Final Report
Police Officer and Firefighter Health Study

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Executive Summary

The Police Officer and Firefighter Health Study was awarded in November 2006 to the University of Utah's Rocky Mountain Center for Occupational and Environmental Health and begun in December 2006 after funding through the Labor Commission provided through House Bill 009 (2006 Utah G.S.). This project required two primary products: 1) a comprehensive review of the prior epidemiological literature on cancers among these workers, and 2) conducting an epidemiological study among Utah's police officers and firefighters.

A comprehensive literature review demonstrated there is not a single, published epidemiological study of risks for cancer among police officers that has evaluated risks from methamphetamine-related tasks. In contrast, there are numerous epidemiological studies of firefighters. Those demonstrate different findings among the various studies. The most common cancers generally found to have been elevated were: colon, rectal, NHL, melanoma, and prostate.

We identified 144 municipalities or agencies for police officers in Utah. Of these, 70 (49%) of police officer agencies agreed to allow police officers to participate. There were 29 agencies for firefighters identified. Among firefighter agencies 27 of 29 (93.1%) of firefighter agencies agreed to allow firefighters to participate. From these agencies, we identified 10,429 potential police officers and 3,946 firefighters eligible to participate. Most participating municipalities agreed to provide names of officers, but not addresses thus mailings of enrollment information and study subject identification numbers were sent out from the municipalities which in turn promised to mail the enrollment information. This mechanism effectively prevented the ability to re-contact non-participants or, when needed, to obtain accurate addresses. This produced an average 15.5% among police and 19.6% among firefighters returned questionnaires due to incorrect addresses (from the municipalities). The cut-off date for participating in this study was September 30th, 2008 to allow for sufficient time to analyze the data prior to the statutory reporting deadlines.

This study enrolled 553 (5.30% of 10,429 eligible) police officers and 549 (13.91% of 3,946 eligible) firefighters. Detailed algorithms primarily relying on answers to several questions were used by the industrial hygienists to categorize workers into high, medium and low levels of exposures to methamphetamine laboratory and combustion products, respectively while blinded to health status. For purposes of worst case analyses, those who were deceased had largely absent exposure data and were included in the high risk category.

The police officers' most frequent cancers reported and confirmed by the Utah Cancer Registry were prostate, non-Hodgkin's lymphoma and rectal cancer. The overall cancer rate was increased in the medium methamphetamine exposure group and was non-statistically significantly elevated in the high exposure group. Risks for lymphoma were elevated in the medium exposure group while also elevated, but not significantly, in the high exposure group. Risks for melanoma, non-Hodgkin's lymphoma, and colon and rectal cancers combined were not significantly elevated, but trended towards being positive.

The firefighters' most frequent cancer reported and confirmed by the Utah Cancer Registry was prostate. The overall cancer rate was increased in the medium combustion products exposure group (3.1-fold) and was non-statistically significantly elevated in the high exposure group (2.4-fold).

Risk estimates were stronger among confirmed cases (8.5- and 4.2-fold respectively). Risks for individual cancers were unstable due to small numbers. Skin cancers were significantly elevated in both the high (4-fold) and medium (3.4-fold) categories.

Thus, there are some suggestions of elevated risks for lymphoma, melanoma and colon and rectal cancers among police officers conducting methamphetamine-related tasks. There also are suggestions of elevated risks for all cancers combined among firefighters. These conclusions must be viewed cautiously based on the low participation rates. Conclusive evidence could be obtained through compulsory, but secure, release of the officer's identifying information with compilation of exact cancer rates through the Utah Cancer Registry data and is discussed in the Future Directions paragraph on page 214.

Executive Summary Addendum

A press article (www.ksl.com/index.php?nid=481&sid=4845600) completed after this study was reported to the Utah State Legislature contained the following. "Dozens of drug enforcement officers could now be denied worker's compensation benefits they say they're due because of illnesses they suffered cleaning up meth labs." Factually, this study's results do not preclude the filing of workers compensation claims for injuries officers feel they have incurred in the line of duty.

Two other lines of questions have been raised and are addressed below.

Regarding participation rates, we enacted every action we and this study's advisory committee could envision to improve participation rates over the past two years. Those actions included developing both paper and internet based questionnaires and also training staff to allow enrollments by telephone so that every practical type of enrollment could be used by workers depending on their own personal preferences and also allowed enrollments 24 hours a day. Actions taken proactively also involved contacting legislators to facilitate participation by municipalities, as well as direct mailings to potential workers, involvement of the unions, police chiefs, fire chiefs, emails, labor trade publication articles, press releases, other press interviews (TV, newspaper), and telephone calls. Despite all these activities, participation rates remained low. We fully embraced every option to stimulate participation and there was no additional recommendation that we did not follow. The one standard research procedure to stimulate participation that we were precluded from doing was directly re-contacting non-participants. That possibility was prohibited by municipalities' interpretations of the law on release of information. We remain very interested in continuing the study, have offered to continue it, and particularly suggested in this report a readily feasible mechanism that would compel release of the necessary information from the municipalities, which we would continue to carefully maintain securely, to be able to calculate precise cancer rates for the state's entire population of firefighters and police officers.

