

Final Report

INVESTIGATION OF HEALTH HAZARDS
IN THE PAINTING TRADES

Contract #210-77-0096

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16. Abstract (Limit 200 words)

A mortality survey among painters (SIC-1721) was conducted. The cohort consisted of approximately 57,000 current and former members (aged 35 to 95) of the International Brotherhood of Painters and Allied Trades in New York, California, Texas, and Missouri. Data was collected from life insurance records, the Social Security Administration, National Death Index, and the Health Care Financing Administration for 1975 through 1979. A case control study of cancer at specific sites was conducted among the union membership in New York. Mailed questionnaires were used to collect information concerning occupational exposure, smoking, dietary habits, and medical histories. The principal causes of death were cardiovascular disease and cancer. Total mortality and mortality due to cardiovascular disease were significantly less than that of the general population. Total cancer mortality was not significantly different from the general population. The case control study found that painters had a higher incidence of lung cancer and lymphatic malignancies (especially leukemia) than members involved in other trades. There was a higher rate of cigarette smoking among lung cancer patients. There was no correlation with dietary habits. The author concludes that painters may have an increased risk of lung cancer and lymphatic malignancies.

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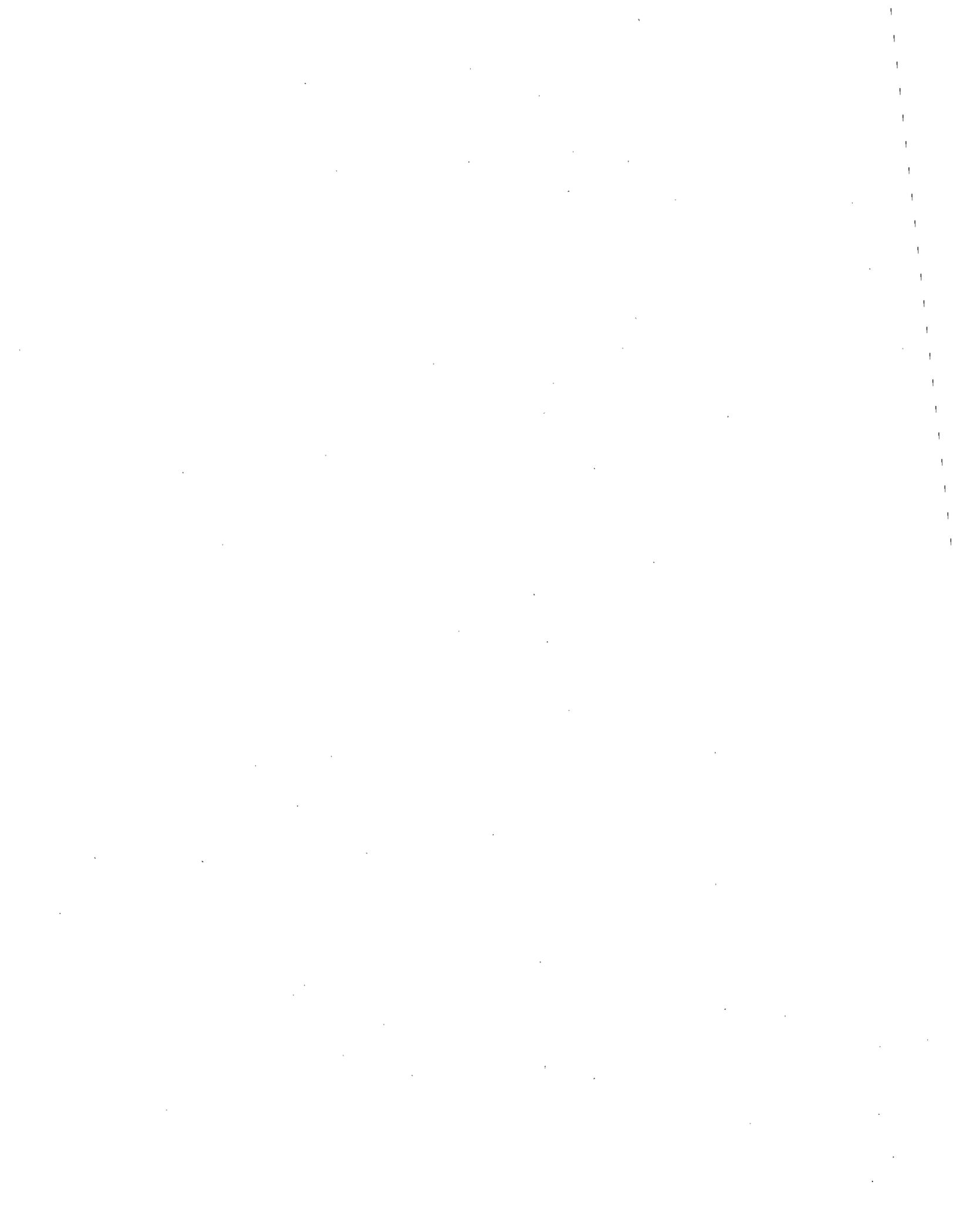
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It is our sincere hope that the information acquired through the research will help to improve the working environments and health of painters.



ABSTRACT

A cohort mortality study and a nested case-control study were conducted of the membership of a large international union of painters and allied tradesmen. The cohort study examined the mortality experience of approximately 57,000 current and former union members in four states between 1975 and 1979. The case-control studies examined the risks of cancer of selected sites among the cohort membership of New York State. A mailed questionnaire was utilized to collect information concerning occupational and exposure history, smoking and dietary characteristics, and medical information.

The results of the cohort study suggested that members of mixed locals experienced a higher mortality from lung cancer and some lymphatic malignancies than did members of specialty locals. The case-control study similarly found that painters, the majority of membership of mixed locals, experienced an increased risk of lung cancer and lymphatic malignancies compared to allied tradesmen. The data suggested that for several other cancer sites there were possible differences in risks, however further study of a larger number of cases is required before conclusions can be drawn.



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CHAPTER 1

INTRODUCTION

In 1977, the National Institute for Occupational Safety and Health (NIOSH) awarded The Johns Hopkins University a contract to study the health hazards associated with work in the painting trades. In order to focus on specific causes of health hazards, the initial plan was to conduct a detailed investigation of the use and application of paints and coatings in a variety of industrial environments. It was to include: (1) walk-through surveys to identify the sites of paint application which warranted further study; (2) in-depth industrial hygiene surveys characterizing the nature and extent of exposures in paint application environments and specific jobs within those environments; (3) in-depth epidemiologic studies, as necessary, based on the results of initial walk-through surveys; (4) in-depth medical studies, as necessary, based on the results of the in-depth industrial hygiene studies and preliminary results of in-depth epidemiologic studies.

Painters belong to a single trade group which can be employed in a large number of industrial settings. Approximately one-half million painters work in construction and maintenance painting. Approximately 180,000 additional painters are employed in a wide variety of manufacturing operations (U.S. Bureau of the Census, 1982). Although work as a painter may represent the life long trade of an individual, the exposures which painters encounter in their work may vary depending on the industrial worksite, type of painting application and many other factors. Paints themselves are not a single substance but a mixture of multiple chemicals which are most frequently classified by their basic resin system.

In the first phase of this study, through the use of production reports and marketing research data, those paint resin systems which currently have the most widespread use and those expected to have increased use in the future were identified. The major users of each resin system were then determined. The ten major industries using paint were: aircraft manufacture and repair, appliances, automobile manufacture, metal furniture and fixtures, wood furniture, railway cars, ships, truck/bus/farm equipment, construction, and maintenance painting (Matanoski GM, 1980).

Once the industries were identified, sites were selected for direct assessment. Telephone surveys were conducted, to determine eligibility for study, followed by walk-through surveys of fifty sites within the ten industries. At each plant during the walk-through surveys, study investigators examined characteristics of the workforce, availability and extent of personnel and medical records, and the nature of the painting operations (Matanoski, 1980). From the profiles generated of paint use, numbers of painters and availability of records within each of these industries, sites were then selected for further industrial hygiene, epidemiologic and medical study.

NIOSH is currently conducting industrial hygiene surveys of a number of these sites. The recommended medical surveys were beyond the cost constraints of NIOSH and were not considered further. Three industries were recommended as candidates for in-depth epidemiologic study: construction and maintenance

painting, the wood furniture industry and the aircraft industry. Construction and maintenance painting employs the majority of individuals who apply paints. The wood furniture industry was of interest due to the high proportion of painters among its workforce and the potential for exposures to a specific resin system, cellulose through spray gun application techniques. The aircraft industry was selected because of the industry's use of urethane and epoxy base paints and the potential worker exposure through the use of hand-held spray guns in the application of coatings on large equipment.

It was NIOSH's decision to include only construction and maintenance painters in the epidemiologic study. Although this group might have less variation in exposure to different paint resin systems, it was believed that enough variation would occur so that painting hazards could be adequately assessed.

Construction painters typically move from one worksite to another so that it is difficult to identify a centralized source of records. The construction trades, including painting, have traditionally been unionized trades. Therefore, union membership records provided the best mechanism for identification of a painter cohort for study. The International Brotherhood of Painters and Allied Trades (IBPAT) represents construction and maintenance painters and so the union population was selected as the focus of the epidemiologic study.

CHAPTER 2

BACKGROUND

I. PAINTS

Paint has been defined as a liquid (vehicle) containing a suspended pigment applied to a solid surface to protect and decorate it (Piper, 1972). A paint without a pigment is commonly called a varnish (Gross, 1970). In addition to adding color to a surface, pigments may provide protection against moisture, ultra-violet radiation, chemical and other damage. Pigments are supplemented by a number of additives. These additives may function as low cost fillers or may serve purposes such as altering the level of gloss in the paint or controlling the settling of the pigment (Shreve, 1977).

The vehicle typically consists of a resin, solvents and additives (Soderberg, 1969). The resin or binder is the film-forming portion of the paint. Generic paint types take their name from the resin used in their formulations. The solvents dissolve or emulsify the other materials in the vehicle and influence adhesion, durability, viscosity and drying time. Latex paints (water-based paints) consist of a dispersion of resin particles within an aqueous medium. Most resin systems can be produced in a water soluble form (Martens, 1964). A variety of different chemicals may be added to the paint to affect its properties both in the can and as a dried film. These additives may include plasticizers, driers and anti-skinning agents (Martens, 1974).

Paints have many different functions and the paint formulation selected for use will depend on the nature of the material being coated and its use. Since specific paint formulations and their components are usually protected as trade secrets, it is not possible to obtain information on the actual composition of most paint formulations. Paint manufacturers provide some information to users as Material Safety Data sheets. These sheets frequently provide limited information, frequently listing components by their trade names only.

Paints and associated coatings (varnishes, lacquers, etc.) are applied in a wide variety of settings. Most manufactured items receive a coating of paint as a step in their manufacturing process. In these industries, much of paint application is automated and the number of workers employed as painters is relatively small. Approximately seventy percent of painters are employed in either new construction or maintenance painting. In addition, construction and maintenance painters rely chiefly on handheld application techniques, such as a brush, roller or spray gun, which put the painter in direct and continuous contact with the paints being applied.

Construction painters are often a transient workforce, frequently moving from one job-site to another and one contractor to another. Despite this job mobility, these painters possess a defined skill acquired over a number of years and tend to remain at their occupation throughout their lifetime. Construction painters are also a population with a known and repeated exposure to paints. The characteristics of the job sites and the movement of the

worker frequently make it difficult to provide adequate ventilation. The use of personal protective equipment may be variable on the worksite. Thus, there is potential exposure to paints and their components as well as to materials used in other jobs at the site.

II. THE INTERNATIONAL BROTHERHOOD OF PAINTERS AND ALLIED TRADES

The International Brotherhood of Painters and Allied Trades (IBPAT) represents unionized construction and maintenance painters. IBPAT is a large international union with locals throughout the United States and Canada. The union membership in 1979 consisted of 192,642 members affiliated with 791 different union locals. The union membership consists both of painters, who comprise approximately 60% of its membership, and a number of allied building trades. These allied trades consist of groups such as glaziers, tile and linoleum layers, drywall tapers, paperhangers and paint makers. Each of IBPAT's 791 locals is classified as either "mixed" or "specialty". A "mixed" local may include members of any of these trades but the majority of the group are usually painters. A "specialty" local includes members of a single trade, such as scenic artists and paint makers. In small communities the number of locals is limited (often only one) and members of all trades are included in the mixed local. In large communities, each trade may have sufficient numbers to warrant a specialty local. In major cities, the mixed locals may consist of painters only, as each of the allied trades has formed its own specialty local.

IBPAT consists of a large number of small locals. The average membership of an IBPAT local is 200-250 members. Some have fewer than 50 members but few have more than 1000 members. Table 2-1 indicates the distribution of locals by specialty both for IBPAT as a whole and for New York state in which the case-control studies of cancer risks were conducted. A slightly higher proportion of specialty locals can be seen in New York state than in the union as a whole. Most of this excess can be attributed to the large number of specialty locals in and around New York city.

III. THE IBPAT DATA BASE

The IBPAT has computerized the membership records of all individuals who have been members of the union since 1968. These records include members who are currently active, as well as those who have retired or withdrawn from the union. Records for individuals who were members prior to 1968 are less complete, as the hardcopy records of these members were not consistently added to the computer files when the computerized record keeping system was introduced.

The computerized membership records of IBPAT contain the following information:

- i) surname and initials,
- ii) Social Security number,
- iii) birthdate,
- iv) date of joining the union,
- v) date of leaving the union,
- vi) address (if an active member), and
- vii) union activity records and associated dates.

Union activities consist of transfers between locals, fines, suspensions (up to three months), temporary absences (up to one year) and other activities related to the payment of membership dues and insurance premiums. Individuals will accrue multiple union activity records during their membership.

If an active member or a vested retiree should die, his next-of-kin becomes eligible for a one time, lump sum death benefit payment from the union. To receive this payment, the next-of-kin must submit a copy of the member's death certificate to the union. If a member leaves the union prior to retirement, life insurance benefits are not continued. The union receives no vital status information for withdrawn members. In 1974, participation in the life insurance plan became optional and some members chose to withdraw. However, a review of records of members who did terminate their policy indicates that most older members elected to remain in the life insurance plan.

The International Brotherhood of Painters and Allied Trades has made copies of its records available to the study team. These include computerized membership files, death certificates and beneficiary records for the 1975-79 study period.

TABLE 2-1
 IBPAT Locals by Trade Area
 1979

<u>Type of Local</u>	<u>All IBPAT</u>		<u>New York State IBPAT</u>	
	<u>#</u>	<u>% of Locals</u>	<u>#</u>	<u>% of Locals</u>
Mixed	531	(67.1)	37	(59.7)
Glass	112	(14.2)	6	(9.7)
Sign Painting	36	(4.6)	4	(6.5)
Carpet/Linoleum	18	(2.3)	0	(0.0)
Specialty	28	(3.5)	6	(9.7)
Paint Making	24	(3.0)	2	(3.2)
Industrial	14	(1.8)	3	(4.8)
Dry Wall Taping	9	(1.1)	1	(1.6)
Civil Service	17	(2.1)	2	(3.2)
Scenic Art	<u>2</u>	<u>(0.3)</u>	<u>1</u>	<u>(1.6)</u>
	791	(100.0)	62	(100.0)

CHAPTER 3

REVIEW OF RELEVANT LITERATURE

There are few epidemiologic studies of the mortality experience of men who work as painters. In England and Wales, the occupational mortality tables of the Registrar General provide data on occupational groups by broad disease categories (1976). National mortality statistics similar to the reports of the Registrar General are not routinely available for the United States. Several reports have, however, provided national or statewide data on the relationship between occupation and mortality among American workers.

The largest of these studies was an analysis of all deaths by occupation during 1950 (Guralnick 1963). This study, conducted by the mortality statistics section of The Department of Health, Education and Welfare, analyzed death certificate information for all deaths occurring during 1950 among men aged 20-64. A second large study, carried out on a statewide basis was a study conducted in the state of Washington (Milham 1976). Death certificate data on cause of death were analyzed for all male Washington residents aged 20 and older who died during the period 1950-71. Information on occupation was abstracted from the death certificates and proportionate mortality ratios calculated for various occupational groups.

There is no evidence from either the U.S. or U.K. data of a significant elevation in mortality from diseases of the cardiovascular system (Table 3-1). In at least one study, causes of death with significantly elevated mortality ratios for painters included tuberculosis, ulcers of the stomach, accidents, suicides, alcoholism and cancers of a variety of sites (Table 3-1). All three studies reported a significant excess mortality for cancer of the trachea, bronchus and lung. Cancer of the larynx was significantly elevated in the U.S. painters and bladder cancer was elevated in both the 1950 U.S. study and in the Report for England and Wales, although statistically significant only in the latter.

The most consistent finding of these studies was an elevated lung cancer risk among painters. In these studies based on death certificate data, it was impossible to consider the impact of additional factors, such as smoking characteristics, which are known to affect lung cancer risks. Several studies have collected smoking as well as occupational data, allowing investigators to adjust for cigarette smoking in their analyses (Table 3-2). The findings of these studies have not been consistent. A study based on over 17,000 admissions to Roswell Park Memorial Institute over the ten year period 1956-65 (Viadana 1976) reported a significantly elevated lung cancer risk among men ever exposed to paints. For men exposed to painting for five years or more the risk was elevated but not significant. After adjustment for smoking, the elevated excess risk among those ever exposed was no longer significant. The size of this adjusted relative risk is not stated.

Data from Roswell Park also reported two fold excess risk of stomach cancer among men who were painters for five years or more. The excess appeared limited to those under age 60 at time of diagnosis. For this group exposed to paints for five or more years, a 16-fold excess was observed, while no excess was observed in those 60 years of age or older.

The authors also reported a statistically significant relative risk of esophageal cancer of approximately three fold among painters. The risk was concentrated in those aged 60 and older at the time of diagnosis who had been exposed to paints for 5 or more years. For this group, the risk increased to almost seven-fold. Neither the Registrar General reports in England nor the 1950 U.S. Mortality Study reported a significant excess of esophageal cancer. An excess of prostate cancer was also observed in the Roswell Park analysis. The risk was lowest for those with five years or more exposure to paints and was not statistically significant. Although the Roswell Park study began with a very large case series, as indicated in Table 3-2 when subdivided by cancer site and exposure, the numbers became very small.

In California, Dunn (1960, 1965) followed 68,153 workers prospectively in a number of occupations, including painting, for the eight years from 1954-62 and observed their lung cancer mortality. Information on current occupation and smoking habits was obtained at the beginning of the study. After eight years of follow-up, painters exhibited a slight excess lung cancer mortality. After adjustment for smoking the risk decreased from 1.29 to 1.14. The findings suggest, as did the Roswell Park study, that smoking may account for some, if not all, the excess lung cancer risks observed.

Alternatively, the interview study of the Third National Cancer Survey (Williams 1977) reported, after adjustment for smoking, a four fold excess lung cancer risk among painters. Individuals classified as having a main lifetime occupation of painter were observed to experience a relative risk for lung cancer of 4.21. This risk estimate, adjusted for smoking and other potentially confounding factors, was statistically significant, although based on only twelve cases. A four-fold excess of leukemia and a three fold excess of Hodgkins Disease were also observed, although based on two and one case respectively. No excess of colon or rectal cancers was observed.

Additional evidence for an excess leukemia risk among painters was found in the Tri-state Leukemia study, conducted in Maryland, New York and Minnesota (Viadana 1972). This study reported a three fold excess risk of leukemia among painters. The risk was estimated at 2.8 when compared to construction worker controls and 3.1 when compared to clerical controls. There is some additional evidence of a paint and leukemia association from the benzene literature. A number of paint solvents often contain benzene as an impurity. Benzene has been shown to produce leukemias and lymphomas in rats and mice (IARC 1982). A number of case reports, some of which included painters, have suggested an association between exposure to benzene and leukemia (IARC 1982). Epidemiologic studies (Askoy 1978, McMichael 1975, Vigliani 1976) have similarly suggested an excess risk of leukemia among benzene-exposed individuals. Whether painters using solvent-containing paints receive a sufficient benzene exposure to result in an increased risk of leukemia remains to be determined.

Little evidence has been found of an association between paint exposure and an increased risk of bladder cancer. Studies by Cole (1972), Dunham (1968), Veys (1969) and Wynder (1963) have specifically investigated the relationship between bladder cancer and occupational exposures. The only supporting evidence of an association between painting and bladder cancer comes from the study by Wynder in which he reported 10 bladder cancer cases

exposed to paints for 10 years or longer compared to only 5 controls, leading to the suggestion of a greater risk of bladder cancer among painters.

There is a suggestion of an excess lung cancer risk among painters from a number of additional sources. Menck (1976) in Los Angeles County, California, reported a significantly elevated Standardized Mortality Ratio (SMR) of 158 for painters in the county. In Georgia, Harrington (1978) reported an excess relative risk of 1.46 ($.05 < p < .1$) in workers in combined chemical industries of which painters composed the largest single group. However, since workers in chemical, petroleum and rubber industries were included, they could have contributed to the lung cancer excess. A Swedish mortality study of workers in various trades reported a 25-30 percent excess mortality from cancer of the bronchus and lung among painters and allied tradesmen in that country (Englund 1980).

A British study of workers at three factories which produce lead and zinc chromate pigments (Davies 1978) observed no excess lung cancer deaths in the factory producing only lead chromate pigments, but lung cancer mortality was significantly elevated in the factories producing zinc and lead chromate pigments. A Norwegian study of similar workers in that country also indicated an excess lung cancer risk in their population (Langard 1975).

In the United States, a study of cancer mortality in counties with a high level of chemical industry reported a positive gradient of lung cancer mortality with the manufacture of paints and organic pigments (Hoover 1975). A recent mortality study of workers in 32 paint manufacturing plants (Morgan 1981) and a proportionate mortality study of spray painters in automobile assembly plants (Chiazze 1980), where workers frequently apply zinc chromate primers, reported no statistically significant excess of lung cancer among these workers. Conversely, a proportionate mortality study of spray painters at two aircraft maintenance bases (Dalager 1980) reported an almost two fold increase in proportionate mortality for lung cancer among painters employed at these bases.

I. SMOKING CHARACTERISTICS OF PAINTERS

Only two studies have collected smoking information from a population of painters; the 1970 Household Interview Survey (Sterling 1976) and Dunn's study of a number of occupational groups in California (1960, 1965). Information from the 1970 Household Interview Survey suggests that painters smoke more than most occupational groups (Table 3-3). When the smoking characteristics of various occupational groups were compared, construction and maintenance painters ranked as the third highest occupation in terms of percent of current cigarette smokers. Generally, construction and maintenance painters smoked more than non-construction painters, with both groups smoking more than the general white male population, as indicated in Table 3-3. Construction and maintenance painters began smoking at an earlier age, smoked more heavily, and were less likely to have quit smoking than the general population (Sterling 1976).

A second study to collect information on the smoking habits of painters was the follow-up study conducted in California of 10 occupational populations (Dunn 1960, 1965). At the beginning of the study, a questionnaire was sent to

all workers in the study cohort requesting occupational and current smoking information. Table 3-4 indicates the smoking characteristics of painters and the control population of workers selected from two utility companies. Again, painters appeared to smoke more heavily than controls, with a smaller proportion of workers classified as non-smokers. When compared to the other occupational groups, painters were among the workers with the lowest percentage of non-smokers and highest percentage of workers smoking 20 cigarettes or more a day. Both of these studies suggest that painters are heavy smokers and probably have been for a number of years. Their smoking habits, as well as their occupational exposures, must be taken into account in assessing the cancer risk which they experience.

II. CONCLUSIONS

It appears that if painters are experiencing any excess chronic disease mortality, the excess is most likely in the area of malignant neoplasms. There is, as noted earlier, no evidence of excess mortality related to disease of the cardiovascular system. There are indications in the literature of possible excess lung cancer risks, as well as possible excess risks associated with cancers of several other sites. For many of these cancers, there is a known increased risk associated with cigarette smoking, making the collection of smoking as well as work history data important to the assessment of the role of occupational factors in the development of these cancers.

TABLE 3-1
Findings from Major Occupational Mortality Studies
in the United States and England and Wales

Mortality	U.S. Mortality Study - 1950 (white males 20-64 yrs.) SMR		Washington State Mortality Study - 1950-71 (white males 20+ yrs.) PMR		Registrar General (England and Wales) 1970-72 (males 15-64 yrs.) SMR	
	Painters/ Plasterers	Painters (construction), Paperhangers, Glaziers	Painters	Painters	Painters and Decorators	Painters and Decorators
All Causes	114	125	100	111		
Tuberculosis	141*	169*	120	-		
Diseases of Cardiovascular System	107	117	99	107		
Malignant Neoplasms						
- Total	126*	133	103	123*		
- Trachea, bronchus, and lung	157*	165*	131*	139*		
- Larynx	200*	-	71	-		
- Bladder	146	145	97	152*		
Ulcers (stomach)	165*	200*	144	-		
Alcoholism	204*	-	160	-		
Accidents (1)	123*	138*	105	121*		
Suicide	148*	160*	119	-		

*p<.05

(1) Accidents, poisoning, violence.

TABLE 3-2
Summary of Results of Retrospective and Prospective Studies
of Cancer of the Lung Among Painters

<u>Third National Cancer Survey</u>		
<u>Cancer</u>	<u>Relative Odds*</u>	<u># Cases</u>
Lung	4.21	12
Hodgkins Disease	3.20	1
Leukemia	4.00	2

Source: Williams R.R. et al., 1977.

*Adjusted for age, race, education, tobacco, alcohol, geographic location.

<u>Roswell Park Memorial Institute</u>				
<u>Cancer</u>	<u>Ever Exposed</u>		<u>Exposed 5 yrs. or More</u>	
	<u>Relative Risk</u>	<u># Cases</u>	<u>Relative Risk</u>	<u># Cases</u>
Lung	1.7	42	1.3	29
Esophagus	3.0	7	3.2	6
Stomach	2.4	8	1.9	6
Prostate	1.9	9	1.3	6

Source: Viadana E. et al., 1976.

<u>Occupational Groups in California (8 Year Follow-up)</u>			
	<u># Deaths</u>	<u>Relative Risk (Unadjusted)</u>	<u>Relative Risk (Adjusted)</u>
Lung Cancer	91	1.29	1.14

Source: Dunn J.E. et al., 1965.

