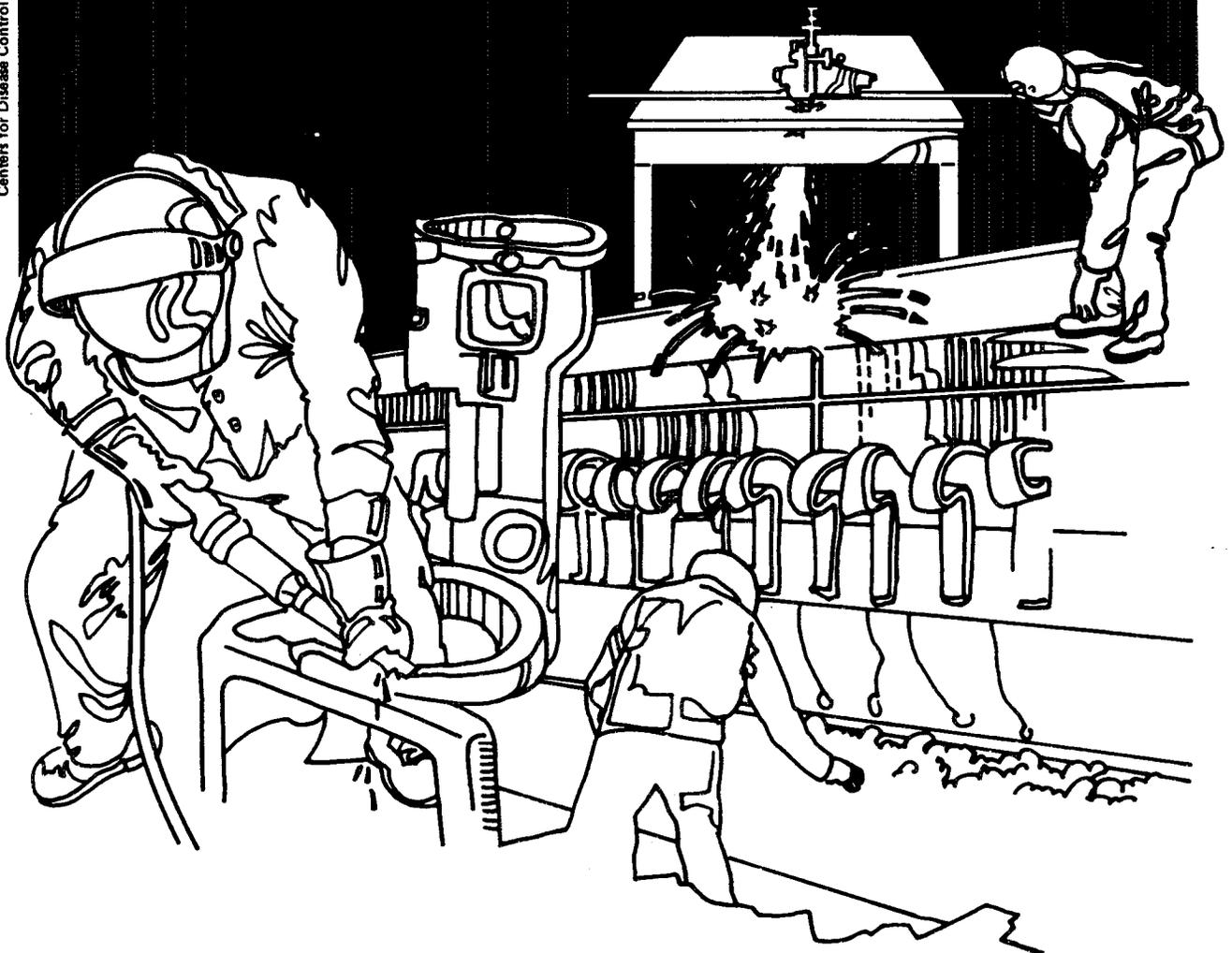


U.S. DEPARTMENT OF HEALTH AND HUMAN SERVICES ■ Public Health Service
Centers for Disease Control ■ National Institute for Occupational Safety and Health

NIOSH



Health Hazard Evaluation Report

HETA 80-104-1344
BALTIMORE COUNTY
POLICE DEPARTMENT
TOWSON, MARYLAND

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PREFACE

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

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

Mention of company names or products does not constitute endorsement by the National Institute for Occupational Safety and Health.