Regarding the quality of the questions contained in the questionnaires, all standard processes for the development of questionnaires were followed. Questionnaires were structured from existing, widely used questionnaires. We incorporated additional questions to address concerns of the police officers and firefighters. Concerns from both remote and recent work practices were of necessity included, as both the police officers and firefighters noted that their work practices, personal protective equipment and policies and procedures changed markedly over the years. We included multiple focus groups and pilot testings of the questionnaires in which the questionnaires underwent revisions based upon recommendations of the workers and union leadership. We exhausted those means until there were no additional recommendations for improvements in any question. Survey completion rates are likely the most precise measure for difficulty of a survey, as those who find a survey unworkable will not complete it. Due to the vast majority of surveys completed electronically, we are able to calculate precise non-completion rates. Despite surveys often being completed on-the-job when interruptions were possible, the survey completion rates were 95.2% for firefighters and 89.6% for police officers, suggesting the workers were able to successfully complete the questionnaires.

Literature Review

The University of Utah's Rocky Mountain Center for Occupational and Environmental Health's research staff carried out a complete and comprehensive literature review, identifying 50 articles evaluating risks of cancer, mortality, or cardiovascular disease among police officers and firefighters.

In order to identify all high quality original research studies, the literature search was broad and comprehensive. Articles reporting studies with the most robust relevant designs were selected for critical appraisal and quality grading. Search strategies and methods included searching PubMed, Pedro, EMBASE and CINAHL for the terms "police officer", "peace officer", "law enforcement", "protective services", "firefighter" "fire fighter" and "fire protection". Articles identified were then evaluated for study design and population addressed. If articles were case reports, case series, or purely descriptive, they were not included. Researchers also performed hand searches of reference lists in related articles, particularly review articles.

Research staff reviewed the abstracts of all citations found in the bibliographic search and identified articles relevant to the topic. Researchers then retrieved the full-text of these articles and perform a second article screening process to determine which studies meet the inclusion criteria to be considered as adequate evidence for these purposes. As part of the second screening process, reviewers graded each article using the numerical quality score in Table 1 (Quality Scoring of Treatment Studies).

Research staff conducted the literature reviews and reviewed each article in detail that met the inclusion criteria. They summarized important information from each article into an evidence table. The relative ranking of study designs for theoretical robustness is outlined below. Review articles are not scored, but were utilized to examine prior findings and assure completeness of the literature search. After research staff completed the evidence tables, articles were critiqued, study quality was evaluated, the body of evidence was graded and the body of literature was summarized.

Table 1. Quality Scoring Scale for Epidemiological Studies
Rating anchors are guides. Criteria scores for a specific study may vary as an integer between 0 and 10 (positive whole numbers).

Criteria	Rating Anchors' Explanation*
Clearly defined groups (0-10)	"0" if the study does not have clearly defined groups or reports that there were and subsequent analyses of the data/tables suggest they are not clearly defined. "5" if there is mention of clearly defined groups, however descriptions are incomplete, or other questions about the adequacy of study groups identification cannot be adequately addressed. "10" if clearly defined groups are specifically stated and reported data show that these groups are well defined.
Exposure Measurements (0-10)	"0" if there is no mention of how exposures are measured. "2.5" if exposure measurement is by job classification, questionnaires of subjects, or exposure assessment methods are

	otherwise unclear "5" if mixture of objective and subjective measures and there are some questions about how these were accomplished. Must be individualized assessments for this level of rating or higher rating. "7.5" if exposures are mostly objective, individualized, and there are few questions about how exposure assessments were accomplished. "10.0" if exposures are objectively measured, individualized, and exposure assessments are well described.
Participation/Drop Out Rate (0-10)	"0" if the participation rate is under 50% or is not mentioned. (For cohort studies, there is an annual drop out rate of 40% or higher.) "2.5" if the participation rate is 50-59%. (For cohort studies, there is an annual drop out rate of 30-39% or higher.) "5" if the participation rate is 60-69%. (For cohort studies, there is an annual drop out rate of 20-29% or higher.) "7.5" if the participation rate is 70-79%. (For cohort studies, there is an annual drop out rate of 10-19% or higher.) "10.0" if the participation rate is 80% or greater. For cohort studies, the drop out rate is under 10% per year.
Blinding of Exposure Measurements (0-10)	"0" if there is no mention of how exposures assessments were blinded or were unlikely to result in blinding. This includes exposure assessments that relied upon subject's perceptions of exposure. "2.5" if there is some mention of blinding, but significant questions remain and complete blinding is unlikely. "5.0" if there is mention of blinding and some questions remain about the adequacy of the blinding "7.5" if blinding procedures were carried out, although some minor questions remain about the adequacy of the procedures used. "10.0" if blinding procedures are described that would result in the exposure assessments being blinded.
Health Outcomes Measurements (0-10)	"0" if there is no mention of how health outcomes are assessed. "2.5" if health outcomes are by administrative databases or health outcomes methods are otherwise unclear or would result in substantial misclassifications. "5" if health outcomes are individualized assessments of the complete population, yet there are questions about the adequacy of the assessments or there are no objective measures used. "7.5" if exposures are mostly objective and there are few questions about how exposure assessments were accomplished. "10.0" if health outcomes are individually measured on all subjects, the most objective methods are used, and health outcomes assessments are well described.
Frequency of Health Outcomes Assessments (0-10)	"0" if there is only one assessment. "2.5" if there is more than one assessment, but they are either annual or less frequently than annually. This includes those with assessments more frequently than that, but not on the entire