TABLE 3-3
Smoking Characteristics of Painters
1970 Household Interview Survey

Smoking Characteristic	Construction and Maintenance Painters	Other Painters	Total White Male Population Surveyed
% Current Smokers	68.29	56.34	42.63
% Smoking < 1pk/day	23.57	50.00	30.45
≥ 1pk/day	72.14	50.00	65.59
Average Amount Smoked/Day	25.30	18.45	21.73
% Starting Smoking Under Age 20	66.43	75.00	65.87
% Aged 20 or Older	13.57	12.50	19.22
% Former Smokers	18.13	25.93	38.38

Source: Sterling T et al. Smoking Characteristics by Type of Employment, 1976.

TABLE 3-4
Smoking Characteristics of Painters in California

Number of Cigarettes Smoked	Percent Distribution	
	Controls	Painters
None	28.1	17.1
5 cigarettes	4.4	3.5
$\frac{1}{2}$ pack	12.6	14.1
1 pack	37.1	45.9
$1\frac{1}{2}$ pack	12.8	13.3
2 packs	4.1	4.9
Not Stated	1.0	1.2

Source: - Dunn J. et al. Lung cancer mortality experience of men in certain occupations in California, 1960.

CHAPTER 4

METHODS

INTRODUCTION

The purpose of this study was to determine whether there was an increased mortality from any cause among painters as compared to other workers and to the general population. The study also examined whether there was an association between cancers of selected sites and potentially hazardous exposures in construction and maintenance painting.

The study consisted of two phases:

Phase I: a non-concurrent prospective study of approximately 60,000 union members over a 5 year period to determine the mortality experience of painters compared both to U.S. white males and to other non-painting tradesmen in IBPAT specialty locals.

Phase II: a case-control study of cancer cases in New York IBPAT locals identified through the State Cancer Registry for the purpose of determining the risks of specific cancers in association with painting and methods of paint application and possibly with certain types of paint.

Phase I

COHORT STUDY

I. SELECTION OF STUDY STATES

Based on the specification of the contracting agency that the cohort study consist of no more than approximately 60,000 individuals, it was decided that the study cohort should consist of the IBPAT membership of selected states throughout the United States. Selection of the states to be included in the cohort study was based on the following criteria:

1. Geographic location: each of the states should be located in a different area of the United States.
2. Size of membership: the state should have a sufficient IBPAT membership to allow for the detection of an increased mortality of the most frequent causes of death (heart disease and cancers of specified sites) within that state's IBPAT population.
3. Types of painting activities within the states: the state should have a range of painting activities typical of the union as a whole.

IBPAT provided statistics on the current union membership by state and district as of December 31, 1979. IBPAT groups its locals into 7 districts, one of which is Canada which was excluded from our study. The states with the largest current membership in each of these districts were then assessed in respect to the range and types of IBPAT locals within those states. The state from each district best meeting the study criteria was then selected. The states were New York, Texas, Michigan, Missouri (or Ohio), New Jersey, and California. Data from New York state were used to estimate the percentage of terminated and deceased members during 1975-79 in each of these states and the estimated membership eligible for inclusion in the study was calculated.

Since the total cohort population of the top 6 selected states exceeded NIOSH's total cohort size criterion, after discussions with NIOSH, four of the recommended states with an estimated cohort size of approximately 60,000 were selected for study. These states were New York, California, Texas and Missouri. At the recommendation of NIOSH, Ohio was selected as an alternate in the event that any state refused to provide death certificates.

II. IBPAT MEMBERSHIP TAPES

The International Brotherhood of Painters and Allied Trades provided computer tapes of the membership listing in 1978, 1979, and 1981. Two types of membership lists exist. Master files are listings of active members of the union at the time the listing is made. History files contain the membership records of previous members as well as the less recent activities of current members. Activities consist of transactions such as fines, suspensions, transfers between locals, temporary absences, deaths, retirements, terminations, etc. The record may indicate member's local of membership at time of activity, but frequently does not. The master files contain approximately 198,000 records each, one per individual. The history files contain approximately one and one-half million records each, with multiple records per individual and varying record length and format depending upon the

activity. In 1978, copies of master and history files were obtained. In 1979 an updated master file was received. In 1981, updated current and history files were received from the union. The 1978 and 1979 files were compatible, using a six digit union identification number as the identifier. Each period of union membership resulted in a new union ID for the member. It appeared that little effort was made to link the multiple numbers and records of individuals. The 1981 records used the Social Security Number as the identifier with no retention of the old union identification number either on the files or in the union data processing center. Individuals who were not active members and whose records lacked a Social Security Number (SSN) were dropped from the new files. Individuals still active with no SSN on their record were given dummy ones.

It was necessary to combine these files to obtain the complete union record of any member. 1978 and 1979 files were matched by union ID and then by SSN and by surname and birthdate in order to collect records from different periods of union membership. A similar procedure was followed to link the 1978 and 1979 files to the 1981 records except union ID was not carried on the 1981 files. All matches were checked for inconsistent data in order to verify that the matches were correct.

Only individuals who were born prior to 1940, who had at least one year of union membership by December 31, 1979, and who had been members of an IBPAT local in one of the four study states at some time during 1975-79 were included (Table 4-1). Difficulties existed in ascertaining whether an individual was in a study state local during the specified time period. Local unions dissolve, merge, and shift frequently. The same local number may refer to different locals in different areas at different time periods. It was necessary to request that IBPAT compile a listing for us of all local number changes. This task proved an enormous and time consuming one for the union, but was invaluable to the study. A second difficulty arose from the fact that dates are only recorded on an individual's file when an activity occurs. The most frequent activities, suspensions and reinstatements, do not indicate local affiliation. Individuals without many union activities may have few or no union activity records during the time period of interest. It was often necessary to determine local of membership during 1975-79 from records prior to or after this time. (Eligibility criteria are summarized in Table 4-B.)

Once the states were selected, permission to access death certificates was requested of all states involved. Approvals were received over the next 6-9 month period from all states, eliminating the need for Ohio.

III. VITAL STATUS ASCERTAINMENT

The main sources of vital status information were (Table 4-2):

- i) IBPAT Life Insurance Records
- ii) Social Security Administration
- iii) National Death Index
- iv) Veterans Administration
- v) Health Care Financing Administration

Additional vital status information was provided for members of the New York state population by

- i) The New York State Cancer Registry
- ii) Internal Revenue Service (fact of death only)

i. IBPAT Life Insurance Records

Death certificates were provided by the IBPAT for all study members who died from 1975-79 for whom the union had a death certificate. The union had death certificates on file either as hardcopy or on microfilm for most individuals for whom the union had paid a death benefit. Fact of death only was required for payment of the death benefit, not cause of death, resulting in some missing information. This problem was most evident for New York City death certificates. In New York City, the death certificate is a two page document with causes of death occurring only on the second page. In almost all cases the union was in receipt of only the first page. For all such death certificates, it was necessary to order the complete document from the appropriate vital records office. In addition, as we were dealing with photocopies of death certificates and microfilm of varying quality, it was necessary to order new death certificates from the states if copies were illegible. The fact of death was determined for 4642 study members based on union records. Union records, however, did not provide death information for any member who had left the union prior to death or did not have either life insurance with the union or a beneficiary to claim benefits. Older retirees posed a particular problem, as the union often was not notified of their death, resulting in retention of these deceased individuals on the active membership roster as living. To ascertain deaths not identified by the union, a number of other sources of death information were searched.

ii. Social Security Administration

To ascertain the vital status of terminated and older retired union members, all such members of the study cohort were searched against the records of the Social Security Administration (SSA). Two searches were conducted: the first in 1982 containing 22,540 records; and a second, in April of 1983, of 5,573 records. One thousand fifty-three deaths among cohort members were identified.

iii. National Death Index

The National Death Index (NDI) at the time of this study contained only deaths in 1979 and 1980, providing information for only the last year of the study. All individuals who were returned from Social Security as "status unknown" were searched through the files of the National Death Index. Since there has been some concern regarding the completeness of death reporting to the Social Security Administration since 1977 when changes in its death benefits were enacted, a 10% sample of those returned from the Social Security Administration assumed as living was also submitted to the National Death Index. A total of 5,144 records were sent to the NDI and 7 additional deaths in 1979 were identified from its records.

iv. Veterans Administration

An additional source of vital status information is the Veterans Administration (VA) through its computerized records system, which accepts the SSN as an identifier. As all of our study population was born prior to 1940, many will have served in the Armed Forces and thus be eligible for a veterans death benefit. Therefore, the decision was made to search the records of the Veterans Administration for vital status information. The Veterans Administration's records include date of death but not place of death. The records do, however, identify the state where the veteran's claim folder was located. This is usually, but not always, the state in which the death occurred. As there was no charge for the matching procedure, it was decided to send all study subjects with a Social Security Number not already known to be dead or who were not current members of IBPAT in 1981 to the Veterans Administration. In total, 33,422 cohort members were searched through the Veterans Administration's records and 165 deaths identified.

v. Health Care Financing Administration

The Health Care Financing Administration (HCFA) provides an additional source of death information for those aged 65 and over. Two tapes were submitted to HCFA for matching against its files. The first tape consisted of 19,317 individuals with Social Security Numbers within the appropriate age category. The second tape consisted of 406 individuals born in the appropriate time period for whom no Social Security Number was known. The records on these tapes were searched against HCFA regional files for California, Missouri, New York, and Texas and 960 deaths identified.

INDIVIDUALS WITHOUT A SOCIAL SECURITY NUMBER

Individuals without Social Security numbers (SSN) pose special problems for vital status ascertainment. Most studies rely on searches of the records of the Social Security Administration to identify deaths in their study populations and individuals without SSN's cannot be searched in this manner. Lack of an SSN posed less of a problem for the Painting Trades study than for other studies, as only 898 or 1.6% of individuals in the cohort were without an SSN. In addition, vital status information was available to us for 73% of these individuals, leaving only 334 individuals without SSN whose vital status was unknown.

Of the 898 individuals without an SSN, 302 were known to be dead based either on union records or HCFA searches. One hundred ninety-seven persons were known to be alive in 1979, as they were active union members in 1981. An additional 24 individuals were assumed alive because they were active union members in October 1979, only three months prior to the end of the study. Forty individuals were documented by the HCFA search and one by the New York State Cancer Registry as living at the end of 1979. The 334 individuals without SSN whose vital status remained unknown represented only 0.6% of the total cohort. These individuals were assumed to be living until the end of follow-up.

ADDITIONAL VITAL STATUS INFORMATION SOURCES

i. The New York State Cancer Registry

The New York State Cancer Registry matched its records against the IBPAT New York state membership files. All cancer cases occurring in the New York study population were identified. The Cancer Registry provided tumor data for all such matches, including date of death if fact of death was known. Death certificates were requested from either the New York City or State Vital Records offices for 179 deaths based on Cancer Registry information.

ii. Internal Revenue Service

The records of the Internal Revenue Service (IRS) were searched for members of the case-control study to obtain address information at the time of last income tax filing. If the individual in question was known to be deceased by the IRS, the fact of death was indicated. However, no date or place of death was indicated, requiring additional sources of death information before a death certificate could be ordered for the 74 deaths identified.

ACQUISITION OF DEATH CERTIFICATES

Once fact of death was ascertained through any of the previously listed procedures, a death certificate was requested from the appropriate state. For most deaths, state of residence at time of death was provided. The Veterans Administration record indicated the office where that individual's file was stored. The state frequently, but not always, corresponded to the state of residence at time of death.

When either the state of residence was not available, or a death certificate could not be found in the first state searched, the death certificate was requested from the state of last union membership. Individuals from the first SSA search who were returned from the state vital records offices were resubmitted to SSA for a Program Center search. This search took over a year to identify new states of residence at time of death for the 29 individuals submitted. This search resulted in new information and receipt of a death certificate for 16 individuals. In addition, death certificates not found in New York City were requested of New York state and vice versa. For study subjects in Missouri whose death certificate could not be found in that state, a search was also made in Kansas for members of locals near the Kansas border. Due to the cost of vital status searches, it was not possible to search a large number of states for each individual. Thus, some death certificates were not found. Of the 5320 deaths within the cohort, death certificates could not be obtained for 288 individuals (5.4%).

IV. CODING OF DEATH CERTIFICATES

All death certificates received were coded in the 8th revision of the International Classification of Diseases (ICDA), and all 1979 death certificates were also coded in the 9th revision. A 10% sample of all death certificates was recoded by a second coder, blind to the previous coding, for

verification purposes. All causes of death data were then either punched to tape or directly entered on computer.

V. RACE AND SEX DATA FROM DEATH CERTIFICATES

Data on race and sex are not available from the IBPAT records which formed the basis of the study cohort. The union reports that almost all union members are white males. Data from the 1980 census suggest that this statement is essentially correct. Of all construction and maintenance painters, 90% were white and 94% male (Bureau of the Census, 1983). Information on race and sex are available on death certificates, however. Since it is important to confirm the sex/racial composition of our population, when making comparisons to race and sex specific standard comparison populations, all cohort death certificates were reviewed for race and sex information.

Twenty-six female deaths were identified. These females tended to work in occupations such as scenic artists or as employees in a glass factory. Due to the small number of female deaths and the differences experienced in cause specific mortality by males and females, these twenty-six deaths were excluded from the number of deaths included in the analysis. One hundred and four black males were identified from the study death certificates. To assess the characteristics of this group birth date, place of residence, occupation and causes of death were reviewed. It was decided that these deaths would remain in the cohort for analysis. Black union members cannot be identified within the cohort except among deaths. To attempt to analyze deaths among blacks separately is impossible without an appropriate denominator. However, to remove these deaths could bias the mortality rates observed. The decision was made to include black males in both the numerator and denominator and analyze the total population as if they were all white males.

VI. ALLOCATION OF BIRTHDATES FOR ANALYSIS PURPOSES FOR INDIVIDUALS WITHOUT A BIRTHDATE

Four hundred and sixty-four members had no birthdate on their union record and no other source of birthdate information, such as a death certificate, was available to provide these data. Twenty-four individuals had invalid birthdates, these were individuals who had fewer than 12 years between birthdate and date of joining the union.

Since a birthdate is required for all age-adjusted analyses, a procedure was developed whereby an estimated birthdate was assigned for these 489 individuals. This procedure utilized date of joining the union (initiation date), which ranged from 1895-1979. Individuals were stratified by 5 year intervals of initiation date. Individuals with no birthdate were assigned the median year of birth (month and day given as July 1) of those individuals with known birthdates in the corresponding initiation date stratum. Of these individuals, 113 were given birthdates prior to 1940 and 376 individuals were given birthdates 1940 or later and therefore were excluded from the study. Table 4-3 gives the breakdown of estimated birthdates.

VII. DATA ANALYSIS

Standardized Mortality Ratios (SMR) and Proportionate Mortality Ratios (PMR) were calculated for the cohort using U.S. white males as the comparison population according to the programs developed by R. Monson (1979). Since the study excluded anyone who was a member of IBPAT for less than one year, it was necessary to discount for all individuals their first year of union membership. This "lagging" was applied to all SMR and PMR analyses.

The third component of the analysis consisted of internal comparisons of the mortality experience of the study cohort by type of local affiliation (trade area) of the members (Breslow, 1975). IBPAT locals are classified either as mixed or specialty. Most painters belong to locals officially classified as mixed, while allied trades such as glaziers may belong to a local specifically for glaziers and the local will be so designated by IBPAT. As a sufficient number of these allied tradesmen (such as glaziers) is needed before they can form their own local, the degree of separation of the trades into their respective locals is a reflection to some extent of the union membership composition in that area. In some areas where the size of the membership is inadequate to support multiple specialty locals, only mixed locals exist. IBPAT has also tried over the last few years to amalgamate a number of smaller locals. One such merge occurred in New York City in 1979. In these situations, the individual trade identities of the smaller locals are often lost.

All individuals in the study cohort were classified by local affiliation for the internal comparisons. Members with affiliations to both mixed and specialty locals were assigned the specialty affiliation as it was felt they would continue their specialty despite movement to a mixed local.

Phase II
CASE-CONTROL STUDY

I. CASE-CONTROL STUDIES OF CANCER RISKS

A retrospective study design was employed to study the cancer risks experienced by painters in New York state. This case-control study was conducted within the New York state cohort selected for the mortality study. Controls consisted of a stratified random sample of non-cancer cases in the New York state cohort population. Each cancer site considered in the analysis was compared to these non-cancer controls. Lung cancer cases were also compared to cancers at all other sites.

II. CANCER SITES SELECTED

Data were collected on all eligible cancer cases identified by the New York State Cancer Registry. The individual cancer sites with a sufficient number of cases for separate analysis consisted of lung, colo-rectal, prostate and bladder cancer and lymphatic malignancies.

III. THE STUDY POPULATION

i. Eligibility Criteria for Entry Population

Cases and controls were drawn from the membership of New York state locals of the International Brotherhood of Painters and Allied Trades. Current members, retirees and previous members were included in the eligible study population. Eligibility criteria for entry into the New York state cohort study and into the case-control study population consisted of:

- i. Membership in an IBPAT local located in New York state during the period January 1, 1975 to December 31, 1979.
- ii. Membership in IBPAT for a minimum of one year.
- iii. A birthdate prior to 1940.
- iv. Male sex.

ii. The Identification of Cancer Cases

Cases of cancer occurring among male members of the New York state IBPAT population were identified by matching the New York state IBPAT membership file against the records of the New York Cancer Registry (NYCR). Those cases of cancer diagnosed 1975 or later were sought. The New York Cancer Registry has been in operation since 1940, with records for New York City boroughs included since 1973. The Registry identifies cancer cases within New York through reports from hospitals and pathology laboratories and review of all New York death certificates by Cancer Registry staff.

A computer tape listing the last name, first and middle initials, birthdate, Social Security Number (if known) and death date (if known) of all

members of the New York study population was submitted to the New York Cancer Registry.

A two-stage matching procedure was employed by the Registry to identify all cancer cases occurring in the study population. The first step matched study members with the NYCR records by soundex and sex (male). All tentative matches identified by this procedure were then evaluated using an algorithm involving name, SSN, birthdate, and death date to select definite and possible matches. A definite match was any record accumulating 13 matching points, a possible match required 10 to 12 points. Any record accumulating fewer points was classified as a non-match and a non-cancer case. Information on all matches was submitted to study personnel for a final manual review of the matched union and Registry individuals.

In addition to the cancer cases identified through the Cancer Registry, all New York death certificates, received as part of the cohort mortality study, were reviewed for any indication of cancer on the death certificate. All cases identified by this death certificate search were submitted to the Cancer Registry for confirmation. For cases for whom the Registry had no date of diagnosis, the median survival time post-diagnosis (US HEW, NCI, 1976) was used to estimate a date of diagnosis. Any case with an estimated date of diagnosis was later excluded from the study if the questionnaire response indicated a date of diagnosis prior to 1975.

iii. Selection of Controls

Once cases had been identified, non-cancer controls were selected from the remainder of the New York IBPAT population (those not matching for any cancer site). All eligible non-matches were stratified by age and residence in or outside the New York City Standard Metropolitan Statistical Area (SMSA) and were randomly ordered within each stratum. The number of controls which was selected in each stratum equalled the total cases of cancers of all sites in that stratum. The controls selected by this method represented a stratified random sample of all non-cancer cases in the New York study population.

If individuals selected as controls were found to be either female or residents of a foreign country, they were excluded and substitutes selected. The next eligible control of the same age-geographic stratum was selected as a replacement.

IV. SUBJECT FOLLOW-UP

Once cases and controls were identified, a questionnaire was mailed to their last known address. Address information was obtained from the following sources:

- i. Computerized IBPAT union records
- ii. Microfilm and microfiche IBPAT records
- iii. New York telephone books
- iv. Internal Revenue Service records
- v. New York State Department of Motor Vehicles records
- vi. Post Office address correction cards

- vii. Post Office information requests
- viii. Local union information
- ix. Telephone tracing in community of last union local.

i. Tracing of Study Subjects

The membership records of IBPAT provided an initial address for many study members. In addition, New York telephone directories in the locality of last union membership and surrounding areas were searched to obtain current addresses for study members and to confirm address information provided by other sources. The telephone books proved extremely useful in upstate New York and much less useful in New York City where many individuals do not have published telephone numbers. The Internal Revenue Service (IRS), via NIOSH, (IRS) provided additional address information on study subjects. The IRS supplied address information which was current at the time of the last income tax filing of the study subject. When the IRS knew a subject to be deceased, it also provided that information to study investigators. The IRS did not, however, provide the date of last filing, date of death, or the date when an address was considered current for any study subject.

For individuals who had recently moved, Post Office address forwarding cards were provided to the study by the Post Office indicating the new address to which a questionnaire had been sent. For individuals whose Post Office forwarding order had expired, address information was requested of the Post Office under the Freedom of Information Act. If an individual was not known to be deceased and a full first name had been obtained, an address request was submitted to the New York State Department of Motor Vehicles.

Telephone tracing of individuals with the same name or same surname residing in the community of their last IBPAT local provided address information for a number of study subjects. Through IBPAT headquarters, address information was sought from the local union to which subjects last belonged. Not all locals responded to these requests.

ii. Identification of Next-of-Kin

For those subjects identified from union files as deceased, the name and address of the designated life insurance beneficiary was obtained from the union records. The next-of-kin of deceased subjects were also identified through obituary notices obtained from local public libraries, from funeral homes and cemeteries, telephone tracing of individuals with the same surname in the last community of residence, and from the local unions of IBPAT. In New York City obituary notices were reviewed using the microfilmed copies of the three major New York dailies from 1975 through 1982. At the request of the New York Cancer Registry, no individual was contacted based on information provided by the Cancer Registry. Similarly, no one was contacted based on next-of-kin information recorded on death certificates.

V. THE QUESTIONNAIRE

Once an address for a study subject or a name and address for the next-of-kin of deceased subjects was obtained, a questionnaire was mailed.

Included with the questionnaire was an introductory letter explaining the study and a letter from the IBPAT indicating the union's support for the study. A pre-addressed, pre-stamped return envelope was enclosed with the questionnaire and a telephone number was provided for members to call the study collect if there were any questions concerning the questionnaire or the study.

The questionnaire was designed with a tear-off face sheet that contained the consent statement which the respondent was requested to sign. Only the study number appeared on remaining pages. If the respondent wrote identifying information on the questionnaire itself, this information was removed prior to coding.

The questionnaire collected exposure and employment data not available from union records and information on personal and lifestyle factors which could significantly alter cancer risks. To assess the possible association between work in the painting trades and lung cancer, information was collected concerning jobs held outside IBPAT as well as work while an IBPAT member. Occupations in addition to those of the painting trades may pose a cancer risk to exposed workers. Only the members themselves could provide information concerning their non-union jobs.

In addition to possible exposures outside IBPAT union contract work, a major concern to the study was the smoking characteristics of the study population. Data from both the Household Interview Survey (1970) and Dunn's study of cancer risks in several occupational groups in California (1960, 1965) have suggested that painters were heavy smokers. Without smoking information it would be impossible to determine whether lung cancers among painters were due to occupational exposures or to smoking characteristics of this occupational group.

The questionnaire collected information concerning the following factors:

1. Demographic characteristics:
 - a) Birthdate
 - b) Race
 - c) Marital Status
 - d) Number of children
 - e) Educational level
2. Occupational history:
 - a) Usual job; job or trade worked at the longest
 - b) Usual job while a member of IBPAT
 - c) Current employment
 - d) Work in the painting and allied trades
 - i) specific trades
 - ii) specific painting industries
 - iii) specific exposures
 - e) Work in potentially high risk environments
 - i) specific industries
 - ii) specific occupations

- f) Exposure to paints
 - i) types
 - ii) frequency of use
 - iii) usual method of application
 - g) Use of protective equipment
 - h) Summary of occupational history from first to last job
3. Medical history:
- a) Dangerous exposure (self-defined)
 - b) Accidents on the job
 - c) Occurrence of specific medical conditions
 - d) Occurrence of medical conditions in immediate family
 - e) Hospitalizations
4. Personal characteristics:
- a) Smoking habits
 - i) amount smoked
 - ii) number of years smoked
 - iii) age started smoking
 - iv) age stopped smoking
 - b) Diet
 - i) frequency of consumption of selected foods
 - ii) frequency of drinking selected beverages including liquors
 - iii) vitamin supplement use
 - iv) artificial sweetener use

VI. QUESTIONNAIRE PRE-TEST AND MAILING PROCEDURES

The initial draft of the questionnaire was reviewed by faculty and staff of the Departments of Epidemiology and Environmental Health Engineering at the Johns Hopkins School of Hygiene and Public Health. The questionnaire was submitted to IBPAT for its comments and suggestions, with particular emphasis on questions relating to the painting trades. The questionnaire was then pre-tested on 6 men, three of whom were painters, and three employed in other building trades. The results of this pre-test were reviewed and incorporated into the final version of the questionnaire. The questionnaire was then submitted to NIOSH for internal and external review.

Mail-out began in April, 1982 with follow-up continuing through July 15, 1983. Study members who did not respond to the first mailing were sent a second questionnaire one month later. Many individuals were found to have moved from the addresses provided by the union and the Internal Revenue Service. Tracing of these individuals as well as those without initial addresses spanned a period of many months.

VII. FOLLOW-UP OF NON-RESPONDERS

If an individual did not respond to either the first or second mailing, a telephone contact was initiated. The respondent was encouraged to complete the questionnaire, or, if he preferred, given the opportunity of completing the questionnaire on the telephone.

Individuals who did not respond to mailings and who could not be reached by telephone because of unlisted telephone numbers were sent a third and final mailing by certified mail. The third mailing and the use of certified mail was adopted when it became clear from the telephone follow-up that despite two mailings, a number of individuals had not received their questionnaires. Certified letters were less likely to be lost in the mail and required that the addressee sign a receipt. This card was then returned to the study by the Post Office. It was further hoped that use of certified mail would prompt some non-responders to complete and mail back their questionnaires.

Once a questionnaire was received, the face-sheet containing the respondent's name was removed and the questionnaires filed by study number for later coding.