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5. Abstract (Limit: 200 words)

To investigate several cancer deaths reported among employees, and concern that these deaths might have resulted from carcinogenic occupational exposures in the crime laboratory, NIOSH investigators collected bulk samples of fingerprint powders for analysis of polynuclear aromatic hydrocarbons (PNA's). Personal breathing-zone air samples were collected during a simulated fingerprint dusting operation and exposure to carbon black was measured. Two of the fingerprint powder samples did not show the presence of any polynuclear aromatic compounds, but in the third sample fluoranthene (66.8 ug/gm) and pyrene (89.9 ug/g) were identified. Air samples taken while the fingerprint powder containing PNA's was in use showed the carbon black air concentration to be 5.6 mg/m³ in the breathing-zone of the person doing the dusting. The 8-hour time-weighted average carbon black exposure for this operation is 0.09 mg/m³; the NIOSH-recommended standard of 0.1 mg/m³ for carbon black containing PNA's. A proportionate mortality ratio (PMR) analysis of 91 death certificates identified a statistically significant excess of large intestine cancer in the overall study population of deceased police officers; a non-statistically significant excess of respiratory tract cancer among those who worked in the crime laboratory. The presence of these clusters neither confirms nor negates occupational carcinogen exposure. The environmental results of this study and a review of the toxicological literature indicate that a potential health hazard does exist in using the "Hi Fi" Volcano latent fingerprint powder. The use of this powder should be discontinued in favor of powders with no polynuclear aromatic hydrocarbons.

Document Analysis a. Descriptors

SIC 9221 (Police protection); carbon black; ninhydrin; polynuclear aromatic hydrocarbons; fluoranthene; pyrene; cancer; carcinogen; fingerprint powders and sprays.

b. Identifiers/Open-Ended Terms

c. COSATI Field/Group

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I. SUMMARY

In July 1980 the National Institute for Occupational Safety and Health (NIOSH) received a request from the Maryland Department of Health and Mental Hygiene to investigate possible health hazards in the Baltimore County Police Department's crime laboratory. Several cancer deaths had been reported among employees in the laboratory, and concern developed that these deaths might have resulted from carcinogenic occupational exposures in the crime laboratory. In September 1980, NIOSH investigators conducted an initial survey of pertinent work areas and death records available through the Police Benefit Association. In November 1980, bulk samples of fingerprint powders were collected for analysis of polynuclear aromatic hydrocarbons (PNA's). In February 1981, personal breathing zone air samples were collected during a simulated fingerprint dusting operation and exposure to carbon black was measured.

Two of the fingerprint powder samples did not show the presence of any polynuclear aromatic compounds, but in the third sample fluoranthene (66.8 ug/gm) and pyrene (89.9 ug/g) were identified. Air samples taken while the fingerprint powder containing PNA's was in use showed the carbon black air concentration to be 5.6 mg/m³ in the breathing zone of the person doing the dusting. The 8-hour time-weighted average carbon black exposure for this operation is 0.09 mg/m³; the NIOSH recommended standard of 0.1 mg/m³ for carbon black containing PNA's.

Proportionate mortality ratio (PMR) analysis of 91 death certificates of police officers from throughout the department identified a statistically significant excess number of cancers of the large intestine (6 observed, 1.49 expected). Lung cancer (11 observed, 6.35 expected) and arteriosclerotic heart disease (38 observed, 31.89 expected) also were increased, although not statistically significantly so. Respiratory tract cancer (3 cases) was the most common neoplasm among the seven crime laboratory employees whose deaths were due to cancer. Among the other four crime laboratory employees, only one case of large intestine cancer was present. The mean age at death for crime lab employees (46 years) was less than for employees working elsewhere in the department (55 years), but the difference was not statistically significant.

A statistically significant excess of large intestine cancer is present in the overall study population of deceased police officers; a non-statistically significant excess of respiratory tract cancer is present among those who worked in the crime laboratory. The presence of these clusters neither confirms nor negates occupational carcinogen exposure. The environmental results of this study and a review of the toxicological literature indicate that a potential health hazard does exist in using the "Hi Fi" Volcano latent fingerprint powder. The use of this powder should be discontinued in favor of powders with no polynuclear aromatic hydrocarbons.