	population. "5" if there are health outcomes assessments of the population at least once every 6 months. "7.5" if health outcomes on the entire population occurs at least quarterly. "10.0" if health outcomes assessments are at least once every month on the entire population.
Blinding of Health Outcomes Assessments (0-10)	"0" if there is no mention of how health outcomes assessments were blinded or were unlikely to result in blinding. "2.5" if there is some mention of blinding, but significant questions remain and complete blinding is unlikely. "5.0" if there is mention of blinding and some questions remain about the adequacy of the blinding "7.5" if blinding procedures were carried out, although some minor questions remain about the adequacy of the procedures used. "10.0" if blinding procedures are described that would result in the health outcomes assessments being blinded.
Comparable groups adjustment for confounders (0-20)	"0" if major confounders (individual risk factors, e.g., age, gender, obesity, diabetes mellitus, tobacco, history of trauma) are unaddressed or statistical control procedures are inadequate to control for confounders. "5.0" if there is some control for major confounders, but significant questions remain and complete control for confounders is unlikely. "10.0" if confounders are addressed, there are attempts to control for confounders, but some questions remain about the adequacy of the control for confounding "15.0" if confounders are addressed, adequate control procedures are likely used, although some minor questions remain about the adequacy of the procedures used or minor confounders are uncontrolled. "20.0" if all major and minor confounders are addressed, control procedures are employed and there are no remaining questions about the adequacy of control for confounders. Confounders are measured objectively where possible.
Lack of Bias (0-10).	"0" if there are felt to be other significant biases (not coded elsewhere) that are uncontrolled in the study and may have influenced the study's results. "5.0" if there are felt to be some biases present, but the results are less likely to have been influenced by those biases. "10" if there are only minor biases, or biases that are well controlled methodologically and are unlikely to have influenced the study's results.
Temporality (0-10)	"0" if there is no description of how the exposure preceded outcomes or methods used could not address this.

	"5.0" if the article mentions the exposure preceding outcomes but there are some questions about the adequacy that the methods could assure addressing temporality. "10.0" if the exposure precedes the outcomes, the study is a prospective cohort study, and the methods used would result in a conclusion of assurance of temporality.
Dose response gradient (0-10)	"0.0" if there is no dose-response assessment possible (e.g., only two categories of exposure) or there was no gradient across categories. "5.0" if there is a dose response gradient assessed, but it is not statistically significant "10.0" if there is a dose response gradient that is identified and is significant
Strength of association (0-10)	"0" if there is no association between exposure and disease. "2.5" if there is a non-statistically significantly positive association "5.0" if there is some strength of association with a statistically significant association of 2-3.9-fold risk. "7.5" if there is a strong association with the measure of effect of 4-7.9-fold risk. "10.0" if the study finds very strong evidence of an association with a measure of effect (RR or OR) of at least 8-fold risk.
Psychosocial (0-10)	"0" if there is no mention of psychosocial factors. "2.5" if there is some evaluation and control within one of the two domains (occupational and non-occupational) "5.0" if there is moderate evaluation and control in each of the two domains of occupational and non-occupational factors. "7.5" if there are advanced evaluation and control methods in at least one domain and moderate evaluation and control methods in the other. "10.0" if there is in-depth evaluation and control in both occupational and non-occupational domains and there are very few remaining minor questions about the adequacy of control.

(Melhorn JM 2008)

Police Officers Only

A study by Violanti et al.(Violanti, Vena et al. 1998) (score=43) evaluated the relationship between duration of working as a police officer for at least five years between 1950 and 1990 and death, as determined by death certificate. This study reports on 1,035 deaths among 2693 white male officers. Statistically significantly, but modestly, higher relationships were found for all causes of death (SMR=1.10, 95% CI 1.04, 1.17), malignant neoplasms (SMR=1.25, 95% CI 1.10, 1.41) cirrhosis of the liver (SMR=1.50, 95% CI 1.00, 2.16) and suicide rates (SMR=1.53, 95% CI 1.00, 2.24) as compared to the mortality of U.S. white males from 1950 to 1990. Statistically significantly lower relationships were found between deaths caused by infective and parasitic disease (SMR=0.25, 95% CI 0.05, 0.73, n=3), all respiratory diseases (SMR=0.70, 95% CI 0.51, 0.94), all accidents (SMR=0.53, 95% CI 0.34, 0.79) and motor vehicle accidents (SMR=0.37, 95% CI 0.15, 0.76, n=7). When analyzing specific types of malignant neoplasms, there were statistically significant relationships with kidney neoplasms (SMR=2.08), Hodgkin's disease (SMR=3.13),and digestive organs and peritoneum as a group (SMR=1.51), which was largely driven by high rates of esophageal cancer (SMR=2.13) and colon cancer (SMR=1.87). When evaluating specific cancer type by years as a police officer, there were no significant trends apparent.