VIII. STUDY DATA AVAILABLE FROM UNION RECORDS

In addition to the questionnaire data, union work history records were available for all study subjects. This information consisted of date of joining union, temporary absences such as military service, transfers between locals, and date of termination or death, as well as data pertaining to the payment of dues.

From these union activity records it was possible to recreate an individual's union work history. Periods of active union membership, association with mixed or specialized locals, and job and geographic mobility were determined for each study subject.

IX. CODING OF COLLECTED DATA

All questionnaires were coded independently by two coders. The eighth edition of the International Classification of Diseases was used to code all medical history data. The Alphabetical Index of Industries and Occupations Codes (1970 census) was employed to code all job and industry data. The three digit occupational classification was expanded to a fourth digit code for the painting trade areas to permit coding the level of job specificity desired.

Each questionnaire was coded twice, then keypunched independently without verification. Two separate tapes were generated, each containing one copy of each questionnaire's information. The two tapes were compared to identify discrepancies in both coding and punching. A listing of all discrepant questionnaire items was then produced. This listing was reviewed manually and corrections entered into the data file.

X. PROTECTION OF CONFIDENTIALITY

All study subjects were issued a unique seven digit study number. The study number was the only personal identifier appearing on the questionnaire or subsequent coding forms. The questionnaire face-sheet which contained the individual's name was removed from the questionnaire upon receipt in the study office and kept locked in a separate cabinet. The master list linking study number to name was also separate from other study data, and stored in a locked

file. Information from the union membership tapes and Cancer Registry was also added to an individual's file using his study number.

XI. DATA ANALYSIS

i. Descriptive Analysis

The purpose of the descriptive analysis was to characterize the study population in terms of the variables of interest to the study and to compare the proportions of cases and controls within each level of these variables. The chi-square test procedure was used to assess the statistical significance of differences in proportions of the study variables among cases and controls. Where appropriate, means were calculated and differences assessed for statistical significance by use of the Student's t test. Fisher's exact test was used in preference to the X^2 procedure whenever a 2 x 2 table had any cell containing an expected value less than 5.

To measure the degree of association between the occurrence of lung cancer and specified study variables, each potential risk factor was dichotomized and odds ratios calculated. The odds ratio is the ratio of the odds of disease in exposed individuals relative to those of the unexposed individuals. Odds ratios and confidence limits on the odds ratio were calculated using a modified Woolf's method (which adds .5 to each cell) reciprocal variance allowing the calculation of an odds ratio when cells with zero frequency occur.

Factors which might confound the association between lung cancer and occupation were identified on the basis of an association both with case-control status and occupation. In order to produce a bias, a confounding variable must be associated with both the independent (occupation) and dependent (case-control status) variable. The X^2 test was used to assess the statistical significance of differences in the study variables among painters and non-painters.

Summary odds ratios adjusting for single confounding variables were calculated using the same modified Woolf's procedure employed in the calculation of crude odds ratios. A X^2 test for heterogeneity was used to test the equality of the odds ratios between strata.

ii. Multivariate Procedures

To study the relationship between disease status and occupation while adjusting for a number of possible confounding variables, a logistic regression model using maximum likelihood estimation of the regression coefficients (natural log odds ratios) adjusted for all other variables in the model was employed.

The general model may be expressed as follows:

$$Y_{(i)} = P_{(i)} + \epsilon_{(i)}$$

$$P_{(i)} = 1/[1 + \exp - (\beta_0 + \beta_1 X_1 + \beta_2 X_2 + \dots + \beta_k X_k)]$$

where: $P_{(i)}$ is the probability of an event

$Y_{(i)}$ is the binary dependent variable,
case/control status

X_1, X_2, \dots, X_k are independent variables representing occupation and selected confounding variables such as age and smoking status and any potential interactions.

$\epsilon_{(i)}$ is an unobserved random error

β 's are the estimated regression coefficients indicating the estimated log odds for lung cancer for a given set of independent variables.

TABLE 4-1
Eligibility Criteria for Inclusion in Mortality Study

Males

Birthdate prior to 1940

Membership in IBPAT for a minimum of one year

Membership in an IBPAT local located in New York, California,
Texas, or Missouri during the period 1/1/75 to 12/31/79

TABLE 4-2
Sources of Death Information

	# Records Searched	# Deaths Identified
IBPAT - Life Insurance Files	Total IBPAT Cohort	4,642
Social Security Administration #1	22,540	1,053
#2	5,573	
National Death Index*	5,144	7
Veteran's Administration	33,422	165
Health Care Financing Administration	19,723	960
New York Cancer Registry	New York Cohort	179
Internal Revenue Service	Case-Control Subjects	74

*1979 data only used.

TABLE 4-3
Distribution of Assigned Birthdates

Initiation Date Interval	Median Date of Birth	Number of Subjects	Number of Subjects Assigned Birthdates
1895-99	1869	9	1
1900-04	1883	12	4
1905-09	1885	72	2
1910-14	1890	244	6
1915-19	1894	450	6
1920-24	1898	1109	7
1925-29	1903	1420	6
1930-34	1904	2242	10
1935-39	1906	6531	27
1940-44	1908	7427	10
1945-49	1915	15138	6
1950-54	1921	12679	0
1955-59	1927	12971	4
1960-64	1932	15345	1
1965-69	1936	23235	23
1970-74	1943	37350	191
1975-79	1949	59696	184

No DOB: 464

Invalid DOB: 24

Given a DOB before 1940: 113

Given a DOB after 1940 and therefore out of cohort: 375

CHAPTER 5

Phase I

RESULTS OF COHORT STUDY

The cohort study population consisted of 57,175 individuals who had been in or were admitted to the union in the period 1975-1979. Thirty-one individuals were omitted from some of the calculations because their ages were one hundred years or more. Because no one was eligible for inclusion in the study cohort if they were born after 1939, the age distribution of the workers at the time of start of follow-up, as seen in table 5-1, includes no ages under 35 years. A total of 257,102 person-years are included. The number of person-years was adjusted to omit the first year after initiation into the union since a minimum of one year union membership was required for inclusion in the cohort. In addition, members were not at risk of chronic illnesses from an occupation in such a short time interval. For most members this would not be reflected in person-years for the five-year period since their first entry was many years prior to 1975.

The year of entry of members was often difficult to identify since it was common for painters to move in and out of the union under different membership numbers and the records of such changes were separated in several different tapes. This movement may account for why there are apparent entries into the population at advanced ages. In addition, some early union activities may never have been transferred to computer files when the membership records were computerized in 1968. The distribution of deaths during the 1975-79 calendar period are shown in table 5-2. The surprising number of deaths at old ages may be a function of the union membership which starts back in the early 1900's and includes many retirees. Thus, we have groups with long periods of survival into the study calendar period. In addition, it is possible for skilled painters who have already spent many years in their trade to join the organization to work on a unionized job site, resulting in membership at advanced ages. A distribution of the deaths by year of entry as seen in table 5-3 demonstrates the frequency of deaths among these early entrants as one might expect. These selection factors might result in a population which has preferential survival experience which would even exceed that of the usual "healthy worker".

I. ANALYSIS OF MORTALITY DATA OF ENTIRE COHORT MEMBERSHIP

The standardized mortality ratio (SMR) for all causes of death as shown in table 5-4 is significantly low compared to U.S. white males, the ratio being 88 percent of the general population rate when the entire cohort is considered. This deficit is due primarily to significantly low ratios for circulatory diseases (.76) except rheumatic heart disease (1.10), and vascular lesions of the central nervous system (.64). An unexpected finding was the low ratios for accidents (.78) and especially motor vehicle accidents (.76). These had reportedly been high among painters. In addition other significantly low ratios included diseases of the digestive system (.83), diseases of the nervous system (.58) and emphysema (.61). In sharp contrast

many ratios for specific cancer sites were at or above the expected mortality for the general population. Cancers of the pancreas and brain (.56) were significantly low and others such as buccal cavity (.75), skin (.66) and (.73) testis (.57) were also low. Cancer of the stomach with a ratio of 1.27 approached significance, as did liver at 1.47. Cancers of the lung (1.06), large intestine (1.10), bladder (1.06), kidney (1.28) and lymphosarcoma (1.01) have higher ratios than those of the all cause mortality and thus are probably worthy of mention.

Proportional mortality ratios (PMRs) may actually be a better indicator of specific causes of death which are of concern when one is examining mortality in a population with a low overall death rate. This is especially true if all deaths have been ascertained in the population and the low overall mortality may be related to a general characteristic improving survival such as high socioeconomic status. Most deaths probably have been found but we are not sure whether the low mortality may not be due to some factors which select for low mortality from specific causes of death. The results of the PMR analysis as shown in table 5-E show that the study population has experienced a statistically significant excess of all malignant neoplasms (1.12) and a number of specific cancer sites. The PMRs were significantly elevated for cancers of the stomach (1.44), large intestine (1.24), liver (1.64), lung (1.14), prostate (1.20), and kidney (1.40). The ratios for some of the other cancers, such as bladder (1.24), are high but not significant. Cancer of the brain still is significantly low (0.58). None of the other specific causes except cancers showed a significant excess. The only significant excess was in ill-defined conditions (1.32). In fact, several causes were significantly low, such as arteriosclerotic heart disease (.87), vascular lesions of the CNS (.78), emphysema (.69) and accidents (.82).

The combined results of the two analyses suggest that the population has an excess risk of several sites of cancer such as stomach, large intestine, liver, lung, kidney and prostate. It has a remarkably low risk of cardiovascular and cerebrovascular diseases, emphysema, and accidents. It is reasonable to expect that individuals with heart disease may not remain in painting until age 40 because the work is too strenuous for persons who have conditions predisposing to the disease, such as obesity. This might have lowered the rates of cardiovascular and cerebrovascular diseases in this population. The low risk of accidents is difficult to understand since construction trade itself is reported to have an increased risk.

II. ANALYSIS OF COHORT DATA BY TYPE OF LOCAL

Local unions of IBPAT are classified as either "mixed" or "specialty". Members of mixed locals may belong to any of the trades while members of specialty locals work in the trades represented by their specific local. In larger communities, mixed locals are composed primarily of painters.

When the study cohort was subdivided by local membership, 33,118 individuals had been members of only mixed locals 1975 or later and 24,064 had been members of a specialty local (Table 5-6). Twenty-three individuals could not be classified by specialty, as the affiliation of their local was unknown. One thousand one hundred and forty-three individuals belonged to both specialty and mixed locals during the period. These latter members were

classified according to their specialty as they most likely retained their trade while a member of a mixed local. 164 individuals within the cohort belonged to two specialty locals, and 3 individuals belonged to three different specialty locals during the time period and were considered in each of their specialties for the analysis.

i) Members of Mixed Locals

The Standardized Mortality Ratios (SMR) for all causes of death were slightly but significantly decreased (.93) among members of mixed locals (Table 5-7). All malignant neoplasms were slightly elevated at 1.10. Two individual cancer sites were significantly elevated, cancer of the stomach (1.36), and cancer of the lung (1.18). Mortality from diseases of the circulatory system was significantly low (.79), while respiratory disease mortality was similar to that of all U.S. white males (1.01). All accidents were only slightly low at .91 and motor vehicle accidents were 81% of the standard rate. Analysis of the Proportionate Mortality Ratios (PMR) suggested similar conclusions (Table 5-8). All malignant neoplasms were slightly elevated (1.14), as was cancer of the stomach (1.44) and cancer of the lung (1.17). Significant elevations in proportionate mortality only were seen for liver cancer (1.62) and bladder cancer (1.40). A deficit of cancers of the brain and other parts of the central nervous system (CNS) were also observed (.51). All diseases of the circulatory system were low (.87) but not diseases of the respiratory system (1.12), again corresponding to the SMR analyses. The PMR for all motor vehicle accidents was low at .74 but not significantly so.

ii) Members of Specialty Locals

Members of specialty locals were calculated to have lower Standardized Mortality Ratios than expected for all causes of death (.75) and all malignant neoplasms (.84) (Table 5-9). Most notably there was a statistically significant deficit of lung cancer (.82) and leukemia (.46) among these workers. Cancers of the liver and testis were slightly elevated, with SMRs of 1.29 and 1.48 respectively, but these increases were not significant. All diseases of the circulatory system were low (.69), including both arteriosclerotic heart disease (.68) and vascular lesions of the CNS (.62). The SMRs for the categories of all respiratory diseases (.54) and emphysema (.28) were low, as were diseases of the digestive system (.66), all accidents (.55) and all motor vehicle accidents (.68).

In the proportionate mortality analysis, the only statistically significant elevation in mortality was for cancer of the large intestine (1.42), an excess not observed in the SMR analyses (Table 5-10). Lower than expected proportionate mortality was observed for diseases of the circulatory (.93) and respiratory (.73) systems. All accidents and all motor vehicle accidents were again low at .52 at .54 respectively.

The risks associated with the different types of specialties were then evaluated. In these analyses, the populations are relatively small and number of comparisons large. These sub-group analyses should be considered suggestive of possible excess risks only and not definitive.

iii) Glaziers and Glass Workers

Glaziers represent the single largest allied trade membership in the union, with 4,943 glaziers or glassworkers in the study cohort. Table 5-11 presents the Standardized Mortality Ratios for this allied trade. There was a statistically significant deficit of all cause mortality (.79), primarily accounted for primarily by the deficit in diseases of the circulatory system (.87). The mortality ratio for all malignant neoplasms of 1.04 was only slightly higher than that for all U.S. white males. Some cancer sites appeared to exhibit a slight excess mortality but none was statistically significant. The proportionate mortality analyses suggest that there was a higher mortality from cancer of the large intestine (2.20) and kidney (1.22) than expected (Table 5-12). The finding of the excess of testicular cancer mortality agrees with the SMR analysis, while the SMR for cancer of the large intestine was not significantly elevated at 1.74.

iv) Sign Painters

The second largest allied trade membership is that of sign painters. 3,694 members of this trade were in the study cohort. Sign painters (Table 5-13) exhibited a low overall SMR of .72. The SMRs for most cancer sites were less than one, but none significantly so. Diseases of the circulatory system (.73), respiratory system (.48) and digestive system (.25) were significantly decreased, with the latter two being unusually low. The proportionate mortality analysis similarly indicated no significant excess of cancer of any site (Table 5-14). The PMR for diseases of the circulatory system was 1.01, for respiratory diseases .66, and .34 for diseases of the digestive system. These analyses suggest that sign painters are experiencing no excess mortality compared to U.S. white males.

v) Floor Covering Installers

The third group of allied trades with a sizable membership in the study cohort was floor covering installers (tile layers, etc.) There were 3,480 members affiliated with these specialty locals in the study. This group exhibited a pattern of low overall mortality (.81) (Table 5-15). Arteriosclerotic heart disease mortality was low (.64), as was mortality from most malignant neoplasms except stomach cancer (2.43). Diseases of the respiratory system, low in most of the allied trades, were only slightly lower than the U.S. white male rate among these workers (.89), and no deficit of digestive system diseases (1.03) was observed. The rates of accidents and motor vehicle accidents were much lower than expected, at .38 and .24 respectively. The proportionate mortality analysis suggests more deaths occurred from stomach cancer (3.08) and cancer of the thyroid (14.37) than expected but latter observation is based on one case (Table 5-16). Also, proportionately more deaths occurred from allergic, endocrine and similar diseases (2.41), pneumonia (2.17), and diseases of the blood (5.46) than was expected. The PMR for all accidents (.40) and motor vehicle accidents (.24) remained low.

vi) Other Trades

All other allied trades contributed fewer than 3,000 members to the cohort. With the decreasing population size and number of deaths, the confidence limits on the SMRs increase accordingly. Table 5-17 indicates the SMRs and PMRs for selected diseases among paintmakers, auto, ship, steel and similar painters, and industrial and maintenance painters. Paintmakers exhibited both low mortality from both arteriosclerotic heart disease (.34) and cancer (.50). Ship, auto, and steel painters exhibited only slightly decreased mortality from each site with no significant differences from the U.S. rate, except for cancer of the kidney, where 4 deaths were observed when only one was expected (4.00). Among members of industrial or maintenance locals, diseases of the respiratory (.24) and circulatory system (.46) were significantly low. There were no significant excesses of cancer of any site, with the ratio for all malignant neoplasms being 1.02. The low disease rate among paintmakers and to a lesser extent industrial/maintenance workers did not affect in the distribution of diseases as calculated in the proportionate mortality analysis. Among industrial/maintenance workers, an excess of cancer of the prostate and digestive organs were the only significant cancer excesses.

As other specialties contributed even fewer members to the cohort, no attempt was made to analyze separately the other specialties, including scenic artists, wood finishers, paperhangers, and dry wall tapers. Throughout these analyses, a large number of comparisons have been made and a number of significant findings would have resulted by chance alone. The results of these analyses of the various trade specialties should be considered suggestive of risks and not viewed as definitive.

The reason for low all accident and motor vehicle accident mortality ratios for most of the specialty tradesmen remains unclear. There is no obvious work associated factor that would reduce their risk of motor vehicle accidents. Investigation of this finding is continuing. The consistently low SMRs among paintmakers are also being investigated in order to determine if vital status ascertainment was, for any reason, less complete for this group of workers.

Internal Comparisons of the Study Population

Internal comparisons of the study population were made using the method of Breslow and Day (1975). This method is an indirect method of standardization and is designed to compare the Standardized Mortality Ratio (SMR) of two or more populations. It represents a log-linear Poisson model with the following assumptions:

- 1) The two or more populations are independent subpopulations of the same population.
- 2) Observed events follow a Poisson distribution -- a reasonable assumption when the populations are large and observed events are rare.
- 3) Age-specific mortality rates vary between populations by a constant factor over all age groups.

The entire study population is used as the standard to calculate expected deaths for the subpopulations. This differs from the classical indirect adjustment method in which an external population is used to calculate expected deaths. For example, in this study, U.S. white males were used in the Monson program as the external population. This population may not be comparable to the study population. Workers employed in the painting industry may differ considerably from the general U.S. white male population in demographic, lifestyle and other factors that may affect health status. In addition, a working population is often healthier than the general population. Because of these differences, comparisons that use the U.S. white male population as a standard may not reflect the true risk of disease for workers employed in the painting industry. The use of an internal group as a standard, such as used in the method of Breslow and Day, provides an alternate basis for assessing the risk of disease due to occupational exposures.

When the entire study population was used as the standard and members of only mixed locals were compared to members of any specialty local, the SMR for all causes of death was 1.06 for members of mixed locals and 0.88 for members of specialty locals. (Table 5-18) The associated p-value for the differences between SMRs was less than 0.001. For all malignant neoplasms the differences were slightly greater with an SMR of 1.09 for members of mixed locals and 0.83 for members of specialty locals. The associated p-value was less than 0.001. In terms of specific cancer sites, there was an even greater difference in SMRs for cancer of the lung, with an SMR of 1.13 for mixed locals and 0.77 for specialty locals. The associated p-value was less than 0.001. Differences were also observed between the two groups in terms of cancer of the bladder and lymphopietic malignancies. For cancer of the bladder an SMR of 1.22 was calculated for members of mixed locals and 0.53 for members of specialty locals. The associated p-value was 0.022. For lymphatic malignancies the SMRs for individuals in mixed locals was 1.15 compared to 0.68 for members of specialty locals. The associated p-value was 0.025.

The elevated SMRs for lung cancer were seen in the comparisons with U.S. white males, and elevated odds ratios for both lung cancer and lymphatic malignancies were observed in the case-control studies. The elevation in bladder cancer was not statistically significant when comparisons were made with U.S. white males nor in the case-control study, although in the latter study only a small number of cases were included.

Phase II

RESULTS OF CASE-CONTROL STUDY

INTRODUCTION

To study the cancer experience of painters further, a nested case-control approach utilizing cancer cases and a random sample of non-cancer controls from the same state union population was employed. The results of the case-control studies are presented in two sections. The first section provides the results of the study of lung cancer risks among painters.

THE CASE-CONTROL STUDY OF LUNG CANCER RISKS AMONG PAINTERS

Sixty-nine respondents were lung cancer cases, 182 were controls without cancer at any site.

Considerable variation existed between cases and controls in terms of type of respondent who answered the questionnaire (Table 5-19). All but four of the questionnaires from the lung cancer cases were completed by proxy respondents. For the controls, proxy respondents were required for only 30%. The spouses provided information for the majority of lung cancer cases while the member provided the information for the majority of non-cancer controls. There is no way of overcoming this potential respondent bias when dealing with a highly lethal disease such as lung cancer. However, most of the questionnaire dealt with information which should be well known to spouse respondents.

I. DEMOGRAPHIC CHARACTERISTICS

There were no statistically significant differences in age between the groups, although a smaller proportion of lung cancer cases than controls was born before 1900 (Table 5-20). Information on race was available for all but ten study subjects. Eleven blacks, (4.6%) in the study reflect, for the most part, the small number of blacks and Hispanics within IBPAT. As the number of non-whites in the study was small, they were pooled with white subjects for analysis.

Of the individuals who provided information on marital status, 82% had been married, 10% widowed, 4% divorced and 4% single, with no significant variation between the cases and control groups in marital status (Table 5-21). Lung cancer cases tended to report a somewhat higher number of children than the control group, with 50% of lung cancer cases reporting three or more children compared to 34% of non-cancer controls.

Information on education was collected as a measure of socio-economic status. There was a statistically significant difference in number of years of schooling between the lung cancer cases and non-cancer controls. Fifty-four percent of lung cancer cases reported fewer than nine years of schooling, but only 36% of non-cancer controls reported fewer than nine years.

II. OCCUPATIONAL CHARACTERISTICS

The occupation of "painter" represents the primary exposure of interest in this study. Work as a painter has been measured in the following ways:

- i. usual job
- ii. job while a member of IBPAT
- iii. ever worked as a painter
- iv. type of painting

Painters are defined for this study as workers who apply paints to buildings and structures (i.e., construction and maintenance painters) or painters of manufactured articles.

i. Usual Occupation

Usual occupation represents the primary measure of the exposure of interest in this study (Table 5-22). The odds ratio associated with a usual job of painter for lung cancer cases compared to non-cancer controls is 2.75 (1.45, 5.21). Odds ratios were significantly elevated for lung cancer cases compared to controls for both those employed 30 or more years (Table 5-23). In this study population overall, there appears to be little job mobility, with both painters and allied tradesmen remaining at their trade for most, if not all, their working lifetime.

ii. Usual Trade Area While a Member of IBPAT

In addition to usual job, information concerning usual occupation while a member of the union was also sought. This question was not as well answered as usual job, with approximately one-third of the case and control group not responding to the question. The estimated odds ratio was 3.17 (1.43, 7.05) for cases vs. non-cancer controls (Table 5-24).

iii. Ever Working in the IBPAT Trade Areas

In addition to determining usual job, information was collected as to whether the subject had ever worked as a painter and in specified IBPAT trade areas. Only 30 individuals indicated they had never worked in any of these areas. The specific trade areas consisted of new construction painting, industrial or maintenance painting, specialty painting, paint making, glazing, paperhanging, tile or carpet laying, and dry wall taping. Overall, new construction painting was the most frequently reported area, followed by industrial or maintenance painting, paperhanging and dry wall taping.

When the three painting categories of new construction, maintenance, and specialty were combined and individuals who had worked in any of these were compared to those who had not (Table 5-25), the odds ratio was 2.57 (1.34, 4.94) for lung cancer cases compared to non-cancer controls.

When compared to non-cancer controls, for specific trade areas, significantly elevated odds ratios were observed for those lung cancer cases reporting they ever worked in new construction painting, industrial or maintenance painting, tile or carpet laying and drywall taping (Table 5-26).

iv. Work as a Painter in Selected Industries

Since working as a painter in industries such as airplane manufacture, railcar manufacture, and shipbuilding may imply exposures to specific types of paints, particularly chromate primers and epoxy resins, work as a painter in these specific areas was queried. However, few respondents had ever worked in any of these industries. Only 19 individuals reported ever working as a painter in the shipbuilding industry and another 14 in either auto, aircraft or railroad car painting. The construction industry was most frequently reported, with 68 individuals reporting they had ever worked in the

construction industry. The odds ratios associated with ever working as a painter in any of these industries compared to never working in any of them are indicated in Table 5-27. Only the odds ratio for work in the construction industry cases compared to non-cancer controls of 2.96 (1.49, 5.90) is significantly different from one, although all are elevated.

III. THE WORK ENVIRONMENT

i. Use of Protective Equipment or Clothing

The use of a respirator or other protective equipment can limit the worker's exposure to the materials in his environment. The majority of workers in this study used little protective equipment. Fifty-four percent of respondents indicated that they never used a respirator. The estimated odds ratios associated with ever wearing a mask was 1.57 (0.86, 2.87) for lung cancer cases compared to non-cancer controls (Table 5-28). When workers did wear a mask, the majority (73%) of lung cancer cases reported using only a paper disposable mask, while the majority of non-cancer controls (56%) reported using other types of masks, such as a cartridge respirator or a hood (Table 5-28). Paper masks can prevent the inhalation of particles but not vapors from paints and solvents. The differences in type of mask worn resulted in elevated odds ratios associated with wearing a paper or disposable mask for cases compared to each controls, with an estimated odds ratio of 3.30 (0.99, 10.93) for lung cancer cases vs. non-cancer controls.

Most respondents (69%) reported wearing no other protective equipment (Table 5-29). There was no statistically significant difference in use of protective equipment other than a mask between cases and controls.

ii. Use of Spackling Compound

Spackling compound is used by painters and dry wall tapers to fill holes in walls and cover the seams between sheets of dry wall. For many years, spackling compound contained asbestos. Ninety-three percent of lung cancer cases, and 69% of non-cancer controls reported ever using spackling. Seventy-eight percent of cases used spackling once a week or more compared to 48% of non-cancer controls. The differences in frequency of use of spackling was significant (Table 5-30). The estimated odds ratios associated with ever using spackling 5.23 (1.89, 14.48) for cases compared to non-cancer controls (Table 5-31).

iii. Work as a Sandblaster

Only 27 individuals reported ever working as a sandblaster. The estimated odds ratio for ever working as a sandblaster was 1.89 (0.83, 4.33) for cases compared to non-cancer controls (Table 5-32).

iv. Reported Exposure To Specific Substances

Approximately 70% of respondents indicated contact with at least one item listed in the materials checklist. Lead was the most commonly reported exposure (Table 5-33), with more cases than non-cancer controls reporting

exposure to lead. Lead was a common component in many paints, suggesting an indirect association with the job of painter. Asbestos was the second most frequently reported substance, with a significantly elevated estimated odds ratio of 2.30 (1.08, 4.90) for lung cancer cases compared to non-cancer controls.

v. Exposures to Possible Lung Carcinogens in Occupations
Other Than The Painting and Allied Trade Areas

To assess possible exposures to occupational carcinogens outside the painting and allied trade areas, work in particular industries and occupations considered to be high risk for cancer was queried. Such exposures outside the painting and allied trade areas were measured by two questions: one eliciting information on employment in specific industries, the second querying work in specific occupations.