KEYWORDS: OIC 9221 (Police protection), carbon black, ninhydrin, polynuclear aromatic hydrocarbons, fluoranthene, pyrene, cancer, carcinogen, fingerprint powders and sprays.

II. INTRODUCTION

In July 1980, the National Institute for Occupational Safety and Health (NIOSH) received a request from the Maryland Department of Health and Mental Hygiene to investigate possible health hazards in the Baltimore County Police Department's crime laboratory. Several cancer deaths had been reported among employees in the laboratory, and concern developed that these deaths might have resulted from carcinogenic occupational exposures in the crime laboratory. In September 1980, NIOSH investigators conducted an initial survey of pertinent work areas and death records available through the Police Benefit Association. In November 1980, bulk samples of fingerprint powders were collected for analysis of polynuclear aromatic hydrocarbons (PNA's). In September 1980, NIOSH distributed a report of the investigation to date. In February 1981, personal breathing zone air samples were collected during a simulated fingerprint dusting operation and exposure to carbon black was measured.

III. BACKGROUND

The Baltimore County Police Department has approximately 1400 employees, of which six to eight work full-time in the crime laboratory. The majority of the employees in both the Police Department as a whole and the crime laboratory are male police officers. The crime laboratory, which has been in operation since 1930, has occupied various locations within the police headquarters building. Since 1976 it has been situated in the lower level of the building.

The main activity of the laboratory personnel which entails the use of chemical substances is the developing and processing of fingerprints. Two techniques are employed, one requiring the application of a solution containing ninhydrin, a coal-tar derivative, the other requiring the application of fingerprinting powders of various compositions. In the past, work practices, especially when using the ninhydrin solution, may have been deficient. Exposure to the ninhydrin solution, and possibly also to the fingerprinting dust, may have been high for a period of many years. During the last few years, work practices have been improved, and protective equipment has been provided. The risk of exposure is now most likely lower.

From 1968 to 1981 seven cancer-related deaths occurred among crime laboratory personnel. Their ages ranged from 26 to 61 years, with three of them younger than 40. The Police Department suspected an association between ninhydrin and fingerprinting dust exposure and cancer, since significant exposures may have taken place in the past. The Police Department also requested that NIOSH identify any current health hazards present in the laboratory.

IV. EVALUATION DESIGN AND METHODS

A. Environmental

Bulk samples were taken of the three fingerprint powders used: 1) Atomic Triple "A" grade latent fingerprint powder (jet black, smearless), 2) "Hi Fi" Volcano latent print powder, and 3) Atomic Triple "A" (sky-gray, smearless). Each powder contains carbon black. To identify the polynuclear aromatic hydrocarbons (PNA's) present in the powders, one-half gram of each bulk material was extracted with 5 mL acetonitrile. Each sample solution was filtered through a 0.5 micron FH filter to remove the particulate bulk material. Ten uL of this solution was analyzed by high pressure liquid chromatography using a Vydac 201 TP reverse phase column fluorescence detector.

Upon confirmation of the presence of polynuclear aromatic compounds in the Hi Fi Volcano latent print powder, personal air sampling was conducted during a simulated fingerprint-dusting operation. Samples for carbon black dust were collected using a personal air sampling pump at 2.0 liters per minute with AA filters (0.8 u) over the typical time span for fingerprint dusting (8 to 10 minutes). Filters were weighed before and after sampling. A full-shift time-weighted average concentration of carbon black was calculated based on the gravimetric analysis of the sample.

B. Epidemiological

Copies of death certificates of deceased members of the Police Benefits Association were provided to NIOSH investigators. A NIOSH contract nosologist coded cause of death according to the death certificate designation using the International Classification of Disease (ICD code) in effect at the time of death. All cause of death data were then analyzed using the Monson Proportionate Mortality Ratio (PMR) computer analysis. Expected numbers of deaths for each cause of death, specific for five-year age group and five-year calendar time of death, were generated based on the proportion of deaths experienced by the U.S. White male population. Observed deaths were compared to those expected to calculate a proportionate mortality ratio for each cause of death. Mantel-Haenszel chi-square values and 95% confidence intervals were calculated for each PMR. PMR's were considered to be significantly elevated or decreased if the 95% confidence interval for the PMR did not include 1.0.

