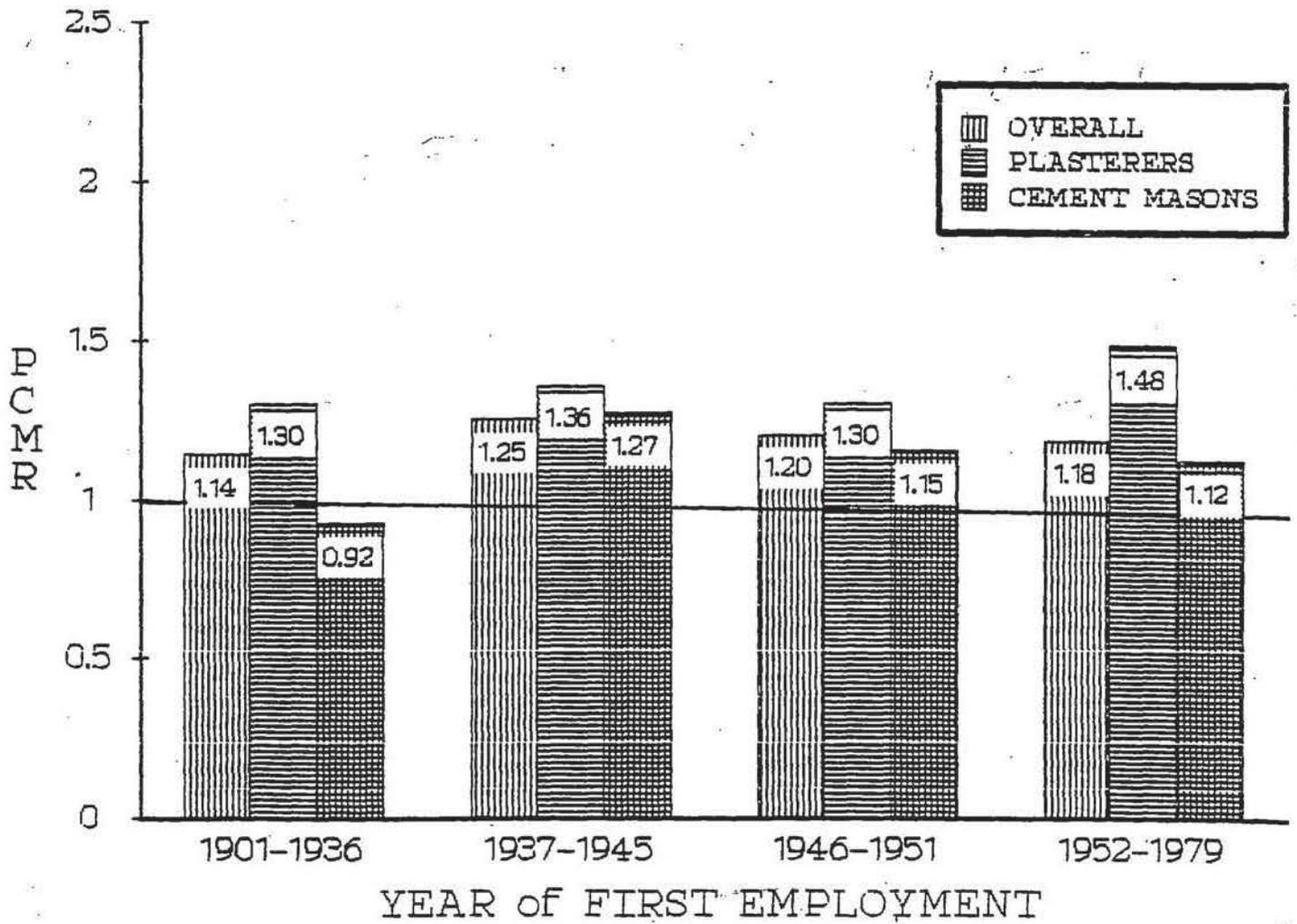


FIGURE VII

CANCER of the TRACHEA, BRONCHUS, and LUNG



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