From these industries and occupations, those considered to be associated with an elevated risk specifically of lung cancer were determined from "Occupation" (Cole, 1975) in Persons At High Risk Of Cancer. The industries selected were: asbestos mining or milling, uranium mining, petroleum production, smelting, tanning, and textile production. The selected occupations were: battery worker, automotive brake repair, insulator and pipefitter. Anyone reporting employment in one of these industries or occupations was classified as having a possible exposure to a lung carcinogen outside the painting and allied trade areas and was compared to individuals not reporting work in any of these specific industries or occupations.

In total, 59% of respondents had never worked in any of the industries in the checklist. The percentage was slightly lower (51%) among lung cancer cases than controls (62%). Work in the construction industry was most frequently reported, with 22 lung cancer cases, 38 cancer controls and 46 non-cancer controls indicating that they had worked in construction. Farming was the second most commonly reported industry, with 15 individuals indicating they had farmed at some time. Except for the construction industry, which is associated with painting, none of the industries listed indicated a significantly elevated odds ratio for lung cancer associated with employment in that industry (Table 5-34).

When work in specific occupations was considered, only 20% of individuals reported working in any of the listed occupations. Machinist was the most frequently reported, with 2 lung cancer cases, and 12 non-cancer controls indicating they had been machinists at one time. However, for none of the listed occupations was there a significantly elevated odds ratio (Table 5-35) for lung cancer associated with the job. When working in any of the high risk industries or occupations was considered (Table 5-36), no excess risks were observed.

IV. SMOKING CHARACTERISTICS

i. Cigarette Smoking

Cigarette smoking is the single most important etiologic agent in the development of lung cancer. Because of the association with cigarette smoking and lung cancer, examination of other potential risk factors including occupation must take into account cigarette smoking as a possible confounding factor.

Among lung cancer cases, 100% (67 individuals) indicated that they were smokers, compared to 77% of non-cancer controls (Table 5-37). Two lung cancer cases, and five non-cancer controls did not report their smoking habits. Lung cancer cases also reported smoking on average more cigarettes per day (28 cigarettes/day) than did non-cancer controls (25 cigarettes/day). The difference in mean number of cigarettes smoked per day was not statistically significant. (cases/non-cancer controls $t=-1.39$ $p=.17$). Among smokers, 29% of lung cancer cases smoked two packs (40 cigarettes) or more a day, compared to and 25% of non-cancer controls (Table 5-38).

ii. Smoking Pipes and Cigars

Sixty-two individuals were regular smokers of cigars and 37 regular smokers of pipes. There was no statistically significant difference between lung cancer cases and controls in the proportion reporting regular use of either a pipe or cigars (Table 5-39).

V. DIETARY CHARACTERISTICS

i. Frequency of Consumption of Specific Food Items

Overall, for each food item, approximately 30% of the subjects did not indicate the frequency with which they ate that specific food. The non-response rate did not appear to vary in any systematic manner, being equally high for different types of items. There was very little difference between the cases and either control group in the frequency of consumption of most food items. The only significant difference in food consumption identified was a higher frequency of spinach consumption and the drinking of beer and whiskey among lung cancer cases compared to non-cancer controls (Table 5-40).

ii. Vitamin Usage

There were no differences between the cases and controls in the use of vitamin supplements: 43% of lung cancer cases, and 46% of non-cancer controls reported ever using vitamins. When analyzed by type of vitamin, multiple vitamins were most frequently reported. There were no significant differences in the estimated odds ratios associated with vitamin use for cases compared to controls in the consumption of any vitamin (Table 5-41).

VI. NEXT-OF-KIN RESPONSES TO SELECTED VARIABLES

Dead cases and controls may have additional common characteristics not shared by living members of the population. In this study, the control population was selected without regard to vital status. The controls were selected as a stratified random sample of all members of the New York cohort not identified by the New York State Cancer Registry as having cancer. The responses of this group should, it is hoped, be fairly representative of those of the union membership without cancer.

However, proxy respondents completed questionnaires for all but 4 (6%) of the lung cancer cases while only 30% of non-cancer control questionnaires were answered by proxies. Because of the possibility of a bias in reporting by proxy respondents and the differing proportions of proxy respondents among the cases and controls, the main study variables were examined separately for those questionnaires completed by proxy respondents. The variables reconsidered using only the questionnaires completed by proxy respondents were: usual job, IBPAT trade area, use of spackling, wearing a mask, and smoking characteristics.

When the relationship between usual job (Table 5-42) and usual job while a member of IBPAT (Table 5-43) was considered, the odds ratios decreased slightly in each case, although never falling below one. Confidence limits, however, did include one in each case, although this is influenced to some extent by the small number of subjects being considered. The estimated odds ratios for usual occupation decreased to 1.69 (0.75, 3.81) for cases compared to non-cancer controls. When IBPAT trade area was considered, a similar pattern emerged, with estimated odds ratio of 1.99 (0.74, 5.36) for cases compared to non-cancer controls.

When the smoking characteristics reported by next-of-kin (Table 5-44) only were compared to those for the entire study population, little change was observed. The percentage of smokers in each group varied only very slightly. Among the non-cancer controls, proxy responders reported a lower proportion of individuals smoking fewer than 20 cigarettes per day.

Use of spackling compound remained statistically significant for lung cancer cases compared to non-cancer controls (Table 5-45). The crude odds ratios are shifted slightly downward for each group of controls. When use of a mask or respirator was considered, the odds ratios decreased slightly. There was little change in the proportions of cases and either control group which reported ever wearing a mask (Table 5-46) and the odds ratios was not elevated.

VII MULTIVARIATE ANALYSIS

Selected variables found to be risk factors for lung cancer from the previous analysis were then assessed using a logistic model considering case-control status as the dependent variable. Either occupation (painter), or the use of spackling was considered as the study factor of primary interest along with cigarette smoking, age, education, exposure to asbestos, wearing a mask, and beer drinking were entered into a logistic regression model as the independent variables. As spackling compound is used by painters and thus is a component in their job, exposure to it is therefore a consequence of their work. Since 97% of painters reported that they used spackling, it was decided to not attempt to put two such highly correlated variables into the same model. Entering spackling along with work as a painter would result in an underestimation of the effect of job, to the extent that the use of spackling is determined by the fact that an individual is a painter. Therefore, separate models were developed, including either occupation or spackling, along with the other covariates previously listed.

Lung cancer cases were initially compared to non-cancer controls using occupation and all other specified variables except spackling in the model. A stepwise procedure was employed to select those significantly associated with the risk of disease, after adjustment for the other variables. The occupation of painter, smoking more than 10 cigarettes a day, never wearing a mask, drinking beer at least once a week; and exposure to asbestos were found to be significantly associated with lung cancer by this procedure. These five variables were then entered into a logistic model and the impact of selected interaction terms on the model was assessed. If not found to be significant, then the interaction term was not included. The likelihood ratio test was utilized to determine whether each of the variables and interaction terms was significantly associated with the risk of disease. One interaction term, the combination of usual occupation and not wearing a mask, was found to be significant.

Table 5-47 indicates the crude and adjusted odds ratios for those factors found to be significantly associated with the risk of lung cancer after adjustment for the other factors in the model. After adjustment, the lung cancer odds ratio associated with smoking ten or more cigarettes per day rose to 5.51 (1.78, 17.12). There was also a slight increase in the odds ratio associated with weekly beer consumption from 2.27 to 2.98. The odds ratio associated with asbestos exposure varied little from the unadjusted odds ratio of 2.30. The most dramatic shift in the estimated odds ratios was associated with usual job and non-use of a respirator. In the presence of the interaction term, there was a 5.45-fold excess risk of lung cancer associated with being a painter and never wearing a mask. Among painters who wore masks and non-painters who did not wear masks, the estimated odds ratio decreased to 1.1 and 0.7, respectively. The elevated odds ratios for these two variables in the crude analysis reflect the increased risk experienced by the subset of workers who are both painters and never wear a mask.

The use of spackling compound was substituted for occupation in the model (Table 5-48) and a similar procedure was followed. The odds ratio associated with beer drinking was similar to that estimated in the unadjusted analysis. The odds ratio associated with the use of spackling compound, adjusted for the other factors in the model, was estimated to decrease to 3.96 from the

unadjusted estimate of 5.23. The odds ratio associated with smoking 10 or more cigarettes a day increased from 3.13 to 6.63.

CASE-CONTROL STUDIES OF THE THE RISK CANCERS OF SITES OTHER THAN LUNG AMONG PAINTERS

I. INTRODUCTION

In this section, the results of the analysis of the case-control study data for colo-rectal cancers, prostate cancer, bladder cancer, and leukemias and lymphatic cancer are presented. No other cancer sites occurred with sufficient frequency to be considered in this analysis.

For each of the four sites, cancer cases were compared to the non-cancer control group for the variables in the questionnaire. Analysis was limited, however, by the smaller number of cases for these sites. To limit duplication of tables, the discussion is presented first, indicating the findings for each of the four sites, followed by the tables for each cancer site. No detectable excess cancer risks appear to be associated with work as a painter for either colo-rectal cancer, prostate cancer or bladder cancer. However, with a larger sample size, the elevated odds ratios associated with colo-rectal cancer might become statistically significant. Elevated odds ratios for leukemias and lymphatic cancers are associated with work as a painter. Although based on extremely small numbers, risks seem particularly high for industrial or maintenance painting and painting in either the automobile, aircraft or railroad industry. However, due to the small numbers, these elevated risks must be interpreted with caution. There is some suggestion in the literature that painters may be experiencing an excess of these cancers. The interview study of the Third National Cancer Survey (Williams 1977) reported a relative risk of 4.0 for leukemia among painters and 3.2 for Hodgkins Disease. However, the number of cases was small (2 and 1 case respectively) and the results were not statistically significant. The Tri-State Leukemia Study (Viadana 1972) reported a 2.8-fold excess of leukemia among construction painters. Risks were elevated for all age groups and increased with age. Conversely, a study from Roswell Park did not report any excess of leukemia or lymphomas among painters (Viadana 1976), nor did the 1970-72 report of the British Registrar General for either Hodgkins Disease or lymphosarcoma, although a slight but not significant excess of myeloid leukemia was observed.

II. COLO-RECTAL CANCER

Forty-three colo-rectal cancer cases were included in the study. Only 33% (14) of the questionnaires of the colo-rectal cancer cases were completed by the union member. Thirty-three percent (14) were completed by the wife, 23% (10) by the son or daughter and 12% (5) by some other proxy respondent. As 70% (127) of the controls completed their own questionnaire, the difference in type of respondent between the colo-rectal cancer cases and controls was statistically significant ($X^2=24.214$, $df=3$, $P=.0001$) (Table 5-49).

When the demographic characteristics of the colo-rectal cancer cases were compared to those of the controls, no differences were noted in terms of year of birth, race, marital status, or number of children. The two groups did differ in number of years of education, with a smaller proportion of colo-rectal cancer cases than controls reporting 9-11 years of schooling (Table 5-50, 5-51).

When the occupational characteristics of the colo-rectal cancer cases were compared to the controls, no significantly elevated odds ratios were observed to be associated with either a usual occupation of painter, an IBPAT trade specialty of painting, or ever working as a painter. Odds ratios are elevated in each case, however, varying from 1.57 for IBPAT trade specialty to 2.06 for ever working as a painter (Table 5-52).

When work in specific trade areas was queried, no significantly elevated colo-rectal cancer risks were observed to be associated with any of the IBPAT trades specified (Table 5-53, 5-54). Similarly, when work as a painter in either the aircraft, automobile, railcar manufacture, shipbuilding, construction or maintenance industries was investigated, no significantly elevated ratios were observed (Table 5-55, 5-56).

The work environment of cases and controls was investigated in respect to use of a mask or respirator, the type of mask worn if used, the use of any other protective equipment, the use of spackling compound, and whether the individual had worked as a sandblaster. The colo-rectal cases did not differ from controls with respect to any of these characteristics. Odds ratios were calculated for each of these variables as indicated in Table 5-57. The confidence limits for the odds ratios included one in each case.

When exposures to possible carcinogens in the workplace were considered, the only significantly elevated odds ratios observed were for those subjects exposed to creosote or other wood preservatives (Table 5-58). Although the odds ratios are elevated for several other substances, the number of reported exposures to most substances is small and odds ratios are not significantly different from one.

Individuals were also asked about any exposures they might have had on the job which they considered dangerous or hazardous. No elevated odds ratios were found for colo-rectal cancers compared to controls for any of these reported exposure categories. As with the lung cancer cases, few colo-rectal cancer cases reported ever working in either industries or occupations outside the painting trades which might result in an excess cancer risk. No odds ratios were calculated, as the number of cases reporting work in this area was small. Tables 5-59 and 5-60 list the industries and occupations of interest in which cases reported working for each of the individual cancer sites. Employment in asbestos mining or milling was reported by two cases, auto repair or service by three cases, petroleum production by one case, the textile industry by one case, the wood treatment industry by three cases and farming by three cases. In terms of occupations reported, one colo-rectal cancer case reported working as an insulator, two as machinists, and two as welders.

Colo-rectal cancer cases were more likely to report being smokers (83%) than were controls (77%), although the difference was small. When number of cigarettes smoked per day was assessed, the cases reported a smaller percentage (13%) of individuals smoking 40 or more cigarettes per day than did the controls, of whom 23% smoked 40+ cigarettes a day, but the difference was not significant ($X^2=3.876$, $df=2$, $P=.144$) (Table 5-61).

There were no differences between cases and controls in the consumption of specified dietary items, nor in the use of vitamins or artificial sweeteners (Tables 5-52, 5-53).

III. PROSTATE CANCER

There were 22 cases of prostate cancer included in the study. Four (18%) of the questionnaires were completed by the union member, nine (41%) by the wife, eight (36%) by the son or daughter and one (5%) by another proxy respondent (Table 5-49). The prostate cancer cases did not differ from the controls in terms of birth date, race, marital status, number of children or years of schooling (Table 5-50). When the occupational characteristics of the prostate cancer cases were compared to controls, no excess risk of prostate cancer was observed to be associated with work as a painter as measured by usual job, IBPAT trade area, or ever working as a painter (Table 5-52). Similarly, no significantly elevated odds ratios were associated with specific IBPAT trades. A ten fold excess was calculated for tile and carpet layers (based on one case) and the odds ratio included one (Tables 5-53, 5-54). When work as a painter in specific industries was considered, a four fold excess risk was associated with work in the shipbuilding industry, with an odds ratio of 4.22, and a 3.82-fold excess was found with work in either the auto, aircraft or railroad industry. The confidence limits of this latter odds ratio included one, however, and both are based on a small number of cases (Tables 5-55, 5-56). When the work environment characteristics of the cases were compared to controls, no major differences were observed (Table 5-57).

When exposures to specific substances were considered, elevated odds ratios were associated with exposure to dyestuffs and formaldehyde among prostate cancer cases, although this finding is based on three and two cases, respectively (Table 5-58). When work in areas outside the painting and allied trades was examined, three prostate cancer cases reported working in the petroleum industry (Table 5-59). No prostate cancer cases reported working in any of the other industries of interest. When work in specific occupations was queried, none of the prostate cancer cases reported working in any of the occupations specified (Table 5-60).

Fewer prostate cancer cases than controls reported smoking cigarettes ($\chi^2=3.999$, $df=1$, $P=0.045$). Among the cases which did smoke cigarettes, there was no significant difference in number of cigarettes smoked per day (Table 5-61). When dietary characteristics were considered, a higher proportion of prostate cancer cases than controls reported drinking both tea and beer once a week or more (Table 5-62). Cases did not differ from controls in their use of vitamins or artificial sweeteners (Table 5-63).

IV. BLADDER CANCER

Twenty-six bladder cancer cases were included in the study. Fifteen (58%) of these individuals completed their own questionnaires and 11 (42%) were completed by proxy respondents. The distribution of type of respondent did not differ significantly between bladder cancer cases and controls (Table 5-49). Bladder cancer cases also did not differ from controls in terms of year of birth, race, marital status, number of children or years of schooling

completed (Table 5-50). There was no indication of any excess bladder cancer risk associated with work as a painter (Table 5-52) when measured either as usual job, IBPAT trade area, or ever working as a painter. Similarly, no excess appeared with working in any of the specific IBPAT trades (Tables 5-54, 5-55) or with working as a painter in the automobile, aircraft, railroad, or shipbuilding industries, or in construction or maintenance painting (Tables 5-55, 5-56). No excess bladder cancer risk was associated with not using a mask or respirator or other protective equipment (Table 5-57). Use of spackling compound is also not associated with a significant excess of bladder cancer, nor is work as a sandblaster (Table 5-57). When exposure to specified substances was examined, no significantly elevated odds ratios for bladder cancer were observed (Table 5-58). When specific industries and occupations outside IBPAT were considered, one bladder cancer case reported working in auto repair or service and two in farming (Table 5-59). One bladder cancer case reported working as a brake repairman, one as a pipefitter, one as a plumber, two as machinists and two as welders (Table 5-60).

Bladder cancer cases were not different from controls in their cigarette smoking characteristics. There was a tendency among the smokers for fewer bladder cancer cases than controls to smoke fewer than twenty cigarettes per day (Table 5-61). There was no difference between bladder cancer cases and controls in the frequency of consumption of various food items or use of vitamins (Tables 5-62, 5-63). A lower proportion of bladder cancer cases than controls reported ever using artificial sweeteners, but the difference was not statistically significant ($X^2=1.6$, $df=1$, $P=.206$).

V. LEUKEMIAS AND LYMPHATIC CANCERS

This grouping consists of ICD-9 codes 200-208. Eighteen cases were included in the study. Only 3 (17%) of the subjects completed the questionnaire themselves, while 83% were completed by proxy respondents. The wife was the respondent for six cases (33%), the son/daughter for five (28%), and other proxy respondents for four (22%) (Table 5-49). Cases did not vary from controls with respect to their marital status, number of children, race or year of birth. Cases were more likely than controls to have completed 12 or more years of education, although the difference was not statistically significant (Table 5-50). When the occupational characteristics of the cases were examined, (Table 5-52) elevated odds ratios were found associated with each of the three measures of work as a painter. A three fold excess was associated with usual job of painter, a six fold excess with painting as the IBPAT trade area, and seven fold excess associated with ever working as a painter. Although the number of cases is small, the confidence limits on the calculated odds ratios do not include one for either usual job of painter or ever working as a painter. For work in specific IBPAT trades, there is a suggestion of elevated risk, but not significantly so for any of the trades except glazing (Tables 5-53, 5-54). When work as a painter in specific paint use industries was examined (Tables 5-55, 5-56), two cases (11%) reported working as a painter in the auto, aircraft, or railcar industry; one in shipbuilding; eight in construction and four in industrial or maintenance painting. A seven fold excess was associated with work as a painter in the auto, aircraft, or railroad industries; a five fold excess associated with the construction industry, and a fifteen fold excess with industrial or maintenance painting. The confidence limits on the odds ratios did not

include one for any of these industries except shipbuilding, but as the number of cases is very small in each category, caution is required in interpreting the results. When the number of years worked in each of these industries was reviewed, no obvious association with years of employment in the industry could be observed (Table 5-64). No excess risks were associated with any of the measured characteristics of the work environment (Table 5-57).

When exposures to specific substances were considered, elevated odds ratios were estimated for most of the substances (Table 5-58). However, the number of cases is small and most substances are not known to be etiologic agents for these cancers. A six fold excess odds ratio was calculated to be associated with solvent exposure, with the confidence limits ranging from 0.91 to 37.75. When reported dangerous or hazardous exposures are considered, the odds ratios are elevated, with confidence limits not including one for exposure to chemicals, metals and other agents.

In terms of work in specific industries and occupations outside the IBPAT trade areas, one case reported working in the asbestos mining or milling industry, one in non-uranium mining, two in petroleum production, one in the wood treatment industry and two in farming (Table 5-59). Work in the petroleum production industry or in farming might suggest exposures outside the painting and allied trade areas which could influence the observed cancer risks. One case reported working as an electrician and one as a machinist (Table 5-60).

When the smoking and dietary habits of cases were compared to controls, cases differ from controls in the reported proportion of cigarette smokers or in the number of cigarettes smoked per day (Table 5-61). Similarly, cases did not vary from controls in the frequency of consumption of specific food items (Table 5-62), in their use of vitamins, or in their reported use of artificial sweeteners (Table 5-63).

Table 5-1
Age Distribution of Study Population in Union 1975-79

<u>Age Group</u>	<u>Population Size</u>	<u>Person-Years</u>
35-39	8,271	19,826.1
40-44	8,492	38,800.0
45-49	8,158	36,677.0
50-54	7,750	36,215.6
55-59	6,773	33,291.7
60-64	5,896	29,394.7
65-69	4,795	24,399.8
70-74	3,415	18,409.9
75-79	1,997	11,169.4
80-84	1,115	5,912.3
85-89	412	2,412.1
90-94	95	634.1
95+	6	79.4
Total	57,175	257,221.5

Table 5-2
Distribution of Deaths by Age

<u>Age</u>	<u>No. of deaths</u>	<u>Cum. Percent</u>
35-39	37	0.7
40-44	97	2.5
45-49	155	5.4
50-54	271	10.5
55-59	419	18.4
60-64	602	29.8
65-69	747	43.8
70-74	992	62.5
75-79	847	78.4
80-84	604	89.8
85-89	401	97.4
90-94	120	99.6
95+	21	100.0
Total	5,313	

Table 5-3

Distribution of Deaths by Year of First Joining Union-

<u>Entry Period</u>	<u>No. of Deaths</u>	<u>% of Deaths</u>
<1930	548	10.3
1930-1939	1,035	19.5
1940-1949	1,699	32.0
1950-1959	1,082	20.4
1960-1969	564	10.6
1970+	385	7.2
Total	5,313	

Table 5-4

Standardized Mortality Ratios for Selected Causes of Deaths in
Members IBPAT 1975-79

	<u>Observed</u>	<u>Expected</u>	<u>Obs/Exp</u>
All Causes of Death	5,313	6063.78	0.88*
All Malignant Neoplasms	1,281	1268.75	1.01
All Infective and Parasitic Disease	30	37.77	0.79
All Tuberculosis	10	11.27	0.89
Cancer of Buccal Cavity and Pharynx	27	35.84	0.75
Cancer of Digestive Organs and Peritoneum	348	337.44	1.03
Cancer of Esophagus	26	28.87	0.90
Cancer of Stomach	69	54.31	1.27
Cancer of Large Intestine	135	123.26	1.10
Cancer of Rectum	30	35.79	0.84
All Cancer of Liver	28	19.02	1.47
Cancer of Pancreas	51	69.44	0.73*
Cancer of Respiratory System	471	444.33	1.06
Cancer of Larynx	17	17.59	0.97
All Cancer of Lung	448	424.39	1.06
Cancer of Bone	4	4.42	0.90
Cancer of Skin	13	19.60	0.66
Cancer of Prostate	117	118.46	0.99
Cancer of Testis	2	3.53	0.57
Cancer of Bladder	48	45.24	1.06
Cancer of Kidney	38	29.63	1.28
Cancer of Eye	0	0.92	0.00
Cancer of Brain and Other Central Nervous System	15	27.02	0.56*
Cancer of Thyroid	2	1.95	1.03
Lymphosarcoma and Reticulosarcoma	20	19.74	1.01
Hodgkin's Disease	3	7.21	0.42
Leukemia and Aleukemia	44	47.19	0.93
Cancer of Other Lymphatic Tissue	32	34.57	0.93
All Lymphopoietic Cancer	105	112.78	0.93
Benign Neoplasms	14	14.01	1.00
Allergic, Endocrine, Metabolic, Nutritional Diseases	78	106.02	0.74*
Diabetes Mellitus	63	87.79	0.72*
All Diseases of Blood and Blood-Forming Organs	6	13.07	0.46
Mental, Psychoneurotic, and Personality Disorders	17	28.15	0.60*
All Diseases of Nervous System and Sense Organs	25	43.01	0.58*
All Diseases of Circulatory System	2,555	3379.47	0.76*
Chronic Rheumatic Heart Disease	40	36.37	1.10
Arteriosclerotic Heart Disease, Including CHD	1,820	2400.87	0.76*
All Vascular Lesions of CNS	329	516.64	0.64*
All Respiratory Diseases	387	447.18	0.87*
All Pneumonia	150	160.27	0.94
Emphysema	64	105.27	0.61*
Asthma	3	4.17	0.72
All Diseases of Digestive System	201	242.09	0.83*
All Gastric and Duodenal Ulcer	19	27.01	0.70
Cirrhosis of Liver	115	124.14	0.93
All Diseases of Genito-Urinary System	60	75.23	0.80
Chronic Nephritis	12	15.69	0.76
All Diseases of the Skin and Cellular Tissue	4	4.18	0.96
All Diseases of the Bones and Organs of Movement	6	10.33	0.58
Symptoms, Senility, and Ill Defined Conditions	84	70.55	1.19
All External Causes of Death	276	318.76	0.87*
All Accidents	157	202.56	0.78*
Motor Vehicle Accidents	55	72.34	0.76*
Suicide	81	81.10	1.00
Total Residual	289	5.20	55.54
Cancer Residual	91	87.59	1.04

* Significant at p <.05

Table 5-5

Proportional Mortality Ratios for Selected Causes of Death in
Members IBPAT 1975-79

	<u>Observed</u>	<u>Expected</u>	<u>Obs/Exp</u>
All Malignant Neoplasms	1,282	1142.21	1.12*
All Infective and Parasitic Disease	30	33.22	0.90
All Tuberculosis	10	10.01	1.00
Cancer of Buccal Cavity and Pharynx	28	32.98	0.85
Cancer of Digestive Organs and Peritoneum	348	300.73	1.16*
Cancer of Esophagus	26	26.39	0.99
Cancer of Stomach	69	47.98	1.44*
Cancer of Large Intestine	135	109.02	1.24*
Cancer of Rectum	30	31.61	0.95
All Cancer of Liver	28	17.08	1.64*
Cancer of Pancreas	51	62.62	0.81
Cancer of Respiratory System	471	410.35	1.15*
Cancer of Larynx	17	16.10	1.06
All Cancer of Lung	448	392.11	1.14*
Cancer of Bone	4	4.04	0.99
Cancer of Skin	13	18.05	0.72
Cancer of Prostate	117	97.85	1.20*
Cancer of Testis	2	3.40	0.59
Cancer of Bladder	48	38.80	1.24
Cancer of Kidney	38	27.22	1.40*
Cancer of Eye	0	0.84	0.00
Cancer of Brain and Other Central Nervous System	15	25.94	0.58*
Cancer of Thyroid	2	1.76	1.14
Lymphosarcoma and Reticulosarcoma	20	18.11	1.10
Hodgkin's Disease	3	6.86	0.44
Leukemia and Aleukemia	44	41.60	1.06
Cancer of Other Lymphatic Tissue	32	31.19	1.03
All Lymphopietic Cancer	105	101.38	1.04
Benign Neoplasms	14	12.74	1.10
Allergic, Endocrine, Metabolic, Nutritional Diseases	78	93.28	0.84
Diabetes Mellitus	63	77.29	0.82
All Diseases of Blood and Blood-Forming Organs	6	11.21	0.54
Mental, Psychoneurotic, and Personality Disorders	17	26.46	0.64
All Diseases of Nervous System and Sense Organs	25	39.05	0.64*
All Diseases of Circulatory System	2,555	2903.62	0.88*
Chronic Rheumatic Heart Disease	40	33.57	1.19
Arteriosclerotic Heart Disease, Including CHD	1,820	2086.60	0.87*
All Vascular Lesions of CNS	329	423.23	0.78*
All Respiratory Diseases	387	381.99	1.01
All Pneumonia	150	130.33	1.15
Emphysema	64	92.98	0.69*
Asthma	3	3.82	0.78
All Diseases of Digestive System	201	222.70	0.90
All Gastric and Duodenal Ulcer	19	23.74	0.80
Cirrhosis of Liver	115	119.29	0.96
All Diseases of Genito-Urinary System	60	61.97	0.97
Chronic Nephritis	12	13.61	0.88
All Diseases of the Skin and Cellular Tissue	4	3.54	1.13
All Diseases of the Bones and Organs of Movement	6	9.23	0.65
Symptoms, Senility, and Ill Defined Conditions	84	63.49	1.32*
All External Causes of Death	276	306.25	0.90
All Accidents	157	191.53	0.82*
Motor Vehicle Accidents	55	71.32	0.77
Suicide	81	78.97	1.03
Total Residual	291	5.04	57.73
Cancer Residual	91	78.88	1.15

* Significant at p < .05

Table 5-6
 Number of Individuals in Cohort by
 Specialty Affiliation (1975+)*

Mixed local only	33118
Auto, Ship, Structural Steel Painters	2144
Industrial/Maintenance Painters	1648
Civil Service Painters	554
Glaziers	4943
Sign Painters	3694
Paint Makers	2413
Floor Coverers	3480
Scenic Artists/Fresco Painters	1054
Wood Finishers	1185
Paperhangers	462
Dry Wall Tapers	512
Warehouse Workers	1088
Metal Polishers	1053

*Individuals may be counted into more than one specialty local.