Occupational histories were obtained for employees who worked in the crime lab and whose deaths were cancer-related.

V. EVALUATION CRITERIA

A. Environmental Criteria

As a guide to the evaluation of the hazards posed by workplace exposures, NIOSH field staff employ environmental evaluation criteria for assessment of a number of chemical and physical agents. These criteria are intended to suggest levels of exposure to which most workers may be exposed up to 10 hours per day, 40 hours per week for a working lifetime without experiencing adverse health effects. It is, however, important to note that not all workers will be protected from adverse health effects if their exposures are maintained below these levels. A small percentage may experience adverse health effects because of individual susceptibility, a pre-existing medical condition, and/or a hypersensitivity (allergy).

In addition, some hazardous substances may act in combination with other workplace exposures, the general environment, or with medications or personal habits of the worker to produce health effects even if the occupational exposures are controlled at the level set by the evaluation criterion. These combined effects are often not considered in the evaluation criteria. Also, some substances are absorbed by direct contact with the skin and mucous membranes, and thus potentially increase the overall exposure. Finally, evaluation criteria may change over the years as new information on the toxic effects of an agent become available.

The primary sources of environmental evaluation criteria for the workplace are: 1) NIOSH Criteria Documents and recommendations, 2) the American Conference of Governmental Industrial Hygienists' (ACGIH) Threshold Limit Values (TLV's), and 3) the U.S. Department of Labor (OSHA) occupational health standards. Often, the NIOSH recommendations and ACGIH TLV's are lower than the corresponding OSHA standards. Both NIOSH recommendations and ACGIH TLV's usually are based on more recent information than are the OSHA standards. The OSHA standards also may be required to take into account the feasibility of controlling exposures in various industries where the agents are used; the NIOSH-recommended standards, by contrast, are based solely on concerns relating to the prevention of occupational disease. In evaluating the exposure levels and the recommendations for reducing these levels found in this report, it should be noted that industry is legally required to meet only those levels specified by an OSHA standard.

A time-weighted average (TWA) exposure refers to the average airborne concentration of a substance during a normal 8- to 10-hour workday. Some substances have recommended short-term exposure limits or ceiling values which are intended to supplement the TWA where there are recognized toxic effects from high short-term exposures.

B. Carbon Black^{1,2}

Exposure to carbon black may cause fibrotic changes in the lung. Repeated contact of skin with carbon black may produce a marked embedding of carbon in hair follicles, producing black spots on the skin. Carbon black may contain various polynuclear aromatic hydrocarbon compounds which may pose a cancer risk. The OSHA standard³ for carbon black is an 8-hour TWA concentration of 3.5 mg/m³. This is also the NIOSH recommended standard for carbon black not containing PNA's; if PNA's are present, NIOSH recommends exposure to carbon black not exceed 0.1 mg/M³.

C. Polynuclear Aromatic Hydrocarbons⁴

Exposure to polynuclear aromatics may produce reddening, burning, and itching of skin; photophobia; conjunctivitis; and skin and lung cancer. The PNA's benzo(a)pyrene, benzathracene, chrysene, and phenanthrene are carcinogens. Anthracene, carbazole, fluoranthene, and pyrene may also cause cancer, but this has not been well documented. There is no OSHA standard or NIOSH recommended standard for PNA's per se. Because PNA's are carcinogens, NIOSH recommends that exposure be kept as low as possible.

D. Ninhydrin

Exposure to ninhydrin (1,2,3-triketohydrindene) may cause irritation of the skin and eyes. Cancer has not been associated with exposure to ninhydrin.

VI. RESULTS

A. Environmental

Analysis of the jet black and sky-gray Atomic Triple "A" grade latent fingerprint powders showed no PNA's present above the detection limit of 0.8 mg PNA's per gram of bulk. The Hi Fi Volcano latent print powder, however, contained 66.8 mg fluoranthene and 98.9 mg pyrene per gram of sample. Unquantitated amounts of acenaphthene and naphthylene were also identified in the Hi Fi Volcano powder by gas chromatography and mass spectroscopy.

Gravimetric analysis of the personal air sample for carbon black showed 5.6 mg/M³ in the breathing zone when a typical dusting job was done using the Hi Fi Volcano powder. Converting this concentration to a time-weighted average gives 0.09 mg/m³ over an 8-hour work day, within the NIOSH recommended standard of 0.1mg/m³ for carbon black containing PNA's.