Firefighters Only: Cardiovascular

A prospective study (score=77) of firefighters' blood pressure and employment status on hazardous materials teams of 334 hazardous materials firefighters concluded that "although we could not directly measure the impact of hypertension on cardiovascular outcomes, persons with hypertension, especially stage II hypertension, are more prone to cardiovascular disease and should receive further evaluation." (Kales, Soteriades et al. 2002) The authors found that there were statistically significantly elevated risks for having blood pressures higher than 160/100, even after adjustment for age, smoking, BMI, total cholesterol, and blood pressure medication use. The highest risk estimate, HR=4.6 (95% CI 2.08, 10.11), was found when study authors excluded firefighters who were taking medication for their hypertension. Limitations of this study include the reliance on annual examinations and data collection processes. There are also issues regarding the lack of standardization of physicians for fitness determination of the participants. The authors did adjust for this potential confounder, and reported that significant results remained. Authors also excluded resignations that were attributed to promotions to higher rank and were therefore unlikely to be health related.

A prospective cohort study (score=58) of risk factors for coronary heart disease (CHD) among firefighters in Cincinnati concluded that "firefighting does not appear to be an occupation associated with significantly increased CHD event rate. Firefighter cohorts appear to be characteristic of healthy worker populations. Those CHD events that develop appear to be governed by traditional, modifiable CHD risk factors." (Glueck, Kelley et al. 1996) The authors noted statistically significant differences between those firefighters with CHD (n=22) as compared to those without CHD (n=784). There are statistically significant differences at baseline between the two groups for the factors of age at entry to the study, diastolic blood pressure, systolic blood pressure, number of cigarettes per day, low density lipoprotein cholesterol, triglycerides, total cholesterol, family history of CHD, and time of follow-up. Similar trends exist for the follow up data. These data indicate that those that developed CHD over the follow up period were already at increased risk. The authors suggest that these factors, regardless of the occupational factors related to combustion byproducts including CO, are contributory factors for the development of CHD in this population.

A prospective cohort study of obesity and cardiovascular disease risk factors in firefighters (score=58) based on reports from 332 firefighters at baseline with follow-up of only 270 firefighters (81.3%) concluded that “obesity is a major concern among firefighters and shows worsening trends over time. Periodic medical evaluations coupled with exercise and dietary guidelines are needed to address this problem, which threatens firefighters’ health and may jeopardize public safety.” (Soteriades, Hauser et al. 2005) This study did not calculate risk estimates, but did analyze data for statistical differences between groups. There were attempts to analyze other co-morbid disease states.

A cross-sectional study (score=55) analyzing data gathered as part of a state wide surveillance program analyzed correlates of body mass index in hazardous materials firefighters concluded that “the prevalence of overweight and obesity and the associated adverse health effects support the development and implementation of fitness-promotion programs for firefighters.”(Kales, Polyhronopoulos et al. 1999) This study relied upon reports of 333 hazardous materials firefighters’ medical exams performed at three Massachusetts hospitals, without standardization of exam procedures for the purpose of determining fitness for duty. Summary results were abstracted to a “face problem sheet” which was reviewed by a board certified internist who was blinded to the study participants’ fitness for duty outcomes. The main measure, body mass index (BMI) was calculated, however it is unclear if these were self reported or measured anthropomorphic data. BMI was classified into low (BMI<27 kg/m2) medium (BMI 27 to <30 kg/m2) and high (BMI over 30 kg/m2). There were statistically significant associations between BMI and age, systolic blood pressure, diastolic blood pressure, forced vital capacity, total cholesterol, creatinine, aspartate aminotransferase, alanine aminotransferase and the blinded measure of increasing morbidity among male and females in this study. Among males only, and after age adjustment, only systolic blood pressure, forced vital capacity, total cholesterol, aspartate aminotransferase, alanine aminotransferase and the blinded measure of increasing morbidity remained statistically significant. After excluding smokers, age-adjusted analyses on males only resulted in forced vital capacity, total cholesterol creatinine, alanine aminotransferase and the blinded measure of increasing morbidity remained statistically significant.