Table 5-7

Standardized Mortality Ratios for Selected Causes of Death
in Members of Only "Mixed" Local of IBPAT 1975-79

	<u>Observed</u>	<u>Expected</u>	<u>Obs/Exp</u>
All Causes of Death	3811	4092.68	0.93*
All Malignant Neoplasms	927	843.78	1.10*
All Infective and Parasitic Disease	20	25.31	0.79
All Tuberculosis	6	7.49	0.80
Cancer of Buccal Cavity and Pharynx	18	23.02	0.78
Cancer of Digestive Organs and Peritoneum	249	227.15	1.10
Cancer of Esophagus	19	18.83	1.01
Cancer of Stomach	50	36.72	1.36*
Cancer of Large Intestine	93	83.70	1.11
Cancer of Rectum	24	24.27	0.99
All Cancer of Liver	20	12.82	1.56
Cancer of Pancreas	37	46.35	0.80
Cancer of Respiratory System	342	288.51	1.19*
Cancer of Larynx	12	11.44	1.05
All Cancer of Lung	326	275.54	1.18*
Cancer of Bone	3	2.87	1.04
Cancer of Skin	10	12.39	0.81
Cancer of Prostate	84	85.73	0.98
Cancer of Testis	0	2.18	0.00
Cancer of Bladder	40	31.73	1.26
Cancer of Kidney	27	19.12	1.41
Cancer of Eye	0	0.61	0.00
Cancer of Brain and Other Central Nervous System	9	16.39	0.55
Cancer of Thyroid	1	1.27	0.79
Lymphosarcoma and Reticulosarcoma	17	12.76	1.33
Hodgkin's Disease	1	4.46	0.22
Leukemia and Aleukemia	37	31.81	1.16
Cancer of Other Lymphatic Tissue	22	22.87	0.96
All Lymphopoietic Cancer	83	74.71	1.11
Benign Neoplasms	8	9.12	0.88
Allergic, Endocrine, Metabolic, Nutritional Disease	57	71.91	0.79
Diabetes Mellitus	49	59.76	0.82
All Diseases of Blood and Blood-Forming Organs	3	8.98	0.33*
Mental, Psychoneurotic, and Personality Disorders	13	17.22	0.75
All Diseases of Nervous System and Sense Organs	20	28.25	0.71
All Diseases of Circulatory System	1824	2318.28	0.79*
Chronic Rheumatic Heart Disease	28	23.37	1.20
Arteriosclerotic Heart Disease, Including CHD	1299	1630.95	0.80*
All Vascular Lesions of CNS	237	368.83	0.64*
All Respiratory Diseases	315	312.53	1.01
All Pneumonia	108	113.62	0.95
Emphysema	55	73.09	0.75*
Asthma	3	2.72	1.10
All Diseases of Digestive System	142	152.76	0.93
All Gastric and Duodenal Ulcer	14	18.26	0.77
Cirrhosis of Liver	73	73.38	0.99
All Diseases of Genito-Urinary System	44	53.29	0.83
Chronic Nephritis	8	10.71	0.75
All Diseases of the Skin and Cellular Tissue	2	2.91	0.69
All Diseases of the Bones and Organs of Movement	5	6.85	0.73
Symptoms, Senility, and Ill Defined Conditions	64	46.01	1.39
All External Causes of Death	190	192.37	0.99
All Accidents	114	124.77	0.91
Motor Vehicle Accidents	35	43.00	0.81
Suicide	53	47.83	1.11
Total Residual	177	3.12	56.77
Cancer Residual	61	58.11	1.05

* Significant at $p < .05$

Table 5-8

Proportional Mortality Ratios for Selected Causes of Death in
Members of Only "Mixed" Locals of IBPAT 1975-79

	<u>Observed</u>	<u>Expected</u>	<u>Obs/Exp</u>
All Malignant Neoplasms	928	816.90	1.14*
All Infective and Parasitic Disease	20	23.69	0.84
All Tuberculosis	6	7.12	0.84
Cancer of Buccal Cavity and Pharynx	19	23.12	0.82
Cancer of Digestive Organs and Peritoneum	249	216.70	1.15*
Cancer of Esophagus	19	18.69	1.02
Cancer of Stomach	50	34.61	1.44*
Cancer of Large Intestine	93	78.93	1.18
Cancer of Rectum	24	22.85	1.05
All Cancer of Liver	20	12.35	1.62*
Cancer of Pancreas	37	44.98	0.82
Cancer of Respiratory System	342	290.42	1.18*
Cancer of Larynx	12	11.39	1.05
All Cancer of Lung	326	277.54	1.17*
Cancer of Bone	3	2.83	1.06
Cancer of Skin	10	12.37	0.81
Cancer of Prostate	84	73.67	1.14
Cancer of Testis	0	2.30	0.00
Cancer of Bladder	40	28.65	1.40*
Cancer of Kidney	27	19.10	1.41
Cancer of Eye	0	0.60	0.00
Cancer of Brain and Other Central Nervous System	9	17.54	0.51*
Cancer of Thyroid	1	1.24	0.81
Lymphosarcoma and Reticulosarcoma	17	12.70	1.34
Hodgkin's Disease	1	4.68	0.21
Leukemia and Aleukemia	37	29.82	1.24
Cancer of Other Lymphatic Tissue	22	22.22	0.99
All Lymphopietic Cancer	83	72.07	1.15
Benign Neoplasms	8	8.95	0.89
Allergic, Endocrine, Metabolic, Nutritional Disease	57	67.27	0.85
Diabetes Mellitus	49	55.93	0.88
All Diseases of Blood and Blood-Forming Organs	3	8.12	0.37
Mental, Psychoneurotic, and Personality Disorders	13	17.81	0.73
All Diseases of Nervous System and Sense Organs	20	27.57	0.73
All Diseases of Circulatory System	1824	2102.19	0.87*
Chronic Rheumatic Heart Disease	28	23.48	1.19
Arteriosclerotic Heart Disease, Including CHD	1299	1503.10	0.86*
All Vascular Lesions of CNS	237	313.53	0.76*
All Respiratory Diseases	315	280.88	1.12*
All Pneumonia	108	95.71	1.13
Emphysema	55	68.66	0.80
Asthma	3	2.71	1.11
All Diseases of Digestive System	142	152.95	0.93
All Gastric and Duodenal Ulcer	14	17.09	0.82
Cirrhosis of Liver	73	79.04	0.92
All Diseases of Genito-Urinary System	44	45.63	0.96
Chronic Nephritis	8	9.83	0.81
All Diseases of the Skin and Cellular Tissue	2	2.58	0.77
All Diseases of the Bones and Organs of Movement	5	6.57	0.76
Symptoms, Senility, and Ill Defined Conditions	64	44.50	1.44
All External Causes of Death	190	204.01	0.93
All Accidents	114	129.04	0.88
Motor Vehicle Accidents	35	47.30	0.74
Suicide	53	51.99	1.02
Total Residual	178	3.35	53.09
Cancer Residual	61	56.29	1.08

* Significant at $p < .05$

Table 5-9.

Standardized Mortality Ratios for Selected Causes of Death in
Members of any "Specialty" locals of IBPAT, 1975-79

	<u>Observed</u>	<u>Expected</u>	<u>Obs/Exp</u>
All Causes of Death	1480	1961.60	0.75*
All Malignant Neoplasms	354	423.79	0.84*
All Infective and Parasitic Disease	10	12.41	0.81
All Tuberculosis	4	3.77	1.06
Cancer of Buccal Cavity and Pharynx	9	12.79	0.70
Cancer of Digestive Organs and Peritoneum	99	109.93	0.90
Cancer of Esophagus	7	10.02	0.70
Cancer of Stomach	19	17.52	1.08
Cancer of Large Intestine	42	39.42	1.07
Cancer of Rectum	6	11.47	0.52
All Cancer of Liver	8	6.18	1.29
Cancer of Pancreas	14	23.04	0.61
Cancer of Respiratory System	129	155.62	0.83*
Cancer of Larynx	5	6.13	0.82
All Cancer of Lung	122	148.66	0.82*
Cancer of Bone	1	1.55	0.65
Cancer of Skin	3	7.20	0.42
Cancer of Prostate	33	32.46	1.02
Cancer of Testis	2	1.35	1.48
Cancer of Bladder	8	13.44	0.60
Cancer of Kidney	11	10.49	1.05
Cancer of Eye	0	0.31	0.00
Cancer of Brain and Other Central Nervous System	6	10.62	0.56
Cancer of Thyroid	1	0.67	1.49
Lymphosarcoma and Reticulosarcoma	3	6.97	0.43
Hodgkin's Disease	2	2.74	0.73
Leukemia and Aleukemia	7	15.31	0.46*
Cancer of Other Lymphatic Tissue	10	11.66	0.86
All Lymphopietic Cancer	22	37.96	0.58*
Benign Neoplasms	6	4.88	1.23
Allergic, Endocrine, Metabolic, Nutritional Disease	21	33.95	0.62*
Diabetes Mellitus	14	27.91	0.50*
All Diseases of Blood and Blood-Forming Organs	3	4.06	0.74
Mental, Psychoneurotic, and Personality Disorders	4	10.91	0.37*
All Diseases of Nervous System and Sense Organs	5	14.73	0.34*
All Diseases of Circulatory System	728	1054.76	0.69*
Chronic Rheumatic Heart Disease	12	12.99	0.92
Arteriosclerotic Heart Disease, Including CHD	519	765.88	0.68*
All Vascular Lesions of CNS	91	146.41	0.62*
All Respiratory Diseases	72	133.82	0.54*
All Pneumonia	42	46.16	0.91
Emphysema	9	32.07	0.28*
Asthma	0	1.45	0.00
All Diseases of Digestive System	59	89.13	0.66*
All Gastric and Duodenal Ulcer	5	8.71	0.57
Cirrhosis of Liver	42	50.74	0.83
All Diseases of Genito-Urinary System	16	21.74	0.74
Chronic Nephritis	4	4.95	0.81
All Diseases of the Skin and Cellular Tissue	2	1.26	1.59
All Diseases of the Bones and Organs of Movement	1	3.47	0.29
Symptoms, Senility, and Ill Defined Conditions	20	24.44	0.82
All External Causes of Death	86	126.16	0.68*
All Accidents	43	77.59	0.55*
Motor Vehicle Accidents	20	29.31	0.68
Suicide	28	33.24	0.84
Total Residual	93	2.10	44.21
Cancer Residual	30	29.40	1.02

* Significant at $p < .05$

Table 5-10

Proportional Mortality Ratios for Selected Causes of Death in
Members of Any "Specialty" Locals of IBPAT 1975-79

	<u>Observed</u>	<u>Expected</u>	<u>Obs/Exp</u>
All Malignant Neoplasms	354	321.77	1.10
All Infective and Parasitic Disease	10	9.39	1.07
All Tuberculosis	4	2.85	1.40
Cancer of Buccal Cavity and Pharynx	9	9.78	0.92
Cancer of Digestive Organs and Peritoneum	99	82.99	1.19
Cancer of Esophagus	7	7.64	0.92
Cancer of Stomach	19	13.19	1.44
Cancer of Large Intestine	42	29.68	1.42*
Cancer of Rectum	6	8.63	0.69
All Cancer of Liver	8	4.67	1.71
Cancer of Pancreas	14	17.46	0.80
Cancer of Respiratory System	129	119.08	1.08
Cancer of Larynx	5	4.67	1.07
All Cancer of Lung	122	113.77	1.07
Cancer of Bone	1	1.19	0.84
Cancer of Skin	3	5.63	0.53
Cancer of Prostate	33	23.54	1.40
Cancer of Testis	2	1.09	1.84
Cancer of Bladder	8	9.96	0.80
Cancer of Kidney	11	8.06	1.36
Cancer of Eye	0	0.23	0.00
Cancer of Brain and Other Central Nervous System	6	8.37	0.72
Cancer of Thyroid	1	0.51	1.94
Lymphosarcoma and Reticulosarcoma	3	5.36	0.56
Hodgkin's Disease	2	2.17	0.92
Leukemia and Aleukemia	7	11.61	0.60
Cancer of Other Lymphatic Tissue	10	8.88	1.13
All Lymphopotent Cancer	22	28.99	0.76
Benign Neoplasms	6	3.75	1.60
Allergic, Endocrine, Metabolic, Nutritional Disease	21	25.62	0.82
Diabetes Mellitus	14	21.05	0.67
All Diseases of Blood and Blood-Forming Organs	3	3.03	0.99
Mental, Psychoneurotic, and Personality Disorders	4	8.59	0.47
All Diseases of Nervous System and Sense Organs	5	11.37	0.44
All Diseases of Circulatory System	728	786.62	0.93*
Chronic Rheumatic Heart Disease	12	10.02	1.20
Arteriosclerotic Heart Disease, Including CHD	519	573.91	0.90
All Vascular Lesions of CNS	91	106.68	0.85
All Respiratory Diseases	72	99.11	0.73*
All Pneumonia	42	33.63	1.25
Emphysema	9	23.98	0.38*
Asthma	0	1.11	0.00
All Diseases of Digestive System	59	69.20	0.85
All Gastric and Duodenal Ulcer	5	6.55	0.76
Cirrhosis of Liver	42	40.16	1.05
All Diseases of Genito-Urinary System	16	15.90	1.01
Chronic Nephritis	4	3.72	1.08
All Diseases of the Skin and Cellular Tissue	2	0.93	2.14
All Diseases of the Bones and Organs of Movement	1	2.64	0.38
Symptoms, Senility, and Ill Defined Conditions	20	18.76	1.07
All External Causes of Death	86	101.64	0.85
All Accidents	43	62.01	0.69
Motor Vehicle Accidents	20	23.92	0.84
Suicide	28	26.88	1.04
Total Residual	93	1.69	55.19
Cancer Residual	30	22.34	1.34

*Significant at $p < .05$

Table 5-11

Standardized Mortality Ratios for Selected Causes of Death in
Members of "Glaziers and Glass Workers" Locals of IBPAT, 1975-79

	<u>Observed</u>	<u>Expected</u>	<u>Obs/Exp</u>
All Causes of Death	297	376.95	0.79*
All Malignant Neoplasms	83	79.93	1.04
All Infective and Parasitic Disease	2	2.40	0.83
All Tuberculosis	2	0.72	2.76
Cancer of Buccal Cavity and Pharynx	2	2.39	0.84
Cancer of Digestive Organs and Peritoneum	28	20.72	1.35
Cancer of Esophagus	2	1.86	1.07
Cancer of Stomach	3	3.32	0.90
Cancer of Large Intestine	13	7.46	1.74
Cancer of Rectum	1	2.17	0.46
All Cancer of Liver	2	1.15	1.73
Cancer of Pancreas	6	4.32	1.39
Cancer of Respiratory System	27	28.98	0.93
Cancer of Larynx	1	1.14	0.88
All Cancer of Lung	25	27.68	0.90
Cancer of Bone	0	0.30	0.00
Cancer of Skin	0	1.42	0.00
Cancer of Prostate	6	6.24	0.96
Cancer of Testis	2	0.28	7.22
Cancer of Bladder	1	2.55	0.39
Cancer of Kidney	2	1.98	1.01
Cancer of Eye	0	0.06	0.00
Cancer of Brain and Other Central Nervous System	0	2.05	0.00
Cancer of Thyroid	0	0.13	0.00
Lymphosarcoma and Reticulosarcoma	0	1.33	0.00
Hodgkin's Disease	0	0.54	0.00
Leukemia and Aleukemia	4	2.96	1.35
Cancer of Other Lymphatic Tissue	3	2.21	1.36
All Lymphopietic Cancer	7	7.28	0.96
Benign Neoplasms	1	0.94	1.07
Allergic, Endocrine, Metabolic, Nutritional Disease	4	6.50	0.62
Diabetes Mellitus	1	5.32	0.19
All Diseases of Blood and Blood-Forming Organs	1	0.78	1.28
Mental, Psychoneurotic, and Personality Disorders	0	2.16	0.00
All Diseases of Nervous System and Sense Organs	0	2.86	0.00
All Diseases of Circulatory System	149	202.19	0.74*
Chronic Rheumatic Heart Disease	3	2.48	1.21
Arteriosclerotic Heart Disease, Including CHD	111	146.24	0.76*
All Vascular Lesions of CNS	18	28.51	0.63
All Respiratory Diseases	12	25.48	0.47*
All Pneumonia	4	9.06	0.44
Emphysema	3	5.96	0.50
Asthma	0	0.27	0.00
All Diseases of Digestive System	10	17.38	0.58
All Gastric and Duodenal Ulcer	2	1.66	1.20
Cirrhosis of Liver	7	9.96	0.70
All Diseases of Genito-Urinary System	1	4.24	0.24
Chronic Nephritis	0	0.95	0.00
All Diseases of the Skin and Cellular Tissue	1	0.24	4.11
All Diseases of the Bones and Organs of Movement	0	0.66	0.00
Symptoms, Senility, and Ill Defined Conditions	1	4.73	0.21
All External Causes of Death	19	26.02	0.73
All Accidents	10	15.92	0.63
Motor Vehicle Accidents	6	6.11	0.98
Suicide	6	6.83	0.88
Total Residual	13	0.43	30.57
Cancer Residual	8	5.56	1.44

* Significant at $p < .05$

Table 5-12

Proportional Mortality Ratios for Selected Causes of Death in
Members of Only "Glazier & Glass Workers" Locals of IBPAT 1975-79

	<u>Observed</u>	<u>Expected</u>	<u>Obs/Exp</u>
All Malignant Neoplasms	83	64.46	1.29
All Infective and Parasitic Disease	2	1.90	1.05
All Tuberculosis	2	0.58	3.47
Cancer of Buccal Cavity and Pharynx	2	1.96	1.02
Cancer of Digestive Organs and Peritoneum	28	16.55	1.69
Cancer of Esophagus	2	1.53	1.31
Cancer of Stomach	3	2.63	1.14
Cancer of Large Intestine	13	5.91	2.20*
Cancer of Rectum	1	1.72	0.58
All Cancer of Liver	2	0.93	2.15
Cancer of Pancreas	6	3.48	1.72
Cancer of Respiratory System	27	23.88	1.13
Cancer of Larynx	1	0.93	1.07
All Cancer of Lung	25	22.81	1.10
Cancer of Bone	0	0.24	0.00
Cancer of Skin	0	1.17	0.00
Cancer of Prostate	6	4.57	1.31
Cancer of Testis	2	0.23	8.59
Cancer of Bladder	1	1.96	0.51
Cancer of Kidney	2	1.63	1.22*
Cancer of Eye	0	0.05	0.00
Cancer of Brain and Other Central Nervous System	0	1.74	0.00
Cancer of Thyroid	0	0.10	0.00
Lymphosarcoma and Reticulosarcoma	0	1.09	0.00
Hodgkin's Disease	0	0.46	0.00
Leukemia and Aleukemia	4	2.36	1.70
Cancer of Other Lymphatic Tissue	3	1.79	1.68
All Lymphopoietic Cancer	7	5.89	1.19
Benign Neoplasms	1	0.76	1.31
Allergic, Endocrine, Metabolic, Nutritional Disease	4	5.13	0.78
Diabetes Mellitus	1	4.21	0.24
All Diseases of Blood and Blood-Forming Organs	1	0.60	1.66
Mental, Psychoneurotic, and Personality Disorders	0	1.80	0.00
All Diseases of Nervous System and Sense Organs	0	2.34	0.00
All Diseases of Circulatory System	149	156.25	0.95
Chronic Rheumatic Heart Disease	3	2.04	1.47
Arteriosclerotic Heart Disease, Including CHD	111	114.30	0.97
All Vascular Lesions of CNS	18	20.91	0.86
All Respiratory Diseases	12	19.53	0.61
All Pneumonia	4	6.61	0.61
Emphysema	3	4.72	0.64
Asthma	0	0.22	0.00
All Diseases of Digestive System	10	14.30	0.70
All Gastric and Duodenal Ulcer	2	1.31	1.53
Cirrhosis of Liver	7	8.45	0.83
All Diseases of Genito-Urinary System	1	3.13	0.32
Chronic Nephritis	0	0.74	0.00
All Diseases of the Skin and Cellular Tissue	1	0.18	5.43
All Diseases of the Bones and Organs of Movement	0	0.53	0.00
Symptoms, Senility, and Ill Defined Conditions	1	3.82	0.26
All External Causes of Death	19	21.91	0.87
All Accidents	10	13.25	0.75
Motor Vehicle Accidents	6	5.21	1.15
Suicide	6	5.82	1.03
Total Residual	13	0.36	36.07
Cancer Residual	8	4.49	1.78

* Significant at $p < .05$

Table 5-13

Standardized Mortality Ratios for Selected Causes of Death in
Members of "Sign Painter" Locals of IBPAT, 1975-79

	Observed	Expected	Obs/Exp
All Causes of Death	291	402.21	0.72*
All Malignant Neoplasms	70	85.77	0.82
All Infective and Parasitic Disease	2	2.49	0.80
All Tuberculosis	0	0.75	0.00
Cancer of Buccal Cavity and Pharynx	2	2.47	0.81
Cancer of Digestive Organs and Peritoneum	16	22.72	0.70
Cancer of Esophagus	0	1.98	0.00
Cancer of Stomach	5	3.64	1.38
Cancer of Large Intestine	7	8.25	0.85
Cancer of Rectum	0	2.40	0.00
All Cancer of Liver	1	1.29	0.78
Cancer of Pancreas	2	4.71	0.42
Cancer of Respiratory System	28	30.58	0.92
Cancer of Larynx	1	1.21	0.83
All Cancer of Lung	27	29.22	0.92
Cancer of Bone	1	0.30	3.38
Cancer of Skin	0	1.30	0.00
Cancer of Prostate	8	7.67	1.04
Cancer of Testis	0	0.23	0.00
Cancer of Bladder	4	2.99	1.34
Cancer of Kidney	1	2.02	0.50
Cancer of Eye	0	0.06	0.00
Cancer of Brain and Other Central Nervous System	1	1.85	0.54
Cancer of Thyroid	0	0.13	0.00
Lymphosarcoma and Reticulosarcoma	1	1.34	0.75
Hodgkin's Disease	0	0.48	0.00
Leukemia and Aleukemia	1	3.12	0.32
Cancer of Other Lymphatic Tissue	1	2.33	0.43
All Lymphopietic Cancer	3	7.54	0.40
Benign Neoplasms	3	0.94	3.19
Allergic, Endocrine, Metabolic, Nutritional Disease	4	7.05	0.57
Diabetes Mellitus	3	5.84	0.51
All Diseases of Blood and Blood-Forming Organs	0	0.86	0.00
Mental, Psychoneurotic, and Personality Disorders	1	1.88	0.53
All Diseases of Nervous System and Sense Organs	0	2.86	0.00
All Diseases of Circulatory System	162	223.02	0.73*
Chronic Rheumatic Heart Disease	2	2.47	0.81
Arteriosclerotic Heart Disease, Including CHD	116	159.43	0.73*
All Vascular Lesions of CNS	22	33.24	0.66
All Respiratory Diseases	14	29.47	0.48*
All Pneumonia	7	10.26	0.68
Emphysema	2	7.09	0.28
Asthma	0	0.28	0.00
All Diseases of Digestive System	4	16.23	0.25*
All Gastric and Duodenal Ulcer	0	1.80	0.00
Cirrhosis of Liver	3	8.43	0.36
All Diseases of Genito-Urinary System	1	4.85	0.21
Chronic Nephritis	0	1.04	0.00
All Diseases of the Skin and Cellular Tissue	0	0.27	0.00
All Diseases of the Bones and Organs of Movement	0	0.69	0.00
Symptoms, Senility, and Ill Defined Conditions	4	4.71	0.85
All External Causes of Death	14	20.76	0.67
All Accidents	7	13.18	0.53
Motor Vehicle Accidents	4	4.69	0.85
Suicide	6	5.33	1.13
Total Residual	12	0.34	34.92
Cancer Residual	6	5.92	1.01