B. Epidemiological

A total of 91 death certificates of White males who belonged to the Police Benefits Association were obtained for the years 1957-1981. For each cause of death, Table 1 lists the PMR, and the 95% confidence limits. An increase in all malignant neoplasms (27 observed, 18.3 expected 95% confidence interval 1.1-2.1) resulted largely from a statistically significant increase in cancers of the large intestine (6 observed, 1.5 expected, 95% confidence interval 1.9-8.4) and a somewhat increased number of lung cancers (11 observed, 6.4 expected, 95% confidence interval 1.0-3.0). The overall trend for arteriosclerotic heart disease was an increase in proportionate mortality (38 observed, 31.9 expected, 95% confidence interval 0.9-1.4) that was not statistically significant; neither this overall trend nor any increase for a particular age group or chronological period within it was statistically significant.

The underlying or contributing causes of death for seven employees who worked in the crime lab included carcinoma of the lung (2 cases), adenocarcinoma of the colon (1), rhabdomyosarcoma (1), acute myelocytic leukemia (1), central nervous system metastatic carcinoma, primary site unknown (1), and malignant pleural effusion (1). Six employees were male; one was female. The average length of employment in the crime lab was nine years.

The mean age at death for crime lab employees (46 years) was less than for those who worked elsewhere (55 years), but the difference was not statistically significant ($t = 1.6$, $d.f = 92$, $P > 0.1$). Distribution of the ages at death was similar for both groups (Figure 1).

VII DISCUSSION

This proportionate mortality ratio study, based on 91 deaths reported to an employee death benefit association, identified a statistically significant excess number of cancers of the large intestine. This excess proportion of intestinal cancer is probably not due to a decreased proportion of other causes of death; notably, the observed number of deaths associated with arteriosclerotic heart disease is no lower than expected. The excess number of large intestine cancers present in the study population as a whole is absent in the group of crime lab employees whose deaths were cancer-related. The most common cancer in these seven employees involved the respiratory tract, specifically two cases of primary carcinoma of the lung and one case of malignant pleural effusion, a condition which most commonly results from bronchogenic carcinoma⁵. All three of these employees with respiratory cancer had histories of smoking tobacco products, as did three of the other four crime lab employees. Among these remaining four cases only one definitive diagnosis of large intestine cancer was present. The variety of cancer types in the seven employees tends not to suggest a shared carcinogenic exposure unique to the crime lab.

There is a potential hazard, however, in using the Hi Fi Volcano print powder, since 1) its use creates relatively high dust levels in the breathing zone of the user; 2) it contains PNA's, a known cause of lung and skin cancer; and 3) while the TWA of carbon black exposure associated with using this powder is within the recommended standard, the lowest levels at which PNA's cause cancer have yet to be established.

Preliminary findings from another study⁶ showed a significantly higher hospital admission rate for police officers than for other occupational groups. Admitted diagnoses frequently involved problems of the digestive and circulatory systems. The digestive system disorders in that study consisted of typical stress-related changes in the small intestine, primarily duodenal ulcers, in contrast to the large intestine cancers identified in this PMR study. These cancers of the large intestine, while comprising a statistically significant excess, may only represent a cluster of events with no biological basis.

VIII. RECOMMENDATIONS

Use of the Hi Fi Volcano powder should be discontinued if technically acceptable powders which contain no PNA's are available. When possible, all dusting should be done in a ventilated laboratory hood in order to reduce the likelihood of breathing any carbon black dust. When using a lab hood is impractical, the person performing the dusting should wear a respirator designed to filter pneumoconiosis-producing dusts.

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IX. AUTHORSHIP AND ACKNOWLEDGEMENTS

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X. DISTRIBUTION AND AVAILABILITY OF REPORT

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1. Maryland Department of Health & Mental Hygiene
2. Baltimore County Police Department
3. NIOSH, Region III
4. OSHA, Region III

For the purpose of informing affected employees, copies of this report shall be posted by the employer in a prominent place accessible to the employees for a period of 30 calendar days.