A retrospective study of firefighters performing emergency duties and deaths from heart disease among firefighters (score=54) analyzed 449 available reports in the United States concluded that “certain emergency firefighting duties were associated with a risk of death from coronary heart disease that was markedly higher than the risk associated with non-emergency duties. Fire suppression was associated with the highest risk, which was approximately 10 to 100 times as high as that for non-emergency duties.” (Kales, Soteriades et al. 2007) These analyses were not adjusted for suspected or known cardiovascular risk factors, including tobacco use, age, and BMI. The highest risks were associated with fire suppression, followed by alarm response and alarm return. The authors noted some significant limitations to their study, including the dependency on annual examinations and data collection process and it is possible that not all physicians followed the same fitness determination practices. Stratified analyses to address differences between hospital sites were undertaken and the authors report that a "significantly increased risk for stage II hypertension persisted" suggesting that this limitation was not significant. They also acknowledged that due to the small sample size, there was not enough power to study specific outcomes.

A cohort study (score=50) of cancer and other causes of mortality in San Francisco firefighters concluded that "risk of death from esophageal cancer and cirrhosis and other liver disease in San Francisco firefighters was about two times larger than expected. These increase risks may have been due to toxic exposure, alcohol consumption, or interaction between alcohol and toxic exposure. While there were no increased disease risks that could be confidently attributed to firefighting, there were 24 line-of-duty injury deaths that were clearly associated with firefighting."(Beaumont, Chu et al. 1991) The authors enrolled 3066 firefighters employed between 1940 and 1970 and followed them through 1982. Of those 3066, vital status at the time of the end of the study in 1982, 1769 (58 %) were alive, 1186 (39 %) were dead, and 101 (3 %) were unknown. Regarding Diseases of the heart, there were 508 deaths, which when compared with US death rates for white males adjusted for age and calendar time, was statistically significant and protective, with a rate ratio of 0.89 (95% Confidence Interval 0.81, 0.97). When that category is subdivided and evaluates only ischemic heart disease, there are no statistically significant results. Similarly, when evaluating other diseases of the circulatory system, including cerebrovascular disease, there were no statistically significant results.

A retrospective study (score=50) of the evolution of some cardiovascular risk factors during the careers of 326 male firefighters concluded that "an obvious explanation for the low mortality rates in the cohort is the fact that they are comparatively young. Further research in this group is underway to see if the favorable experience with regards to general and IHD specific mortality persists into later life." (Ide 2000) The authors note a statistically significant increase over time with statistically significant differences between two retirement cohorts, those retiring between 1985-89 and those retiring between 1990-94, are achieved at the final examination for body mass index, systolic blood pressure, diastolic blood pressure, and triglycerides. There were statistically significant changes in tobacco use throughout the retrospective period. Authors note that there were significant proportions of participants who had elevated cholesterol (33%), systolic or diastolic hypertension (33%) or were obese (17%).

A comparative study (score=48) of Body Mass Index (BMI) compared standard categorization (low, medium, and high groupings) with age adjusted WHO categorization (normal, over-weight, obese, and morbidly obese groupings for 218 firefighters.(Clark, Rene et al. 2002) The study concluded that "the principal advantages in using BMI as a screening tool lies in the simplicity of its calculation and rapid classification of an individual's risk for multiple adverse health conditions and fitness levels. Additional studies should be undertaken using larger study populations which would be inclusive of women and minorities and which would simulate work environs."

A case control study of firefighters and on-duty deaths from coronary heart disease (Score=45) concluded that "most on-duty CHD fatalities are work-precipitated and occur in firefighters with underlying CHD. Improved fitness promotion, medical screening and medical management could prevent many of these premature deaths" (Kales, Soteriades et al. 2003) This study involved two control groups one consisting of 51 males whose cause of death was on-duty trauma, and also 310 male firefighters who were examined. There were three statistically significant Odds Ratios (OR) for the association of risk factors for CHD deaths (on duty) was restricted to firefighters less than 60 years of age who had no prior diagnosis of CHD. The three were increased risk for age > or = 45 years old (OR=6.2, 95% confidence interval 2.4, 16.0), Current Smoking (OR=8.7, 95% confidence interval 3.3, 22.5) and Hypertension (OR=6.2, 95% confidence interval 2.4-15.7)

A normative aging study (score=38) of fire fighting and coronary heart disease compared smokers and non-smokers among 1646 firefighters and non-firefighters concluded that "results from our study place some doubt on the hypothesis that fire fighters are at greater risk of coronary heart disease. Based on the available small sample, we can rule out, with 95% confidence, an increased relative risk for fire fighters of greater than 1.4 for coronary heart disease and great than 1.9 for myocardial infarction." (Dibbs, Thomas et al. 1982) The original aging study cohort consisted of 2078 male participants with detailed baseline data collection. Examinations were repeated an average of every five years. Smokers were defined as those who smoked one or more cigarettes per day. The outcomes of myocardial infarction (MI) and angina pectoris were those used by the Framingham Heart Study, and records of all possible cases of MI were reviewed by a cardiologist. Death from CHD was assigned by death certificate.