* Significant at $p < .05$

Table 5-14

Proportional Mortality Ratios for Selected Causes of Death in
Members of Only "Sign Painters" Locals of IBPAT 1975-79

	<u>Observed</u>	<u>Expected</u>	<u>Obs/Exp</u>
All Malignant Neoplasms	70	63.00	1.11
All Infective and Parasitic Disease	2	1.79	1.11
All Tuberculosis	0	0.54	0.00
Cancer of Buccal Cavity and Pharynx	2	1.85	1.08
Cancer of Digestive Organs and Peritoneum	16	16.62	0.96
Cancer of Esophagus	0	1.48	0.00
Cancer of Stomach	5	2.65	1.89
Cancer of Large Intestine	7	6.00	1.17
Cancer of Rectum	0	1.75	0.00
All Cancer of Liver	1	0.95	1.06
Cancer of Pancreas	2	3.47	0.58
Cancer of Respiratory System	28	22.81	1.23
Cancer of Larynx	1	0.90	1.11
All Cancer of Lung	27	21.79	1.24
Cancer of Bone	1	0.22	4.62
Cancer of Skin	0	0.94	0.00
Cancer of Prostate	8	5.41	1.48
Cancer of Testis	0	0.16	0.00
Cancer of Bladder	4	2.16	1.85
Cancer of Kidney	1	1.50	0.67
Cancer of Eye	0	0.05	0.00
Cancer of Brain and Other Central Nervous System	1	1.38	0.73
Cancer of Thyroid	0	0.10	0.00
Lymphosarcoma and Reticulosarcoma	1	0.98	1.02
Hodgkin's Disease	0	0.35	0.00
Leukemia and Aleukemia	1	2.24	0.45
Cancer of Other Lymphatic Tissue	1	1.71	0.59
All Lymphopoietic Cancer	3	5.48	0.55
Benign Neoplasms	3	0.69	4.36
Allergic,Endocrine,Metabolic,Nutritional Disease	4	5.10	0.78
Diabetes Mellitus	3	4.23	0.71
All Diseases of Blood and Blood-Forming Organs	0	0.62	0.00
Mental,Psychoneurotic,and Personality Disorders	1	1.37	0.73
All Diseases of Nervous System and Sense Organs	0	2.07	0.00
All Diseases of Circulatory System	162	160.94	1.01
Chronic Rheumatic Heart Disease	2	1.82	1.10
Arteriosclerotic Heart Disease, Including CHD	116	115.64	1.00
All Vascular Lesions of CNS	22	23.47	0.94
All Respiratory Diseases	14	21.19	0.66
All Pneumonia	7	7.23	0.97
Emphysema	2	5.17	0.39
Asthma	0	0.21	0.00
All Diseases of Digestive System	4	11.86	0.34*
All Gastric and Duodenal Ulcer	0	1.31	0.00
Cirrhosis of Liver	3	6.22	0.48
All Diseases of Genito-Urinary System	1	3.42	0.29
Chronic Nephritis	0	0.74	0.00
All Diseases of the Skin and Cellular Tissue	0	0.20	0.00
All Diseases of the Bones and Organs of Movement	0	0.51	0.00
Symptoms, Senility, and Ill Defined Conditions	4	3.43	1.17
All External Causes of Death	14	14.57	0.96
All Accidents	7	9.26	0.76
Motor Vehicle Accidents	4	3.26	1.23
Suicide	6	3.77	1.59
Total Residual	12	0.25	48.71
Cancer Residual	6	4.34	1.38

Table 5-15

Standardized Mortality Ratios for Selected Causes of Death in
Members of "Floor Covering" Locals of IBPAT, 1975-79

	Observed	Expected	Obs/Exp
All Causes of Death	186	230.91	0.81*
All Malignant Neoplasms	43	51.26	0.84
All Infective and Parasitic Disease	0	1.49	0.00
All Tuberculosis	0	0.46	0.00
Cancer of Buccal Cavity and Pharynx	1	1.61	0.62
Cancer of Digestive Organs and Peritoneum	11	13.02	0.84
Cancer of Esophagus	1	1.24	0.81
Cancer of Stomach	5	2.06	2.43
Cancer of Large Intestine	4	4.60	0.87
Cancer of Rectum	0	1.34	0.00
All Cancer of Liver	0	0.73	0.00
Cancer of Pancreas	1	2.77	0.36
Cancer of Respiratory System	19	19.49	0.97
Cancer of Larynx	0	0.76	0.00
All Cancer of Lung	18	18.63	0.97
Cancer of Bone	0	0.20	0.00
Cancer of Skin	1	0.95	1.05
Cancer of Prostate	4	3.22	1.24
Cancer of Testis	0	0.19	0.00
Cancer of Bladder	0	1.46	0.00
Cancer of Kidney	0	1.33	0.00
Cancer of Eye	0	0.04	0.00
Cancer of Brain and Other Central Nervous System	1	1.45	0.69
Cancer of Thyroid	1	0.08	11.96
Lymphosarcoma and Reticulosarcoma	1	0.88	1.13
Hodgkin's Disease	0	0.37	0.00
Leukemia and Aleukemia	0	1.82	0.00
Cancer of Other Lymphatic Tissue	3	1.43	2.10
All Lymphopoietic Cancer	4	4.65	0.86
Benign Neoplasms	0	0.61	0.00
Allergic, Endocrine, Metabolic, Nutritional Disease	8	3.98	2.01
Diabetes Mellitus	5	3.25	1.54
All Diseases of Blood and Blood-Forming Organs	2	0.46	4.34
Mental, Psychoneurotic, and Personality Disorders	1	1.48	0.67
All Diseases of Nervous System and Sense Organs	0	1.85	0.00
All Diseases of Circulatory System	89	119.56	0.74*
Chronic Rheumatic Heart Disease	4	1.66	2.41
Arteriosclerotic Heart Disease, Including CHD	57	88.60	0.64*
All Vascular Lesions of CNS	15	15.01	1.00
All Respiratory Diseases	13	14.64	0.89
All Pneumonia	8	4.78	1.67
Emphysema	3	3.61	0.83
Asthma	0	0.18	0.00
All Diseases of Digestive System	12	11.66	1.03
All Gastric and Duodenal Ulcer	1	1.02	0.98
Cirrhosis of Liver	7	7.11	0.98
All Diseases of Genito-Urinary System	1	2.27	0.44
Chronic Nephritis	1	0.57	1.76
All Diseases of the Skin and Cellular Tissue	0	0.14	0.00
All Diseases of the Bones and Organs of Movement	0	0.42	0.00
Symptoms, Senility, and Ill Defined Conditions	0	3.05	0.00
All External Causes of Death	12	17.75	0.68
All Accidents	4	10.66	0.38*
Motor Vehicle Accidents	1	4.22	0.24
Suicide	5	4.77	1.05
Total Residual	5	0.30	16.83
Cancer Residual	1	3.57	0.28

* Significant at $p < .05$

Table 5-16

Proportional Mortality Ratios for Selected Causes of Death in
Members of Only "Floor Covering" Locals of IBPAT 1975-79

	<u>Observed</u>	<u>Expected</u>	<u>Obs/Exp</u>
All Malignant Neoplasms	43	41.07	1.05
All Infective and Parasitic Disease	0	1.20	0.00
All Tuberculosis	0	0.37	0.00
Cancer of Buccal Cavity and Pharynx	1	1.31	0.77
Cancer of Digestive Organs and Peritoneum	11	10.34	1.06
Cancer of Esophagus	1	0.99	1.01
Cancer of Stomach	5	1.62	3.08*
Cancer of Large Intestine	4	3.65	1.10
Cancer of Rectum	0	1.06	0.00
All Cancer of Liver	0	0.58	0.00
Cancer of Pancreas	1	2.22	0.45
Cancer of Respiratory System	19	15.68	1.21
Cancer of Larynx	0	0.61	0.00
All Cancer of Lung	18	14.99	1.20
Cancer of Bone	0	0.16	0.00
Cancer of Skin	1	0.83	1.21
Cancer of Prostate	4	2.37	1.69
Cancer of Testis	0	0.18	0.00
Cancer of Bladder	0	1.12	0.00
Cancer of Kidney	0	1.08	0.00
Cancer of Eye	0	0.03	0.00
Cancer of Brain and Other Central Nervous System	1	1.26	0.79
Cancer of Thyroid	1	0.07	14.37 *
Lymphosarcoma and Reticulosarcoma	1	0.72	1.38
Hodgkin's Disease	0	0.33	0.00
Leukemia and Aleukemia	0	1.46	0.00
Cancer of Other Lymphatic Tissue	3	1.14	2.62
All Lymphopoietic Cancer	4	3.78	1.06
Benign Neoplasms	0	0.51	0.00
Allergic, Endocrine, Metabolic, Nutritional Disease	8	3.21	2.49*
Diabetes Mellitus	5	2.61	1.91
All Diseases of Blood and Blood-Forming Organs	2	0.37	5.46*
Mental, Psychoneurotic, and Personality Disorders	1	1.30	0.77
All Diseases of Nervous System and Sense Organs	0	1.54	0.00
All Diseases of Circulatory System	89	93.99	0.95
Chronic Rheumatic Heart Disease	4	1.37	2.92*
Arteriosclerotic Heart Disease, Including CHD	57	69.98	0.81
All Vascular Lesions of CNS	15	11.40	1.32
All Respiratory Diseases	13	11.29	1.15
All Pneumonia	8	3.68	2.17*
Emphysema	3	2.77	1.08
Asthma	0	0.15	0.00
All Diseases of Digestive System	12	9.82	1.22
All Gastric and Duodenal Ulcer	1	0.81	1.23
Cirrhosis of Liver	7	6.13	1.14
All Diseases of Genito-Urinary System	1	1.75	0.57
Chronic Nephritis	1	0.46	2.19
All Diseases of the Skin and Cellular Tissue	0	0.11	0.00
All Diseases of the Bones and Organs of Movement	0	0.34	0.00
Symptoms, Senility, and Ill Defined Conditions	0	2.56	0.00
All External Causes of Death	12	16.68	0.72
All Accidents	4	9.95	0.40
Motor Vehicle Accidents	1	4.10	0.24
Suicide	5	4.42	1.13
Total Residual	5	0.27	18.38
Cancer Residual	1	2.87	0.35

Table 5-17
Other Allied Trades
Number of Deaths, SMRs, and PMRs for Selected Disease Categories

Cause of Death	Paint Makers		Auto/Ship/Steel		Industrial/ Maintenance	
	#	SMR	#	SMR	#	SMR
All Causes of Death	78	.54*	171	.89	93	.72
All Malignant						
Neoplasms	17	.50*	38	.92	30	1.02
Cancer of the Kidney	0	0.00	4	4.00	1	1.31
Digestive Organs and Peritoneum	3	.35	9	.83	10	1.34
Prostate	0	0.00	2	.58	5	2.79
All Diseases of Circulatory System	32	.44	78	.74	31	.46
						.65

* p < .05

TABLE 5-18

Breslow-Day SMRs: Mixed versus Specialty Locals
(01 versus 02 to 14)

Cause of Death	SMR		Chi-Square	P-Value
	Mixed	Specialty		
All causes of death	1.06 (3788)	0.88 (1480)	37.85	<0.001
All malignant neoplasms	1.09 (927)	0.83 (354)	18.51	<0.001
Cancer of lung	1.13 (325)	0.77 (122)	13.24	<0.001
Cancer of stomach	1.05 (50)	0.90 (19)	0.31	0.580
Cancer of small intestine	1.66 (3)	0.00 (0)	2.97	0.085
Cancer of large intestine	1.00 (93)	1.01 (42)	0.00	0.950
Cancer of rectum	1.17 (23)	0.65 (6)	1.77	0.184
Cancer of liver	1.07 (13)	0.85 (5)	0.19	0.667
Cancer of prostate	1.01 (85)	0.98 (33)	0.02	0.893
Cancer of bladder	1.22 (40)	0.53 (8)	5.28	0.022
Cancer of kidney	1.08 (27)	0.84 (11)	0.49	0.484
Cancer of thyroid	0.85 (1)	1.22 (1)	0.06	0.802
All lymphopoietic cancer	1.15 (77)	0.68 (22)	5.02	0.025
Persons:	32884	24064	Total -	56948
Person-years	147595	109229	Total -	256824

(Parentheses contain observed numbers of deaths)

TABLE 5-19
Type of Respondent by Case-Control Status*

Respondent	Lung Cancer Cases	Non-Cancer Controls
IBPAT Member	4 (5.8%)	127 (69.8%)
Wife	41 (59.4%)	17 (9.3%)
Son/Daughter	15 (21.7%)	26 (14.3%)
Other	9 (13.1%)	12 (6.6%)
TOTAL	69 (100.0%)	182 (100.0%)

Cases vs. non-cancer controls $\chi^2=97.736$ $df=3$ $P=.0001$

TABLE 5-20
Year of Birth of Cases and Controls*

Birthyear	Lung Cancer Cases	Non-Cancer Controls
< 1900	5 (8.0%)	24 (13.7%)
1900-1909	21 (33.3%)	50 (28.4%)
1910-1919	23 (36.5%)	65 (36.9%)
1920+	14 (22.2%)	37 (21.0%)
TOTAL	63 (100.0%)	176 (100.0%)

Cases vs. non-cancer controls $X^2 = 1.654$ $df=3$ $P=.647$

*Birthdate was not reported for 6 cases, and 6 non-cancer controls.

TABLE 5-21
Demographic Characteristics of Cases and Controls

Demographic Characteristics	Lung Cancer Cases	Non-Cancer Controls	Total
Marital Status:			
Married	44 (83.0%)	138 (81.2%)	182 (81.6%)
Widowed	4 (7.6%)	18 (10.6%)	22 (9.9%)
Divorced	2 (3.8%)	8 (4.7%)	10 (4.5%)
Single	3 (5.6%)	6 (3.5%)	9 (4.0%)
Number of Children:			
None	7 (12.1%)	19 (11.5%)	26 (11.6%)
One	5 (8.6%)	22 (13.2%)	27 (12.1%)
Two	17 (29.3%)	69 (41.6%)	86 (38.4%)
Three or more	29 (50.0%)	56 (33.7%)	85 (37.9%)
Race:			
White	62 (95.4%)	166 (94.3%)	228 (94.6%)
Black	3 (4.6%)	8 (4.6%)	11 (4.6%)
Hispanic	0 (0.0%)	2 (1.1%)	2 (0.8%)
Education* - Number Grades Completed:			
≤ 8	31 (53.5%)	55 (35.5%)	86 (40.4%)
9-11	9 (15.5%)	49 (31.6%)	58 (27.2%)
12+	18 (31.0%)	51 (32.9%)	69 (32.4%)

*Cases vs. non-cancer controls $\chi^2=7.435$ $df=2$ $P=.024$

TABLE 5-22
Usual Occupation of Cases and Controls*

Usual Occupation	Lung Cancer Cases	Non-Cancer Controls
Painter	51 (77.3%)	98 (54.8%)
Other Jobs	15 (22.7%)	81 (45.2%)
TOTAL	66 (100.0%)	179 (100.0%)

Lung Cancer Cases vs. Non-Cancer Controls
OR = 2.75 (1.45, 5.21)

*3 lung cancer cases and 3 non-cancer controls did not respond to this question.

TABLE 5-23
 Reported Number of Years at Usual Occupation Among
 Cases and Controls*

Years Worked	Lung Cancer Cases	Non-Cancer Controls	Total
<20	3 (4.8%)	16 (9.0%)	19
20-29	19 (30.1%)	29 (17.0%)	48
30-39	17 (27.0%)	48 (27.1%)	65
40-49	14 (22.2%)	47 (26.6%)	61
50+	10 (15.9%)	36 (20.3%)	46
TOTAL	63 (100.0%)	176 (100.0%)	239

Cases/non-cancer controls $X^2=6.290$ $df=4$ $P=.179$

*6 lung cancer cases and 6 non-cancer controls did not respond to this question.

TABLE 5-24
Usual IBPAT Trade Area
of Cases and Controls*

IBPAT Trade Area	Lung Cancer Cases	Non-Cancer Controls
Painter	37 (80.4%)	66 (56.0%)
Other Jobs	9 (19.6%)	53 (44.0%)
TOTAL	46 (100.0%)	119 (100.0%)

Lung Cancer Cases vs. Non-Cancer Controls
OR = 3.17 (1.43, 7.05)

*23 lung cancer cases and 63 non-cancer controls did not respond to this question.

TABLE 5-25
Ever Worked in Any Painting Trade*

	Lung Cancer	Non-Cancer Controls
Painter	52	103
Non-Painter	14	73
TOTAL	66	176

O.R. = 2.57 (1.34, 4.94)

*A painter is anyone who reported working in either construction, industrial and maintenance or specialty painting.

TABLE 5-26
Odds Ratios Associated with Ever Working in Specified IBPAT Areas*

	Lung Cancer Cases	Non-Cancer Controls	OR Cases/ Non-Cancer Controls
Painter			
New			
Construction	44	77	3.38 (1.17, 9.81)
Industrial	39	58	3.98 (1.35, 11.68)
Specialty	12	42	1.73 (0.53, 5.65)
Glazier	8	36	1.37 (0.39, 4.77)
Paperhanger	20	41	2.91 (0.94, 9.01)
Paint Maker	5	9	3.41 (0.80, 14.53)
Tile and Carpet Layer	5	1	21.59 (2.74, 170.01)
Dry Wall Taper	23	42	3.26 (1.06, 9.97)

Never Worked in any of these areas	4	26	

*3 lung cancer cases and 6 non-cancer controls did not respond to this question.

TABLE 5-27
 Number of Individuals and Odds Ratios Associated with Working
 as a Painter in Specific Industries*

	Lung Cancer Cases	Non-Cancer Controls	OR Cases vs. Non-Cancer Controls
Auto/Air/Railroad	5	9	2.92 (0.92, 9.30)
Shipbuilding	6	13	2.43 (0.85, 6.98)
Construction	25	43	2.96 (1.49, 5.90)
Worked in None of These Industries	19	98	

*14 cases and 20 non-cancer controls did not respond to this question.

TABLE 5-28
Use and Type of Respirators Worn by Cases and Controls

1. Wearing a Mask or Respirator Among Cases and Controls*

	Lung Cancer Cases	Non-Cancer Controls
Never Wear a Mask	37	86
Ever Wear a Mask	22	81
TOTAL	59	167

OR = 1.57 (0.86, 2.87)

2. Type of Mask Worn by Cases and Controls

	Lung Cancer Cases	Non-Cancer Controls
Paper Mask	11	27
Other Types	4	35
TOTAL	15	62

OR = 3.30 (0.99, 10.93)

*10 lung cancer cases and 15 non-cancer controls did not respond to this question.

TABLE 5-29
Use of Other Protective Equipment Among Cases and Controls*

Use of Other Equipment	Lung Cancer Cases	Non-Cancer Controls
No	37	116
Yes	20	49
TOTAL	57	165

OR = 0.78 (0.41, 1.46)

*12 cases and 17 non-cancer controls did not respond to the question.

TABLE 5-30
 Frequency of Use of Spackling Compound
 Among Cases and Controls*

Frequency of Use	Lung Cancer Cases	Non-Cancer Controls
Everyday	18 (32.1%)	34 (21.4%)
Once a week or more	26 (46.4%)	43 (27.1%)
Less than once a week	8 (14.3%)	33 (20.7%)
Never	4 (7.1%)	49 (30.8%)
TOTAL	56 (100.0%)	159 (100.0%)

χ^2 cases/non-cancer controls = 17.156 df=3 P=.0007

*13 cases and 23 non-cancer controls did not respond to the question.

TABLE 5-31
Odds Ratios Associated with the Use of Spackling Compound
Among Cases and Controls*

Ever Used Spackling	Lung Cancer Cases	Non-Cancer Controls
Yes	53	112
No	4	49
TOTAL	57	161

OR = 5.23 (1.89, 14.48)

*12 cases and 21 non-cancer controls did not respond to the question.

TABLE 5-32
Frequency Distribution and Odds Ratios for Ever Working
as a Sandblaster among Cases and Controls*

Work as a Sandblaster	Lung Cancer Cases	Non-Cancer Controls
Ever	10	17
Never	44	147
TOTAL	54	164

OR = 1.99 (0.86, 4.59)

*15 cases and 18 non-cancer controls did not respond to the question.

TABLE 5-33
Exposures to Specific Substances Among Cases and Controls*

<u>Exposure</u>	<u>Lung Cancer Cases</u>	<u>Non-Cancer Controls</u>	<u>Odds Ratio Cases/ Non-Cancer Controls</u>
Arsenic	0	3	0.52 (0.03, 10.55)
Asbestos	20	32	2.30 (1.08, 4.90)
Beryllium	0	0	--
Chromium	1	3	1.56 (0.21, 11.33)
Coal Tar/Soot	1	11	0.47 (0.08, 2.81)
Dyestuffs	5	6	3.09 (0.89, 10.74)
Formaldehyde	1	5	0.99 (0.15, 6.50)
Insecticides/ Pesticides	5	8	2.36 (0.72, 7.76)
Lead	32	66	1.78 (0.92, 3.46)
Oils	4	11	1.43 (0.43, 4.76)
Nickel	0	2	0.73 (0.03, 15.87)
Solvents	5	11	1.75 (0.56, 5.45)
Uranium/ other radio- active substances	2	2	3.65 (0.59, 22.67)
Creosote/Wood Preservatives	8	19	1.59 (0.61, 4.14)
Other Exposures	3	10	1.22 (0.33, 4.53)
No Exposures	18	67	

*Frequencies reflect number of exposures reported, not number of individuals.

TABLE 5-34
Work in Selected High Risk Industries*°

Industry	Lung Cancer Cases	Non-Cancer Controls	OR Cases vs. Non-Cancer Controls
Asbestos	4	6	2.21 (0.63, 7.80)
Uranium	-	-	--
Other Mining	2	4	1.78 (0.36, 8.72)
Farming	6	9	2.19 (0.75, 6.35)
Auto (repair/service)	3	7	1.49 (0.40, 5.61)
Construction	22	46	1.56 (0.83, 2.93)
Petroleum/rubber/other chemical	1	5	0.87 (0.14, 5.51)
Smelting	2	2	3.20 (0.53, 19.21)
Tanning	2	0	--
Textile	1	2	1.92 (0.24, 15.04)
Wood Treatment	0	1	1.07 (0.04, 26.75)
None of these Industries	35	113	

*5 lung cancer cases and 5 non-cancer controls did not respond to this question.

°Frequencies reflect number of industries reported, not number of individuals.

TABLE 5-35
Work in Selected High Risk Occupations*

Occupation	Lung Cancer Cases	Non-Cancer Controls	OR Cases/ Non-Cancer Controls
Battery worker	0	1	0.97 (0.04,24.13)
Brake repair	2	3	2.07 (0.40,10.84)
Boilermaker	1	2	1.74 (0.22,13.50)
Electrician	1	4	0.97 (0.15, 6.31)
Insulator	2	4	1.61 (0.33, 7.81)
Pipefitter	1	2	1.74 (0.22,13.51)
Plumber	2	2	2.90 (0.49,17.24)
X-ray technician	0	0	--
Radar technician	0	0	--
Machinist	2	12	0.58 (0.14, 2.34)
Welder	5	5	2.90 (0.85, 9.87)
None of these Occupations	51	149	

*7 cases and 7 non-cancer controls did not respond to this question.
Frequencies reflect number of occupations reported, not number of individuals.

TABLE 5-36

Possible Exposure to Lung Carcinogens through Work
in Specified Industries and Occupations Outside the
Painting and Allied Trade Areas

Ever Exposed	Lung Cancer Cases	Non-Cancer Controls
Yes	5	10
No	60	169
TOTAL	65	179

OR = 1.47 (0.50, 4.29)

TABLE 5-37
Ever Smoked Cigarettes Among Cases and Controls*

Ever Smoked 100 Cigarettes	Lung Cancer Cases	Non-Cancer Controls
Yes	67	136
No	0	41
TOTAL	67	177

OR = 41.04 (2.49, 677.43)

*2 lung cancer cases and 5 non-cancer controls did not respond to this question.

TABLE 5-38

Average Number of Cigarettes/Day Among Cases and Controls (smokers only)*		
	Lung Cancer Cases	Non-Cancer Controls
<20	11 (16.7%)	34 (27.0%)
20-39	36 (54.5%)	61 (48.4%)
40+	19 (28.8%)	31 (24.6%)
TOTAL	66 (100.0%)	126 (100.0%)

Lung cancer cases vs. non-cancer controls $X^2=2.581$ $df=2$ $P=.275$

*1 Case and 10 non-cancer controls who were smokers did not respond to this question.