TABLE 1
 PROPORTIONATE MORTALITY RATIOS
 BALTIMORE COUNTY POLICE DEPARTMENT
 TOWSON, MARYLAND
 TA 80-104

CAUSE OF DEATH	OBSERVED	EXPECTED	OBSERVED/ EXPECTED	95% CONFIDENCE LIMIT
All malignant neoplasms	27	18.3	1.5	1.1 - 2.1
All infective & parasitic disease	0	0.85		
All tuberculosis	0	0.39		
Cancers of buccal cavity & pharynx	1	0.63	1.6	0.23 - 11
Cancer of digestive organs & peritoneum	8	4.6	1.8	0.90 - 3.4
Cancer of esophagus	1	0.43	2.3	0.34 - 15.4
Cancer of stomach	0	0.79		
Cancer of large intestine	6	1.5	4.0	1.9 - 8.4
Cancer of rectum	0	0.50		
All cancer of liver	0	0.28		
Cancer of pancreas	1	0.97	1.0	0.15 - 7.3
Cancer of respiratory system	12	6.7	1.8	1.1 - 3.1
Cancer of larynx	1	0.28	3.6	0.57 - 22
All cancer of lung - primary & secondary	11	6.4	1.7	0.99 - 3.1
Cancer of prostate	0	0.65		
Cancer of testis	0	0.17		
Cancer of kidney	0	0.51		
Cancer of bladder	1	0.40	2.5	0.38 - 16
Cancer of skin	0	0.45		
Cancer of eye	0	0.02		
Cancer of brain & other central nervous system	0	-0.75		
Cancer of thyroid	0	0.04		
Cancer of bone	0	0.1		
Lymphosarcoma & reticulosarcoma	0	0.46		
Hodgkin's disease	0	0.31		
Leukemia & aleukemia	1	0.76	1.3	0.19 - 9.2
Cancer of other lymphatic tissue	1	0.47	2.1	0.37 - 14
All lymphopoietic cancer	2	2.0	1.0	0.25 - 3.9
Allergic, endocrine, metabolic, nutritional diseases	1	1.6	0.61	0.09 - 4.2
Asthma	0	0.13		
Diabetes mellitus	1	1.2	0.81	0.12 - 5.7
All diseases of blood & blood-forming organs	0	0.18		

(TABLE 1, continued)

	<u>OBSERVED</u>	<u>EXPECTED</u>	<u>OBSERVED/ EXPECTED</u>	<u>95% CONFIDENCE LIMIT</u>
Mental, psychoneurotic & per- sonality disorders	0	0.73		
All diseases of nervous system and sense organs	2	5.3	0.38	0.10 - 1.4
All vascular lesions of CNS	2	4.5	0.45	0.12 - 1.7
All diseases of circulatory system	44	38.0	1.2	0.93 - 1.4
Chronic rheumatic heart disease	0	1.0		
Arteriosclerotic heart disease, including CHD	38	32.9	1.2	0.93 - 1.4
All respiratory diseases	3	4.4	0.69	0.23 - 2.1
All pneumonia	1	1.6	0.62	0.09 - 4.2
Emphysema	1	1.1	0.90	0.13 - 6.3
All diseases of digestive system	4	5.5	0.73	0.28 - 1.9
All gastric and duodenal ulcer	0	0.55		
Cirrhosis of liver	4	3.4	1.2	0.45 - 3.1
All diseases of genito-urinary system	1	0.95	1.1	0.15 - 7.4
Chronic nephritis	1	0.40	2.5	0.38 - 16
All diseases of the skin & cellular tissue	0	0.06		
All diseases of the bones and organs of movement	0	0.17		
Symptoms, senility & ill defined conditions	0	1.3		
All external causes of death	9	13.2	0.68	0.40 - 1.2
All accidents	3	8.5	0.35	0.13 - 0.92
Motor vehicle accidents	0	4.1		
Suicide	3	3.2	0.94	0.31 - 2.8

1 Expected numbers are based on proportional mortalities for white males.

2 95% LCL (95% Lower Confidence Limit) and 95% UCL (95% Upper Confidence Limit) signify a 95% probability that the true PMR value lies between these two limits.

FIGURE 1

DISTRIBUTION OF AGES AT DEATH
BALTIMORE COUNTY POLICE DEPARTMENT
TOWSON, MARYLAND

HETA 80 - 104