A review article (not scored) discussing the implications and impacts of cardiovascular disease among firefighters concluded that "cardiovascular disease continues to be a significant risk for firefighters. Appropriate preventive and medical programs are needed to help control this problem."(Melius 1995)

A methodological article (not scored) discussing the healthy worker effect utilized the example of firefighting and cardiovascular disease and concluded that "there is strong evidence for an increased risk of death overall from heart disease among firefighters, we noted two important points: First, the extent of the true increase in risk is unknown at this time. Second, because of the inability of cohort mortality studies to control for other confounding factors, such as smoking, high blood pressure, hypercholesterolemia, obesity, and physical and psychological stress, it cannot be determined from the current literature whether the increased risk of death overall from heart disease among firefighters after re-assessment in light of the HWE is due to firefighters per se, other non-occupational risk factors, or both." (Choi 2000)

Firefighters Only: Cancer Incidence and Mortality

A cohort study of mortality of urban firefighters in Alberta (Score=62) concluded that "the evidence from our cohort does not support a consistent causal association in modern times (since 1950) in our two urban populations between exposures resulting from employment as a firefighter and mortality from heart disease, and chronic obstructive pulmonary disease, despite the obvious and well-documented exposures to hazardous substances inherent in the occupation." (Guidotti 1993) The authors of this study used firefighters who had been employed between 1927 and 1987, totaling to 370 firefighters among 64,983.3 person-years. The Standardized Mortality Ratio (SMR) for 11 cancer sites were analyzed with two being statistically significant. Both sites were at an increased risk for Malignant neoplasms (SMR=126.6, 95 % confidence interval 102.0, 155.2, n=40 cases) Kidney and ureter (SMR=414.0, 95% confidence interval 166.4, 853.1, n=3 cases)

A large, multi-state case-control study (score=57) of United States non-Hodgkin's lymphoma (NHL) surveillance by occupation 1984-1989 concluded that "despite weaknesses, death certificate analyses have been useful in generating clues to possible occupational exposures. This allowed analysis by occupations and diseases for rare race and gender groups. Few strong associations were observed. Links between NHL and white-collar occupations in part reflect socioeconomic factors. Excess among various occupations engaged in machine operation and repair may indicate etiologic roles for solvents and metals. A positive association among central region farmers was consistent with earlier findings. Further investigation and analyses may explain this region-specific observation."(Figgs, Dosemeci et al. 1995) As cases this study utilized 23,890 deaths from non-Hodgkin's lymphoma as identified from 3,159,417 deaths. Controls were frequency matched to cases by age in 5 year age groups, as well as gender and race. There were 5 controls for each case. The author notes that there were similar distributions of residence, autopsy status, and geographic region of residence. When evaluating race, there were 17 times more deaths due to NHL among whites as compared to deaths due to NHL among blacks. Among white male firefighter supervisors, there were 12 cases which resulted in a mortality odds ratio of 5.6 (95% CI 2.5, 12.3). Weaknesses of this study include the reliance on death certificate data and accurate diagnosis of cancer.

A cohort study of mortality and cancer incidence in Stockholm fire fighters (Score=55) concluded that "that Stockholm fire fighters are healthy with lower total mortality than expected. The increased incidence of brain and stomach cancer needs confirmation in further studies. Systematic investigations of exposure during fires are essential." (Tornling, Gustavsson et al. 1994) This study investigated 1,153 men that had been employed as a Stockholm City firefighter between 1931 and 1983 who had been employed for at least a year, 37 men were excluded from this study leaving 1,116 men total in the study. Of the 12 cancer sites only one site had a statistically significant protective relationship for All hematopoietic cancer (Standardized Mortality Ratio (SMR) =32, 95% confidence interval 6, 92, n=3 cases).

A cohort study of mortality of fire fighters in Western Australia (Score=54) concluded that "there was no evidence of increased mortality from cardiovascular or respiratory disease, or from any other cause." (Eliopulos, Armstrong et al. 1984) This study included all men who were full time firefighters for the Western Australian Fire Brigade, this turned out to be a total of 990 men. The authors analyzed the Standardized Proportionate Mortality Ratio (SPMR) for 7 cancer sites, none of the sites analyzed were statistically significant.

A cohort study of mortality among firefighters from three northwestern United States cities (Score=52) concluded that "this study found excesses of brain cancer and leukemia among city firefighters from the northwest United States and suggests that they may be at risk of dying from emphysema." (Demers, Heyer et al. 1992) This cohort study used 4,401 male firefighters from Seattle and Tacoma Washington, and Portland, Oregon who were employed for at least a year between 1944 and 1979.The Standardized Mortality Ratio (SMR) was analyzed for 21 different cancer sites of the 21 there were several that were statistically significant. These include a statistically significant protective relationship for Kidney cancer (SMR=0.27, 95% confidence interval 0.03, 0.97, n=2 cases) and for Bladder and other Urinary cancers (SMR=0.23, 95% confidence interval0.03, 0.83, n=2 cases). There was also an increased risk for Brain and nervous system tumors (SMR= 2.09, 95 % confidence interval 1.31, 3.17, n=22 cases) Brain and nervous system cancers (SMR=2.07, 95% confidence interval 1.23, 3.28, n=18 cases)