TABLE 5-39
Cigar and Pipe Smoking
Among Cases and Controls

Smoked Cigars Regularly	Cigar Smoking*	
	Lung Cancer Cases	Non-Cancer Controls
Yes	14 (22.2%)	48 (27.9%)
No	51 (77.8%)	124 (72.1%)
TOTAL	65 (100.0%)	172 (100.0%)

OR = 0.71 (0.31, 1.59)

*4 lung cancer cases and 10 non-cancer controls did not respond to this question.

Smoked Cigars Regularly	Pipe Smoking*	
	Lung Cancer Cases	Non-Cancer Controls
Yes	8 (12.7%)	29 (17.3%)
No	57 (87.3%)	139 (82.7%)
TOTAL	65 (100.0%)	168 (100.0%)

OR = 0.71 (0.31, 1.59)

*4 lung cancer cases and 14 non-cancer controls did not respond to this question.

TABLE 5-40
 Frequency of Consumption of Selected Foods
 Once a Week or More Among Cases and Controls

Eaten Once a Week or More	Lung Cancer Cases	Non-Cancer Controls
Apples	33 (60.0%)	79 (50.0%)
Citrus Fruit/Juice	34 (65.4%)	123 (76.9%)
Tomatoes	36 (67.9%)	104 (64.6%)
Cabbage	12 (21.4%)	22 (14.9%)
Brussel Sprouts	4 (7.7%)	11 (7.5%)
Cauliflower	9 (15.0%)	15 (10.4%)
Broccoli	14 (26.4%)	25 (17.6%)
Collard/Kale	4 (8.3%)	9 (7.1%)
*Spinach	16 (32.6%)	26 (17.8%)
Carrots	19 (39.6%)	56 (36.4%)
Liver	10 (19.6%)	18 (12.9%)
Pork/Beef/Veal	37 (67.3%)	104 (68.9%)
Fish/Seafood	33 (58.9%)	83 (51.2%)
Chicken/Poultry	33 (60.0%)	112 (68.3%)
Cured Meats	19 (35.2%)	51 (33.1%)
Milk	37 (71.2%)	126 (77.8%)
Coffee	50 (90.9%)	143 (89.9%)
Tea	23 (46.0%)	73 (49.0%)
Diet Soda	3 (6.3%)	21 (15.0%)
Regular Soda	14 (28.0%)	46 (32.2%)
*Beer	30 (54.6%)	54 (34.4%)
Wine	12 (23.1%)	29 (19.9%)
*Whiskey	23 (42.6%)	39 (24.7%)

*Spinach X^2 cases/non-cancer controls = 3.946 df=1 P=.047
 *Beer X^2 cases/non-cancer controls = 6.097 df=1 P=.013
 *Whiskey X^2 cases/non-cancer controls = 5.403 df=1 P=.020

TABLE 5-41
Vitamin Usage Among Cases and Controls*

Vitamin	Lung Cancer Cases	Non-Cancer Controls
Multiple	21 (38.2%)	43 (32.6%)
Vitamin A	3 (8.1%)	10 (10.1%)
Cod Liver Oil	2 (5.6%)	13 (12.8%)
Vitamin B	2 (5.6%)	17 (16.0%)
Vitamin C	11 (24.4%)	32 (26.4%)
Vitamin E	9 (20.9%)	28 (23.9%)
Other Vitamins	2 (5.6%)	12 (11.9%)

*Frequencies represent number of times a vitamin was reported, not number of subjects.

TABLE 5-42
Usual Occupation as Reported by Proxy Respondent

Usual Occupation	Lung Cancer Cases	Non-Cancer Controls	Total
Painter	48	36	84
Other Jobs	14	18	32
TOTAL	62	54	116

OR = 1.69 (0.75, 3.81)

TABLE 5-43
IBPAT Trade Area as Reported by Proxy Respondent

IBPAT Job	Lung Cancer Cases	Non-Cancer Controls	Total
Painter	35	23	58
Other Jobs	9	12	21
TOTAL	44	35	79

OR = 1.99 (0.74, 5.36)

TABLE 5-44
Smoking Characteristics as Reported by Proxy Respondent

Ever Smoked	Lung Cancer Cases	Non-Cancer Controls
Yes	63 (100.0%)	37 (69.8%)
No	0 (0.0%)	16 (30.2%)
TOTAL	63 (100.0%)	53 (100.0%)
Cases vs. non-cancer controls $X^2=19.596$ $df=1$ $P<.0001$		
Average Number of Cigarettes Per Day	Lung Cancer Cases	Non-Cancer Controls
<20 cigarettes	9 (14.5%)	6 (17.7%)
20-39 cigarettes	35 (56.5%)	17 (50.0%)
40+ cigarettes	18 (29.0%)	11 (32.3%)
TOTAL	62 (100.0%)	34 (100.0%)
Cases vs. non-cancer controls $X^2=0.387$ $df=2$ $P=.824$		

TABLE 5-45
Use of Spackling Compound as Reported by Proxy Respondent

Use of Spackling	Lung Cancer Cases	Non-Cancer Controls
Ever	49	30
Never	4	13
TOTAL	53	43
Cases vs. non-cancer controls OR = 4.87 (1.53, 15.51)		

TABLE 5-46
Use of a Mask or Respirator as Reported by Proxy Respondent

Wore a Mask	Lung Cancer Cases	Non-Cancer Controls
Never	36	30
Ever	19	16
TOTAL	55	47
Cases vs. non-cancer controls OR = 1.01 (0.45, 2.28)		

TABLE 5-47
 Crude and Adjusted Odds Ratios for Occupation
 and Other Lung Cancer Risk Factors when Compared to Non-Cancer Controls

	O.R. Crude	O.R. Adjusted
Occupation (usual painting)	2.75 (1.45, 5.21)	1.14 (0.34, 3.79)
Smoking > 10 cigarettes/day	3.13 (0.54, 18.24)	5.51 (1.78, 17.12)
Mask	1.57 (0.86, 2.87)	0.75 (0.18, 3.04)
Asbestos	2.30 (1.08, 4.90)	2.36 (0.97, 5.78)
Beer	2.27 (1.22, 4.22)	2.98 (1.33, 6.63)
Painter/No Mask Interaction	--	5.45 (1.01, 29.33)

TABLE 5-48
Crude and Adjusted Odds Ratios for Spackling
and Other Lung Cancer Risk Factors

	Cases vs. Non-Cancer Controls	
	OR Crude	OR Adjusted
Smoking	3.13 (0.54, 18.24)	6.63 (2.17, 20.23)
Spackling	5.23 (1.89, 14.48)	3.96 (1.79, 8.76)
Beer	2.27 (1.22, 4.22)	2.16 (1.04, 4.49)

TABLE 5-49
Type of Respondent by Cancer Site for Cancer Cases and Controls

Respondents	Colo-rectal Cancers	Prostate Cancer	Bladder Cancer	Leukemias and Lymphatic Cancers	Non-Cancer Controls
Member	14 (32.6%)	4 (18.2%)	15 (57.7%)	3 (16.7%)	127 (69.8%)
Wife	14 (32.6%)	9 (40.9%)	4 (15.4%)	6 (33.3%)	17 (9.3%)
Son/daughter	10 (23.2%)	8 (36.4%)	7 (26.9%)	5 (27.8%)	26 (14.3%)
Other	5 (11.6%)	1 (4.5%)	0 (0.0%)	4 (22.2%)	12 (6.6%)
Total	43 (100.0%)	22 (100.0%)	26 (100.0%)	18 (100.0%)	182 (100.0%)

TABLE 5-50
Demographic Characteristics of Cancer Cases and Controls

Demographic Characteristics	Colo-rectal Cancers	Prostate Cancer	Bladder Cancer	Leukemias and Lymphatic Cancers	Non-Cancer Controls
Race:					
White	39 (95.1%)	22 (100.0%)	24 (96.0%)	17 (94.4%)	166 (94.3%)
Marital Status:					
Married	33 (86.8%)	13 (86.7%)	21 (91.3%)	11 (78.6%)	138 (81.2%)
Number of Children:					
1-2	22 (57.9%)	13 (61.9%)	12 (50.0%)	5 (29.4%)	91 (54.8%)
Education:					
≤8th grade	18 (48.7%)	10 (50.0%)	5 (20.8%)	6 (40.0%)	55 (35.5%)
Year of Birth					
<1900	8 (20.0%)	6 (28.6%)	3 (11.5%)	3 (17.7%)	24 (13.7%)
1900-1909	16 (40.0%)	7 (33.3%)	8 (30.8%)	4 (23.5%)	50 (28.4%)
1910-1919	9 (22.5%)	7 (33.3%)	12 (46.2%)	7 (41.1%)	65 (36.9%)
1920+	7 (17.5%)	1 (4.8%)	3 (11.5%)	3 (17.7%)	37 (21.0%)

TABLE 5-51
 Highest Grade in School Completed by Colo-rectal Cancer
 Cases and Controls*

Highest Grade	Colo-rectal Cancer Cases	Non-Cancer Controls
≤8 grades	18 (48.7%)	55 (35.5%)
9-11 grades	3 (8.1%)	49 (31.6%)
12+	16 (43.2%)	51 (32.9%)
Total Reporting	37 (100.0%)	155 (100.0%)

*6 colo-rectal cancer cases and 27 controls did not respond to this question.

TABLE 5-52A
Occupational Characteristics of Cases and Controls and Associated Odds Ratios

Occupation	Colo-rectal Cancers	Prostate Cancer	Bladder Cancer	Leukemias and Lymphatic Cancers	Non-Cancer Controls
<u>Usual Occupation</u>					
No. and (%) Painters	30 (71.4%)	15 (68.2%)	15 (57.7%)	14 (82.3%)	100 (55.3%)
Odds Ratio	2.02 (0.98, 4.15)	1.71 (0.68, 4.29)	1.11 (0.49, 2.53)	3.43 (1.03, 11.42)	--
<u>IBPAT Trade</u>					
No. and (%) Painters	18 (66.7%)	13 (68.4%)	12 (57.1%)	10 (90.0%)	66 (55.5%)
Odds Ratio	1.57 (0.66, 3.71)	1.67 (0.61, 4.55)	1.06 (0.42, 2.65)	5.63 (0.98, 32.30)	--
<u>Ever a Painter</u>					
No. and (%) Painters	30 (75.0%)	17 (77.3%)	17 (65.4%)	15 (93.7%)	105 (59.0%)
Odds Ratio	2.06 (0.96, 4.42)	2.26 (0.83, 6.16)	1.31 (0.56, 3.04)	7.34 (1.34, 40.27)	--

Table 5-52B

Odds Ratios for Occupation for Selected Cancer Sites Adjusted for Age

Occupation	Colo-rectal Cancer	Prostate Cancer	Bladder Cancer	Lymphatic Malignancies
<u>Usual Occupation</u>				
Odds Ratio	1.92 (0.91, 4.04)	1.76 (0.66, 4.66)	1.16 (0.50, 2.67)	3.77 (1.04, 13.74)
<u>IBPAT Trade</u>				
Odds Ratio	1.43 (0.58, 3.50)	1.80 (0.60, 5.40)	1.07 (0.42, 2.73)	7.94 (0.96, 65.55)
<u>Ever a Painter</u>				
Odds Ratio	1.91 (0.87, 4.21)	2.20 (0.75, 6.43)	1.34 (0.56, 3.18)	9.91 (1.27, 77.12)

TABLE 5-53
Number of Reports of Work in IBPAT Trades Among Cancer Cases and Controls*

IBPAT Trade Area	Colo-rectal Cancers	Prostate Cancer	Bladder Cancer	Leukemias and Lymphatic Cancer	Non-Cancer Controls
<u>Painting</u>					
New Construction	25 (24.3%)	11 (21.2%)	16 (22.2%)	11 (22.9%)	77 (22.3%)
Industrial/Maintenance	24 (23.3%)	10 (19.2%)	15 (20.8%)	10 (20.8%)	58 (16.8%)
Specialty	10 (9.7%)	5 (9.6%)	5 (6.9%)	5 (10.4%)	42 (12.2%)
Paint Making	4 (3.9%)	1 (1.9%)	2 (2.8%)	3 (6.3%)	9 (2.6%)
Glazing	8 (7.8%)	1 (1.9%)	4 (5.6%)	1 (2.1%)	36 (10.4%)
Paperhanging	16 (15.5%)	9 (17.3%)	11 (15.3%)	7 (4.6%)	41 (11.9%)
Tile Laying	0 (0.0%)	1 (1.9%)	0 (0.0%)	0 (0.0%)	1 (0.3%)
Dry Wall Taping	9 (8.7%)	7 (13.5%)	13 (18.1%)	7 (14.6%)	42 (12.2%)
Other Trades	3 (2.9%)	5 (9.6%)	5 (6.9%)	3 (6.3%)	13 (3.8%)
None of these trades	4 (3.9%)	2 (3.9%)	1 (1.4%)	1 (2.1%)	26 (7.5%)
Total # Reports	103 (100.0%)	52 (100.0%)	72 (100.0%)	48 (100.0%)	345 (100.0%)

*Frequencies reflect number of reports, not number of individuals.

TABLE 5-54
Odds Ratios Associated with Work in Specific IBPAT Trades
When Compared to Individuals Never Working in these Trades

IBPAT Trade Areas	Colo-Rectal Cancers	Prostate Cancer	Bladder Cancer	Leukemias and Lymphatic Cancers
New Construction	1.94 (0.65, 5.79)	1.57 (0.37, 6.62)	3.76 (0.67, 21.19)	2.62 (0.45, 15.20)
Industrial/Maintenance	2.47 (0.82, 7.45)	1.90 (0.44, 8.14)	4.68 (0.82, 26.61)	3.17 (0.54, 18.64)
Specialty	1.45 (0.43, 4.86)	1.37 (0.28, 6.61)	2.29 (0.35, 14.83)	2.29 (0.35, 14.83)
Paint Making	2.79 (0.62, 12.53)	1.67 (0.19, 14.45)	4.65 (0.54, 40.14)	6.51 (0.84, 50.63)
Glazing	1.37 (0.39, 4.77)	0.43 (0.05, 3.50)	2.18 (0.32, 14.77)	0.73 (0.07, 7.37)
Paperhanging	2.34 (0.74, 7.40)	2.43 (0.55, 10.62)	4.89 (0.83, 28.74)	3.19 (0.52, 19.70)
Tile Laying	--	10.60 (0.78, 143.91)	--	--
Dry Wall Taping	1.32 (0.39, 4.47)	1.87 (0.41, 8.48)	5.61 (0.97, 32.46)	3.12 (0.51, 19.22)
Other Trades	1.53 (0.33, 7.14)	4.32 (0.84, 22.09)	7.20 (1.05, 49.13)	4.58 (0.61, 34.59)

TABLE 5-55
Number of Reports of Work as a Painter in Specific Industries Among Cases and Controls*

Painter in	Colo-rectal Cancers	Prostate Cancer	Bladder Cancer	Leukemias and Lymphatic Cancers	Non-Cancer Controls
Auto, Aircraft, or Railcar Industry	3 (7.1%)	3 (11.1%)	0 (0.0%)	2 (11.1%)	9 (5.3%)
Shipbuilding	5 (11.9%)	5 (18.5%)	3 (11.1%)	1 (5.6%)	13 (7.6%)
Construction	11 (26.2%)	8 (29.6%)	10 (37.0%)	8 (44.4%)	43 (25.1%)
Industrial/Maintenance	2 (4.8%)	2 (7.4%)	1 (3.7%)	4 (22.2%)	8 (4.7%)
None of these Industries	21 (50.0%)	9 (33.4%)	13 (48.2%)	3 (16.7%)	98 (57.3%)
Total # Reports	42 (100.0%)	27 (100.0%)	27 (100.0%)	18 (100.0%)	171 (100.0%)

*Frequencies reflect number of reports, not number of individuals.

TABLE 5-56
 Odds Ratios Associated with Work as a Painter as Specific Industries
 When Compared to Individuals not Employed in These Trades

Industry	Colo-rectal Cancers	Prostate Cancer	Bladder Cancer	Leukemias and Lymphatic Cancers
Auto, Aircraft, or Railroad Industry	1.69 (0.45, 6.26)	3.82 (0.95, 15.41)	--	7.41 (1.28, 42.80)
Shipbuilding	1.87 (0.62, 5.58)	4.22 (1.28, 13.95)	1.89 (0.51, 6.98)	3.13 (0.43, 23.00)
Construction	1.21 (0.54, 2.69)	2.03 (0.75, 5.46)	1.76 (0.73, 4.25)	5.50 (1.51, 20.07)
Industrial/Maintenance	1.35 (0.31, 5.95)	3.05 (0.64, 14.58)	1.29 (0.21, 8.00)	14.90 (3.12, 71.10)

TABLE 5-57
Work Environment Characteristics and Associated Odds Ratios
for Cancer Sites and Controls

Work Environment Characteristics	Colo-rectal Cancers	Prostate Cancers	Bladder Cancers	Leukemias and Lymphatic Cancers	Non-Cancer Controls
Use of Spackling Compound					
Ever	29 (80.6%)	16 (80.0%)	19 (79.2%)	12 (75.0%)	112 (69.6%)
Odds Ratio	1.73 (0.73, 4.12)	1.61 (0.54, 4.82)	1.56 (0.57, 4.25)	1.22 (0.39, 3.78)	
Wearing a Mask					
Never	17 (47.2%)	13 (68.4%)	14 (60.9%)	9 (56.3%)	86 (51.5%)
Odds Ratio	0.85 (0.41, 1.72)	1.96 (0.73, 5.23)	1.44 (0.60, 3.44)	1.19 (0.44, 3.26)	
Type of Mask					
Paper	4 (33.3%)	2 (66.7%)	4 (66.7%)	1 (33.3%)	27 (43.6%)
Odds Ratio	0.68 (0.20, 1.71)	2.15 (0.27, 17.30)	2.32 (0.46, 11.79)	0.77 (0.09, 6.23)	
Other Protective Equipment					
No	23 (65.7%)	12 (70.6%)	17 (77.3%)	10 (66.7%)	116 (70.3%)
Odds Ratio	0.80 (0.37, 1.71)	0.97 (0.34, 2.70)	1.35 (0.49, 3.73)	0.81 (0.27, 2.40)	
Worked as a Sandblaster					
Yes	5 (14.7%)	2 (11.8%)	2 (10.0%)	2 (16.7%)	17 (10.4%)
Odds Ratio	1.57 (0.56, 4.43)	1.36 (0.33, 5.65)	1.14 (0.28, 4.67)	2.01 (0.46, 8.69)	

TABLE 5-58
 Number of Reports of Exposure to Specified Substances
 and Associated Odds Ratios by Cancer Site*

	Colo-rectal Cancers		Prostate Cancer	
	# Exposures	Odds Ratio	# Exposures	Odds Ratio
Arsenic	1	2.31 (0.31, 17.20)	0	--
Asbestos	8	1.41 (0.54, 3.71)	5	2.54 (0.68, 9.45)
Beryllium	0	--	1	∞
Chromium	1	2.31 (0.31, 17.20)	1	6.43 (0.76, 54.51)
Coal Tar, etc.	5	2.58 (0.79, 8.42)	1	1.96 (0.28, 13.76)
Dyestuffs	4	3.74 (0.97, 14.35)	3	8.08 (1.61, 40.49)
Formaldehyde	1	1.47 (0.22, 9.88)	2	6.82 (1.16, 40.17)
Insecticides, etc.	2	1.59 (0.34, 7.36)	1	2.65 (0.37, 19.19)
Lead	21	1.75 (0.80, 3.79)	13	3.05 (0.99, 9.33)
Cutting Oils, etc.	5	2.58 (0.79, 8.42)	2	3.26 (0.61, 17.28)
Nickel	0	--	0	--
Solvents	1	0.70 (0.11, 4.28)	2	3.26 (0.61, 17.28)
Radioactive Materials	0	--	0	--
Creosote/Wood Preservatives	10	2.91 (1.11, 7.61)	4	3.46 (0.85, 14.04)
Other Exposures	2	1.29 (0.29, 5.79)	1	2.14 (0.30, 15.20)

*Frequencies reflect number of exposures reported, not number of individuals.

TABLE 5-58 (con't)
 Number of Reports of Exposure to Specified Substances
 and Associated Odds Ratios by Cancer Site*

	Bladder Cancer		Leukemias and Lymphatic Cancers	
	# Exposures	Odds Ratio	# Exposures	Odds Ratio
Arsenic	0	--	1	11.57 (1.17, 114.46)
Asbestos	7	2.08 (0.69, 6.21)	4	3.74 (0.75, 18.55)
Beryllium	0	--	0	--
Chromium	0	--	0	--
Coal Tar, etc.	2	1.96 (0.41, 9.33)	3	8.22 (1.44, 46.78)
Dyestuffs	0	--	3	14.54 (2.37, 88.98)
Formaldehyde	0	--	1	7.36 (0.81, 66.65)
Insecticides, etc.	1	1.59 (0.24, 10.54)	2	7.94 (1.20, 52.70)
Lead	10	1.42 (0.52, 3.85)	11	4.67 (1.14, 19.11)
Cutting Oils, etc.	3	2.74 (0.67, 11.27)	3	8.22 (1.44, 46.78)
Nickel	1	5.40 (0.62, 46.83)	0	--
Solvents	0	--	2	5.87 (0.91, 37.75)
Radioactive Materials	0	--	0	--
Creosote/Wood Preservatives	5	2.54 (0.76, 8.51)	5	7.61 (1.57, 36.89)
Other Exposures				

*Frequencies reflect number of exposures reported, not number of individuals.

TABLE 5-59
Distribution of Industries Outside the Painting Trades by Cancer Site

<u>Industries Except Construction</u>	<u>Total Number, All Sites</u>	<u>Specific Cancer Sites</u>	
Asbestos Mining & Milling	5	All other sites*	2
		Colo-rectal cancer	2
		Leukemias and lymphatic cancer	1
Uranium Mining	0		
Other Mining	4	All other sites	3
		Leukemias and lymphatic cancer	1
Auto (repair/service)	6	Colo-rectal cancer	3
		Bladder cancer	1
		All other sites	1
		Other digestive cancers	1
Petroleum Production	7	Prostate cancer	3
		Colo-rectal cancer	1
		Leukemias and lymphatic cancer	2
		All other sites	1
Smelting	0		
Tanning	1	All other sites	1
Textile	2	Colo-rectal cancers	1
		Other digestive cancers	1
Wood Treatment	6	Colo-rectal cancers	3
		Other digestive cancers	1
		Leukemias and lymphatic cancer	1
		All other sites	1
Farming	12	Colo-rectal cancers	3
		Bladder cancer	1
		Leukemias and lymphatic cancer	2
		Other digestive cancers	3
		Other genito-urinary cancer	1
		All other sites	2

*"All other sites" includes all cancers except lung, colo-rectal, bladder, prostate, lymphatic and leukemias.

TABLE 5-60
Distribution of Occupations Outside the Painting Trades by Cancer Site

<u>Occupation</u>	<u>Total Number, All Sites</u>	<u>Specific Cancer Sites</u>	
Battery worker	0		
Brake repair	1	Bladder cancer	1
Boilermaker	2	All other sites*	2
Electrician	2	Leukemia and lymphatic cancer	1
Insulator	2	Colo-rectal cancer	1
		All other sites	1
Pipefitter	3	All other sites	2
		Bladder cancer	1
Plumber	3	All other sites	2
		Bladder cancer	1
X-ray technician	0		
Radar technician	0		
Machinist	7	All other sites	1
		Colo-rectal cancer	2
		Other digestive cancer	1
		Bladder cancer	2
		Leukemia and lymphatic cancer	1
Welder	8	Colo-rectal cancer	2
		Other digestive cancers	3
		Bladder cancer	2
		All other sites	1

*"All other sites" includes all cancers except lung, colo-rectal, bladder, prostate, lymphatic and leukemias.