A cohort study (score=50) of cancer and other causes of mortality in San Francisco firefighters concluded that "risk of death from esophageal cancer and cirrhosis and other liver disease in San Francisco firefighters was about two times larger than expected. These increase risks may have been due to toxic exposure, alcohol consumption, or interaction between alcohol and toxic exposure. While there were no increased disease risks that could be confidently attributed to firefighting, there were 24 line-of-duty injury deaths that were clearly associated with firefighting." (Beaumont, Chu et al. 1991) There were a total of 3,066 firefighters included in this study. Only white male firefighters who had worked at the least one day between January 1, 1940 and December 31, 1970 and had been employed for three years and had been a part of the San Francisco Fire Department were included in this study. The Rate Ratio (RR) for 25 cancer sites was analyzed several of these were statistically significant. These included an increased risk for Digestive organs and Peritoneum (RR=1.27, 95% confidence interval 1.04, 1.55, n=99 cases) Esophagus (RR=2.04, 95% confidence interval 1.05, 3.57, n=12 cases). There were also statistically significant protective relationships for Genital organs (RR=0.40, 95% confidence interval 0.18, 0.77, n=9 cases) Prostate (RR= 0.38, 95% confidence interval 0.16, 0.75, n=8 cases).

A cohort study (score=50) of cancer and other causes of mortality in San Francisco firefighters concluded that "risk of death from esophageal cancer and cirrhosis and other liver disease in San Francisco firefighters was about two times larger than expected. These increase risks may have been due to toxic exposure, alcohol consumption, or interaction between alcohol and toxic

exposure. While there were no increased disease risks that could be confidently attributed to firefighting, there were 24 line-of-duty injury deaths that were clearly associated with firefighting."(Beaumont, Chu et al. 1991) The authors enrolled 3066 firefighters employed between 1940 and 1970 and followed them through 1982. Of those 3066, vital status at the time of the end of the study in 1982, 1769 (58 %) were alive, 1186 (39 %) were dead, and 101 (3 %) were unknown. Regarding malignant neoplasms overall, there were 236 deaths, which when compared with US death rates for white males adjusted for age and calendar time, was not statistically significant, with a rate ratio (RR) of 0.95 (95% Confidence Interval 0.84, 1.08). When evaluating specific cancer sites, there were some statistically significant rate ratios as compared to the US death rates for white males adjusted for age and calendar time. The digestive organs and peritoneum was statistically significantly increased (RR=1.27, 95% Confidence Interval 1.04, 1.55) based on 99 cases, which was driven by statistically significantly increased rate ratio of esophageal cancer (RR=2.04, 95% Confidence Interval 1.05, 3.57). There were statistically significantly protective rate ratios calculated for genital organ neoplasms (RR=0.40, 95% Confidence Interval 0.18, 0.77) which was based on nine cases. Eight of those cases were prostate cancer, which also had a statistically significantly protective rate ratio (RR=0.38, 95% Confidence Interval 0.16, 0.75). When investigating stratified by time since first employment, the found statistically significantly higher rate ratios for biliary passages, liver, gallbladder among 30-39 years (RR=3.87) and stomach cancer for those who it has been 40 or more years since first employment (RR=2.32). All other strata (3-19, 20-29, 30-30, 40+) were statistically negative for 1) esophageal, 2) stomach, 3) intestinal, 4) rectal, 5) pancreatic, 6) trachea, bronchus lung, 7) biliary passages, liver, gallbladder and 8) total cancer. When stratifying by length of employment, only biliary passages, liver, gallbladder among 30+ years of employment was statistically significant (RR=3.87). All other cancer sites (mentioned above) for all other length of employment strata (3-9, 10-19, 20-29, 30+) were statistically negative. Authors explored confounding due to time periods and did not uncover any significant confounding. Limitations include the use of general US population as the comparison group. This group is generally less healthy than the working population and may have biased the results in the negative direction. There was also lack of controlling for confounding for cancers, particularly tobacco use. There also is a large likelihood that one or more of these results may be by chance alone due to the multiple comparisons that were made. The authors have noted these limitations.

A cohort study of mortality of Seattle fire fighters (Score=49) concluded that "these data suggest that the healthy worker effect decreased with time from first employment but was still present to some extent after 30 years. The combined low-and middle-exposure-duration groups in the analysis restricted to fire fighters surviving 30 years or more after first exposure had SMRs approximately 13% below expected levels." (Heyer, Weiss et al. 1990) The authors of this study used 2,289 male firefighters who had been employed by the Seattle Fire Department for at least a year before January 1, 1980 and who had been employed between January 1, 1945 and January 1, 1980. 52,914 person-years of observation were accumulated for the 2,289 firefighters. The authors analyzed the standardized mortality ratios (SMR) for 12 cancer sites none of which were statistically significant.