TABLE 5-61
Cigarette Smoking Among Cancer Cases and Controls

	Colo-rectal Cancers	Prostate Cancer	Bladder Cancer	Leukemias and Lymphatic Cancers	Non-Cancer Controls
<u>A. Ever Smoked 100 or More Cigarettes</u>					
Yes	35 (83.3%)	12 (54.5%)	21 (80.8%)	14 (77.8%)	136 (76.8%)
No	7 (16.7%)	10 (45.5%)	5 (19.2%)	4 (22.2%)	41 (23.2%)

<u>B. Average Number of Cigarettes Smoked/Day (smokers only)</u>					
<20	6 (19.4%)	1 (9.1%)	2 (9.5%)	2 (14.3%)	34 (27.0%)
20-39	21 (67.7%)	8 (72.7%)	15 (71.4%)	9 (64.3%)	61 (48.4%)
40+	4 (21.9%)	2 (18.2%)	4 (19.1%)	3 (21.4%)	31 (24.6%)

<u>C. Smoked a Pipe Regularly</u>					
Yes	10 (26.3%)	5 (26.3%)	3 (11.5%)	1 (5.9%)	29 (17.3%)
No	28 (73.7%)	14 (73.7%)	23 (88.5%)	16 (94.1%)	139 (82.7%)

<u>D. Smoked Cigars Regularly</u>					
Yes	10 (25.6%)	5 (25.0%)	3 (11.5%)	4 (22.2%)	48 (27.9%)
No	29 (74.4%)	15 (75.0%)	23 (88.5%)	14 (77.8%)	124 (72.1%)

TABLE 5-62
Frequency of Consumption of Selected Foods Once a Week or More by Cancer Site

Food Category	Colo-rectal Cancers	Prostate Cancer	Bladder Cancer	Leukemias and Lymphatic Cancers
Apples	21 (58.3%)	13 (68.4%)	11 (47.8%)	11 (64.7%)
Citrus Fruit/Juice	30 (85.7%)	16 (80.0%)	16 (72.7%)	14 (82.3%)
Tomatoes	22 (57.9%)	14 (70.0%)	14 (60.9%)	12 (70.6%)
Cabbage	4 (12.1%)	3 (15.8%)	3 (13.6%)	2 (12.5%)
Brussel Sprouts	3 (9.4%)	1 (5.3%)	2 (9.0%)	2 (14.3%)
Cauliflower	4 (12.9%)	5 (26.3%)	1 (4.8%)	2 (13.3%)
Broccoli	9 (29.0%)	4 (21.0%)	3 (14.3%)	2 (13.3%)
Collard/Kale	2 (7.1%)	1 (6.3%)	0 (0.0%)	0 (0.0%)
Spinach	10 (31.3%)	4 (25.0%)	4 (17.4%)	3 (21.4%)
Carrots	14 (45.2%)	8 (40.0%)	10 (45.5%)	8 (47.1%)
Liver	9 (28.1%)	4 (21.0%)	5 (25.0%)	1 (6.2%)
Pork/Beef/Veal	20 (60.6%)	12 (57.1%)	13 (59.1%)	11 (73.3%)
Fish/Seafood	14 (38.9%)	12 (57.1%)	11 (50.0%)	9 (56.2%)
Chicken/Poultry	22 (62.9%)	16 (80.0%)	12 (60.0%)	11 (73.3%)
Cured Meats	9 (29.0%)	5 (31.3%)	6 (31.6%)	6 (35.3%)
Milk	28 (84.9%)	18 (94.7%)	19 (86.4%)	11 (68.7%)
Coffee	32 (88.9%)	18 (90.0%)	16 (84.3%)	15 (88.2%)
Tea	17 (51.5%)	15 (83.3%) (1)	10 (52.6%)	6 (35.3%)
Diet Soda	2 (6.7%)	3 (17.7%)	1 (4.8%)	1 (6.2%)
Regular Soda	8 (24.2%)	7 (41.2%)	6 (28.6%)	6 (35.3%)
Beer	12 (36.4%)	11 (61.1%) (2)	6 (26.0%)	6 (37.5%)
Wine	13 (36.1%)	6 (35.3%)	4 (18.2%)	4 (26.7%)
Whiskey	10 (27.0%)	7 (35.0%)	4 (18.2%)	4 (25.0%)

(1) $\chi^2 = 6.282$, $df=1$, $P=.012$

(2) $\chi^2 = 3.859$, $df=1$, $P=.049$

TABLE 5-63
Vitamin Usage Among Cancer Cases and Controls by Type of Vitamin*

Ever Used Vitamin	Colo-rectal Cancers	Prostate Cancer	Bladder Cancer	Leukemias and Lymphatic Cancers	Non-Cancer Controls
Multiple	14 (40.0%)	6 (28.5%)	11 (34.4%)	8 (34.8%)	43 (27.7%)
Vitamin A	1 (2.9%)	1 (4.8%)	2 (6.2%)	2 (8.7%)	10 (6.5%)
Cod Liver Oil	2 (5.7%)	3 (14.3%)	1 (3.1%)	1 (4.4%)	13 (8.4%)
Vitamin B	3 (8.6%)	1 (4.8%)	3 (9.4%)	3 (13.0%)	17 (11.0%)
Vitamin C	6 (17.1%)	3 (14.3%)	7 (21.9%)	3 (13.0%)	32 (20.6%)
Vitamin E	5 (14.3%)	5 (23.8%)	6 (18.8%)	4 (17.4%)	28 (18.1%)
Other Vitamins	4 (11.4%)	2 (9.5%)	2 (6.2%)	2 (8.7%)	12 (7.7%)
Total Vitamin Usage	35 (100.0%)	21 (100.0%)	32 (100.0%)	23 (100.0%)	155 (100.0%)

*Frequencies reflect number of vitamins reported, not number of individuals.

Ever Took Any Type of Vitamin

	Colo-rectal Cancers	Prostate Cancer	Bladder Cancer	Leukemias and Lymphatic Cancer	Non-Cancer Controls
Yes	18 (51.4%)	12 (63.2%)	12 (52.2%)	10 (62.5%)	75 (45.7%)
No	17 (48.6%)	7 (36.8%)	11 (47.8%)	6 (37.5%)	89 (54.3%)

8 Colo-rectal cancer cases, 3 prostate cancer cases, 3 bladder cancer cases and 2 lymphatic leukemia cases did not respond to the question on vitamin usage.

Use of Artificial Sweeteners Among Cancer Cases and Controls

Use Artificial Sweeteners	Colo-rectal Cancers	Prostate Cancers	Bladder Cancers	Leukemia and Lymphatic Cancers	Non-Cancer Controls
Regularly/ sometimes	7 (20.0%)	4 (20.0%)	2 (8.3%)	3 (17.7%)	37 (21.8%)

TABLE 5-64
 Years of Employment as a Painter in Various Industries
 by Cases of Leukemia and Lymphatic Cancers

	Auto/Air/Railcar Painting	Ship Painting	Construction Painting*	Industrial/Maintenance Painting
<1 year	0 (0.0%)	0 (0.0%)	0 (0.0%)	1 (25.0%)
2-5 years	2 (100.0%)	0 (0.0%)	0 (0.0%)	1 (25.0%)
6-9 years	0 (0.0%)	1 (100.0%)	0 (0.0%)	0 (0.0%)
10+ years	0 (0.0%)	0 (0.0%)	6 (100.0%)	2 (50.0%)

*2 individuals did not indicate the number of years they had worked at the job.

FIGURE 5-1
Variables Included in the Logistic Regression Analysis

Variable	Description	Value
Disease Status	Case	1
	Control	0
Age	Continuous	-
Education	≤ Grade 8	1
	> Grade 8	0
Smoking	≤ 10 Cigarettes/day	0
	> 10 Cigarettes/day	1
Occupation	Usual, painter	1
	other jobs	0
Mask	Wear ever	0
	Wear never	1
Asbestos	Ever exposed	1
	Never exposed	0
Beer	Once a week or more	1
	Less than once a week	0

CHAPTER 6

STUDY PARTICIPATION

I. Response Rates Among Cases and Controls

Overall, 49.3% of study subjects completed and returned the questionnaires. Lung cancer cases were somewhat more likely than either cases of cancer of other sites or controls to respond to the questionnaire (Table 6-1), with 56% of lung cancer cases, 48% of cases of other cancer sites and 49% of controls completing the questionnaire. There was little variation by disease status in refusal rates or in the proportion lost to follow-up. Sixteen percent of lung cancer cases, 19% of cancers of other sites, and 18% of non-cancer controls could not be traced. Of those individuals who received a questionnaire, responses were received from 66% of lung cancer cases, 59% of cancers of other sites and 59% of controls.

II. Characteristics of Responders and Non-Responders

a. Lung Cancer Cases

Lung cancer cases who responded to the questionnaire were somewhat more likely to be white and live in upstate New York (rather than New York City) than were non-responders. However, these differences were not statistically significant. Responders and non-responders also were not different in year of birth or marital status (Table 6-2). In terms of the lung cancer itself, there was no significant difference between responders and non-responders in year of diagnosis, stage of disease or year of death.

When the union records of responders and non-responders were compared, there was also no difference in terms of union membership status, birthdate on their union record or the type of local with which they were affiliated (Table 6-3).

b. Non-Cancer Controls

Union data only are available for the controls without cancer. Among this group, responders were more likely to be current members than were non-responders (Table 6-4). They also tended to differ in age composition, with fewer responders born prior to 1910 and after 1920 (the oldest and youngest age groups). Responders and non-responders did not vary by type of local to which they belonged.

c. Cases of Cancer of Sites Other Than Lung

Cancer cases (except lung), like lung cancer cases, were more likely to respond to the questionnaire if they lived in upstate New York rather than New York City. The difference was statistically significant (Table 6-5). Responders and non-responders did not differ significantly, however, by year of birth, race or marital status. In terms of tumor data, the two groups did not differ by year of diagnosis, year of death or tumor stage. Responders and

non-responders among the cancer controls did not vary significantly by type of local or year of birth. Responders were less likely to have terminated their union membership than were non-responders (Table 6-6).

Table 6-7 indicates the percent questionnaires received for the cancer sites which were analyzed separately.

TABLE 6-1
Response Status of Cases and Controls

Response Status	Lung Cancer Cases	Cancer Cases (Except Lung)	Non-Cancer Controls	Total
Questionnaire received	69 (55.7%)	187 (47.7%)	182 (49.1%)	438 (49.3%)
Refusal	27 (21.8%)	79 (20.2%)	77 (20.8%)	183 (20.6%)
Lost to follow-up	20 (16.1%)	73 (18.6%)	65 (17.5%)	158 (17.5%)
Non-response to certified mail	6 (4.8%)	34 (8.7%)	38 (10.2%)	78 (10.2%)
Insufficient information	2 (1.6%)	19 (4.8%)	9 (2.4%)	30 (2.4%)
TOTAL	124 (100.0%)	392 (100.0%)	371 (100.0%)	887 (100.0%)

TABLE 6-2
Comparison of Lung Cancer Cases Who Responded and Did Not Respond

Variable	Responders	Non-Responders/ Lost to Follow-up
<u>Residence</u>		
Upstate New York	17 (30.4%)	9 (21.4%)
New York City	20 (35.7%)	24 (57.2%)
Counties Near NYC	19 (33.9%)	9 (21.4%)
	$X^2=4.488$ df=2 P=.106	

<u>Year of Birth</u>		
< 1910	20 (35.7%)	21 (50.0%)
1910-1919	23 (41.1%)	12 (28.6%)
1920+	13 (23.2%)	9 (21.4%)
	$X^2=2.254$ df=2 P=.324	

<u>Race</u>		
White	52 (94.5%)	38 (90.5%)
	Fisher's Exact Test P=0.351	

<u>Marital Status</u>		
Married	47 (83.9%)	34 (81.0%)
	$X^2=0.013$ df=1 P=.908	

<u>Date of Diagnosis</u>		
1975	10 (17.9%)	9 (21.4%)
1976	11 (19.6%)	9 (21.4%)
1977	14 (25.0%)	11 (26.2%)
1978	12 (21.4%)	8 (19.1%)
1979+	9 (16.1%)	5 (11.9%)
	$X^2=0.567$ df=4 P=.967	

<u>Year of Death</u>		
1975	6 (15.0%)	3 (9.4%)
1976	7 (17.5%)	11 (34.4%)
1977	14 (35.0%)	8 (25.0%)
1978+	13 (32.5%)	10 (31.2%)
	$X^2=3.066$ df=3 P=.382	

<u>Stage</u>		
One	8 (19.0%)	9 (27.3%)
	$X^2=0.321$ df=1 P=.571	

TABLE 6-3
 Comparison of Union Data of Lung Cancer Cases
 Who Responded and Did Not Respond

Variable	Responders	Non-Responders & Lost to Follow-up
<u>Union Status</u>		
Current/retiree	8 (11.6%)	9 (16.4%)
Dead	49 (71.0%)	37 (67.2%)
Withdrawn	12 (17.4%)	9 (16.4%)
	X ² =0.589 df=2 P=.745	

<u>Type of Local</u>		
Mixed	43 (62.3%)	38 (70.4%)
Specialty	26 (37.7%)	16 (29.6%)
	X ² =0.552 df=1 P=.458	

<u>Year of Birth</u>		
<1900	5 (7.2%)	5 (9.1%)
1901-1909	23 (33.3%)	25 (45.4%)
1910-1919	26 (37.7%)	15 (27.3%)
1920	15 (21.7%)	10 (18.2%)
	X ² =2.486 df=3 P=.478	

TABLE 6-4
 Comparison of Union Data of Non-Cancer Controls
 Who Responded and Did Not Respond

Variable	Responders	Non-Responders & Lost to Follow-up
<u>Union Status</u>		
Current	129 (70.9%)	102 (54.0%)
Dead	23 (12.6%)	40 (21.1%)
Withdrawn	30 (16.5%)	47 (24.9%)
	X ² =11.368 df=2 P=.003	

<u>Type of Local</u>		
Mixed	87 (47.8%)	89 (47.3%)
Specialty	95 (52.2%)	99 (52.7%)
	X ² =0.000 df=1 P=1.000	

<u>Year of Birth</u>		
<1900	27 (14.9%)	48 (25.4%)
1900-1909	55 (30.2%)	50 (26.5%)
1910-1919	65 (35.7%)	48 (25.4%)
1920+	35 (19.2%)	43 (22.7%)
	X ² =9.367 df=3 P=.025	

TABLE 6-5
Comparison of Cancer Sites (Except Lung)
Who Responded and Did Not Respond

Variable	Responders	Non-Responders
<u>Residence</u>		
Upstate New York	52 (33.8%)	37 (23.1%)
New York City	52 (33.8%)	87 (54.4%)
Counties Near NYC	50 (32.4%)	36 (22.5%)
	X ² =13.510 df=2 P=.001	
<u>Year of Birth</u>		
< 1910	79 (51.0%)	74 (59.2%)
1910-1919	49 (31.6%)	34 (27.2%)
1920+	27 (17.4%)	17 (13.6%)
	X ² =3.040 df=2 P=.219	
<u>Race</u>		
White	145 (95.8%)	147 (93.4%)
	X ² =0.477 df=1 P=.490	
<u>Marital Status</u>		
Married	119 (78.8%)	116 (73.0%)
	X ² =1.145 df=1 P=.285	
<u>Year of Diagnosis</u>		
1975	32 (20.6%)	42 (26.1%)
1976	36 (23.2%)	42 (26.1%)
1977	28 (18.1%)	23 (14.3%)
1978	28 (18.1%)	32 (19.9%)
1979+	31 (20.0%)	22 (13.6%)
	X ² =3.986 df=4 P=.408	
<u>Year of Death</u>		
1975	9 (13.6%)	11 (22.9%)
1976	17 (25.8%)	21 (43.8%)
1977	18 (27.3%)	16 (33.3%)
1978+	22 (33.3%)	
	X ² =2.257 df=3 P=.521	
<u>Stage</u>		
One	53 (43.8%)	47 (37.6%)
	X ² =0.740 df=1 P=.390	

TABLE 6-6
 Comparison of Union Data of Cancer Sites (Except Lung)
 Who Responded and Did Not Respond

Variable	Responders	Non-Responders
<u>Union Status</u>		
Current	77 (41.2%)	62 (30.2%)
Dead	95 (50.8%)	106 (51.7%)
Withdrawn	15 (8.0%)	37 (18.1%)
	$\chi^2=10.724$ df=2 P=.004	
<u>Type of Local</u>		
Mixed	124 (66.3%)	128 (62.4%)
Specialty	63 (33.7%)	77 (37.6%)
	$\chi^2=0.481$ df=1 P=.488	
<u>Year of Birth</u>		
< 1900	35 (18.7%)	50 (24.4%)
1900-1909	60 (32.1%)	73 (35.6%)
1910-1919	62 (33.2%)	49 (23.9%)
1920+	30 (16.0%)	33 (16.1%)
	$\chi^2=4.767$ df=3 P=.190	

TABLE 6-7
Distribution of Response Status by Cancer Site

Response Status	Colo-rectal Cancers	Prostate Cancer	Bladder Cancer	Leukemias and Lymphatic Cancers
Questionnaire Received	43 (49%)	22 (42%)	26 (59%)	18 (43%)
Non-Response*	44 (51%)	31 (58%)	18 (41%)	24 (57%)
TOTAL	87 (100%)	53 (100%)	44 (100%)	42 (100%)

*Non-Response includes refusals, lost to follow-up, non-response to certified mail, and insufficient information.

CHAPTER 7
DISCUSSION & CONCLUSIONS

Phase I
COHORT STUDY

The overall design of this project is a cohort study with a nested case control study within the cohort. The cohort is a large group of workers who belong to the same union but who have various trades. These trades include painting, floor covering, paperhanging, glazing as well as others. The union provided a unique situation for a study of construction painters. This occupation tends to consist of a migrant type of work force which is hard to identify through a central data source such as industrial records. The union provided that type of roster. However, in many cases use of union records for population studies would include a group who were selected for membership and were not necessarily representative of other working groups. In the situation which exists in this union other working groups are also selectively included in the union and can be used as a comparison group in assessing risks of painters.

A second major advantage of the group was that a large number of painters were included in the union and it was possible therefore to select a limited cohort to follow and still have sufficient numbers of deaths to provide adequate power. It is possible that this type of design may under-estimate risk as will be noted below.

The results of Standardized Mortality Ratio (SMR) analysis indicate no significant mortality excess among the study population overall. The Proportionate Mortality Ratio (PMR) analysis, by contrast, suggests a significant excess in mortality from a number of cancer sites within the cohort.

Several factors suggest that the SMR may be underestimating the mortality experience of the study population:

1. The "healthy worker" effect - as the entire U.S. population consists of those too ill to work and at a high risk of death as well as healthy working individuals, the overall SMR of occupational groups is frequently lower than the rate for the U.S. population.
2. All individuals lost to follow-up are considered alive to the end of follow-up. Given the short follow-up period of our study, and small percentage lost to follow-up (1.46%) this estimate, although conservative, is expected to have only a minor impact on the number of deaths observed.
3. The design of the study is a limited duration cohort study in a large population who were of an older age group and therefore should have yielded sufficient numbers of deaths to provide the power to identify excesses of cancer for several common sites. However,

after seeing the results of such a study it is possible that the design biases the results to long survivorship. The member must be alive as of January 1, 1975 to be included in the cohort, regardless of age. Those who died prior to 1975 are excluded. It has been suggested by one author (Johnson 1984) that this study design underestimates the mortality experience of the group. The SMR calculation is further affected by this underestimation, as it is based upon the actual mortality risk for each cause. The PMR, based instead on the distribution of deaths, is less influenced by this bias.

4. Union members may represent an exaggeration of the "healthy worker" effect. It has been suggested that individuals who join organizations and engage in other forms of positive social and preventive health behaviors may have preferred mortality experience. This could certainly play a role in the comparisons of these workers with the general U.S. population rates.

The cancer sites with non-significant excesses in the SMR analysis are, for the most part, the same sites found to be at significant excess in the PMR analysis. In assessing risks, sites have been considered to warrant further attention if both methods of analysis have suggested an excess and the numbers of cases have been relatively large.

It appears from both the SMR and PMR analyses that this population is experiencing lower rates of circulatory, cerebrovascular, and nervous system diseases than the U.S. white male population in general. The rate of respiratory diseases is also significantly lower than expected. The low rate of emphysema may partially account for this. COPD which is not indicated separately but only as part of all respiratory disease is also most likely low, but may not be significantly so. The low rates of respiratory disease suggest that the study population does not consist of a group who are suffering from the effects of unusual smoking habits. This is true despite the high risk of lung cancer, cigarette smokers. The PMR analysis does not indicate a significant deficit of all respiratory disease, although the significant deficit of emphysema remains. Despite excesses of lung, bladder, and stomach cancer all of which have been associated with smoking in other studies it is difficult to see how they explain this personal factor explains the excesses in this population. Not only does the case-control study suggest these cancers are occurring in excess independent of smoking but the deficit of emphysema and respiratory disease mortality also indicates that agents other than smoking probably play a role in the cancer excesses observed.

When the union cohort was subdivided by trade affiliation members of mixed locals had a higher overall mortality (.93) experience than did members of specialty locals (.75), although both are lower than that of all U.S. white males. When the three major specialty trades of glaziers, sign painters and floor covering installers were assessed separately, all three groups exhibited lower overall mortality than members of mixed locals. No significant elevations in mortality from cancer at any site were observed in these three groups, although the SMRs for several cancer sites in individuals trades were at least twice the expected rate and warrant further study.

Overall it appears that members of mixed locals, comprised primarily of painters present a different mortality experience from members of specialty locals. The elevation in lung cancer mortality among members of mixed locals were observed when comparisons were made both with U.S. white males and when using internal standards. A similar elevation in lung cancer mortality has been suggested by other authors in the United States (Guralnick 1963, Milham 1976, Mench 1976), the United Kingdom (Registrar General 1976), and Sweden (Englund 1980). Data from the case-control phase of this study indicates that for smoking does not explain all of the observed association between lung cancer and painting.

There was an elevation in mortality from leukemia and aleukemia among members of mixed locals and a lower than expected mortality from this cause among members of specialty locals. An elevation in leukemia risks among painters has been similarly suggested by the Tri-State Leukemia Study (Viadana 1976).

Although neither the comparisons using U.S. white male rates or the case-control study found an excess of bladder cancer among members of mixed locals (or painters), the results of the internal comparisons suggest that significant differences exist in the mortality experience of members of mixed and specialty locals in mortality from bladder cancer. These risks should also be explored further.

PHASE II

STUDY FINDINGS

i. The Cancer Risks Associated with Work as a Painter

The second phase of the study, the nested-case-control design, takes advantage of the established cohort of workers and selects only the diseases which appears to occur in excess and identify the risk factors associated with these cases. The specific confounding factors which we wished to examine were smoking and other non-union activities. The etiological factors which needed further investigation were the specific work of the union member and the exposures associated with these jobs. By selecting New York State as one of the areas to be included in the cohort it was possible to take advantage of their unique population-based registry which allowed us to identify all incident cases of cancer in this population for a period regardless of vital status. This is an opportunity which has not been possible in many of the occupational studies using a nested case control design since they have only been able to identify the cases from the mortality information

The goal of these case-control studies was to determine whether painters experience an elevated risk of cancer compared to workers in other allied trades. The findings suggest that painters may be experiencing an excess risk of lung cancer, lymphatic malignancies and possibly colo-rectal cancers when compared to men working in allied trades within the same union. These workers were similar in many respects, including most demographic characteristics, dietary habits and smoking characteristics, but did not share the exposure to paint and the painting environment. Elevated estimated odds ratios for lung cancer were found for painters and were elevated regardless of whether work as a painter was assessed by usual occupation, trade area while a member of IBPAT, or ever working in construction or maintenance painting. Results of the multivariate analysis have suggested that the excess lung cancer risk is focused on those painters who do not wear a mask. Among such workers, a five fold excess lung cancer risk was observed.

Elevated odds ratios for lymphatic malignancies were associated with a usual occupation of painter and ever working as a painter. When work in specific industries was considered, the highest risks were observed among industrial/maintenance painters. Most of the painters in this study painted on new construction projects or in maintenance painting, with only a few individuals painting in shipbuilding, automobile, and similar industries. Inquiry into work in areas outside the painting and allied trades which may carry an excess cancer risk yielded similar findings. Few members of the study population had been employed in any of the high risk occupations or industries and no excess lung cancer risk was observed to be associated with any particular industry or occupation outside the painting and allied trades.

ii. The Work Environment

Several characteristics of the work environment appear to be associated with an elevated lung cancer risk. Never wearing a mask or respirator of any type was associated with a slight elevation in risk for lung cancer cases compared to non-cancer controls. The use of spackling compound on the job was an additional factor in determining an individual's lung cancer risks. A five

fold crude odds ratio was associated with the use of spackling compound when compared to non-cancer controls. The risk associated with use of spackling compound decreased to a four fold excess when adjusted for smoking, drinking and other characteristics. The risk associated with use of spackling appears specific to lung cancer. There was no significant association between wearing a mask or use of spackling compound with any site of cancer other than lung.

iii. Smoking Characteristics

Not surprisingly, cigarette smoking represented an important factor in the lung cancer risks of the study population. Elevated lung cancer risks were observed for smokers when compared both to cancer and non-cancer controls. There were no cases of lung cancer among non-smokers in the study. When the smoking characteristics of the painters in the study were compared to those reported for construction and maintenance painters in the 1970 Household Interview Survey (Sterling 1976), 80% of the painters in this study compared to 72% of painters in the Household Interview Survey smoked a pack of cigarettes or more a day. The painter population in this study contains a high proportion of lung cancer cases which may inflate the smoking data for all painters. In addition, proxy respondents may be less accurate in reporting amount smoked per day. If instead the smoking characteristics of non-cancer controls are used for comparisons, 72.8% smoked 20 cigarettes or more per day, which is very close to the estimates from the Household Interview Survey.

iv. Difficulties in Collecting Data Concerning Types of Paints Applied

One purpose this phase of the study was the collection of data concerning the types of paints used by individuals. This information was felt to be unreliable. The use of specific types of paints was queried along with frequency of use and method of application. This question elicited a very high non-response rate, with a minimum of 65% of individuals not indicating whether or not they used specific paints. The question posed particular problems for surrogate respondents who seldom knew the types of paints that had been used by the subject. As almost all lung cancer cases were deceased, it was not possible to improve the quality of the available data by including only the information provided by the member himself. The possibility of collecting work-related information through the local unions was explored, but it was not possible to obtain cooperation and/or appropriate information during the time of the study.

In this analysis, it has been possible to examine the role that the use of spackling played in the development of lung cancer in this occupation group. It has not, however, been possible to assess the role of specific paint formulations on the lung cancer risks of these painters. Asbestos has been removed from spackling and, although past exposures may elevate the lung cancer risks in this occupational group, spackling compound without asbestos is less likely to pose a lung cancer risk in the future. Further work must be done on the risks of lung cancer related to various paint formulations. Other factors in the work environment, of which paints are the most common, may be associated with the risk of lymphatic malignancies and perhaps colo-rectal cancer among painters.

SUMMARY

Use of both cohort and a nested case-control study design has allowed the collection of mortality data on a large population of painters and allied tradesmen as well as the collection of specific work history data and personal characteristics of a subset of the cohort population.

Painters, through their jobs, may be exposed to solvents containing benzene, a wide variety of pigments and additives and may have worked for many years with spackling compounds containing asbestos. Results from both the cohort and case-control studies suggest that painters are at a higher risk of lung cancer and lymphatic malignancies particularly leukemias than their union counterparts who work in the allied trades. Painters may also be experiencing an increase in colo-rectal and bladder cancers, but further investigation of the risks of cancers of these sites through an expansion of the number of cases is required before conclusions can be drawn. With the rapid changes in paint technology and formulations, it has not been possible to identify specific paint components as possible etiologic agents in the non-concurrent (historical) study. Continued assessment of this population and studies of additional painter populations will be required to further investigate the risks of a variety of cancers including lung, bladder, colon, and leukemias among these workers and to determine whether changes in the composition of materials such as the removal of asbestos from spackling compound has altered their cancer risks. Further attempts at collecting information through contractor and union record as well as by personal recall may help identify specific exposures. But this must be done on a nested case-control bases to increase efficiency. Emphasis on worker health and safety including the use and maintenance of appropriate respirators may also assist in reducing the mortality from cancer in this population.

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