A cohort study (score=47) of cancer incidence in Melbourne metropolitan fire brigade members concluded that "the overall incidence of cancer in firemen did not differ greatly from that of the general population. Little evidence was obtained to support an association between cancer incidence and firefighters' occupational exposures to smoke and other combustion products."(Giles, Staples et al. 1993) This study identified 2,865 male firefighters from Melbourne Australia who were employed between 1917 and 1989. Authors estimate that 95% of the firefighters had data collected regarding their exposure. Outcomes were determined by the querying the Victorian Cancer Registry (VCR) for incidence cancer registration from 1980 through 1989. Expected numbers of cancers were calculated using the age-specific incidence rates published annually by the VCR. This study identified 50 cases of cancer but did not identify any statistically significant results for cancers in total or 11 individual cancer classifications. When stratifying by age group, among those ≥ 65 years old there were statistically significantly higher standardized incidence rates (SIRs) for all cancers (SIR=2.14, 95% Confidence Interval 1.32, 2.37, 21 cases) and colorectal cancer (SIR=3.65, 95% Confidence Interval 1.13, 7.94, 6 cases). The authors identified limitations, including the possibility of emigration outside of Victoria, misclassification of cancer among dead participants and the investigation of cancer diagnosed only during one decade.

A mortality study of mortality in city firemen (Score=47) concluded that "the reduced mortality from tuberculosis and from respiratory disease may be explained on the basis of careful medical selection and supervision of city firemen." (Mastromatteo 1959) The authors of this study used the deaths of 271 firemen among 25,918 man-years. Of the information analyzed for cancer none was statistically significant.

A cohort study of mortality among Boston firefighters (Score= 42) concluded that "firefighters on active duty in Boston fire department had an increased risk of dying accidentally, especially if they were in the age bracket 40-49 years. No evidence of an increased number of deaths from cardiovascular disease or malignancy was found for the population as a whole but small subpopulations with excess risk may exist." (Musk, Monson et al. 1978) 5,655 people were used for this study out of the 5,655 people 5,640 were white. There was a total of 142,975 person-years of follow-up 38,414 person-years of the 142,975 were retired employees. The authors did not look at statistical significance, they only looked at observed and expected ratios and observed/expected ratio (standardized mortality ratio)

A cohort mortality study of Philadelphia firefighters (Score=40) concluded that "our study found no significant increase in overall mortality among Philadelphia firefighters. However, we observed increased mortality for cancers of the colon and kidney, non-Hodgkin's lymphoma and multiple myeloma. There was insufficient follow-up since the introduction of diesel equipment to adequately assess risk." (Baris, Garrity et al. 2001) For this cohort study a total of 7,789 firefighters were analyzed. This study began with 8,511 firefighters who could potentially participate, 58.6% (4,987) of the firefighters were living, 26.1% (2,220) were deceased, 6.8% (582) failed to follow-up, and 8.5% (722) were excluded for lack of data. The authors estimated the Standardized Mortality Ratio (SMR) for major causes of death in firefighters. 18 cancer sites were analyzed and of the 18 only one was statistically significant. There was an increased risk for All Cancers (SMR= 1.10, 95% confidence interval 1.00, 1.20, n=500 cases).

A population based case-control study (score=40) of firefighting and risk of testicular cancer concluded that "the association between firefighting and testicular cancer risk is based on only small numbers of exposed subjects in our study, the finding is consistent with a recent cohort study from New Zealand. Occupational hazards experienced by firefighters may increase the risk of testicular cancer."(Stang, Jockel et al. 2003). This study analyzed 269 cases identified between July 1st, 1995 and December 31st, 1997 through an active reporting system and a vast majority of cases (95%) were independently assessed by a pathologist. Controls were randomly selected from residence registry, which were frequency matched for age. There was a 57% response rate for controls. Testicular cancer was analyzed for both ever working as a firefighter as well as stratifying by working for ≥ 10 years and ≥ 5 years prior to the reference date. None of the findings were statistically significant. These data were based on 4 cases and 3 controls.

A study of mortality (score=39) among fire fighters concluded that "this study adds to the evidence that fire fighters are at excess risk of certain causes of mortality. Further morbidity studies of these and other causes of death left unresolved by mortality studies are needed, as well as the development and implementation of appropriate interventions to protect fire fighters." (Burnett, Halperin et al. 1994) The authors identified 5744 deaths among white male firefighters from the National Occupational Mortality Surveillance system which includes 28 states for one or more years between 1979 and 1990. When evaluating neoplasms, there were several that achieved statistically significant increases in death rate among firefighters. These include total neoplasms [proportionate mortality ratio (PMR)=111, 95% confidence interval 104, 121], rectum (PMR=186, 95% confidence interval 110, 294), skin (PMR=167, 95% confidence interval 107, 248), lymphatic and hematopoietic (PMR=161, 95% confidence interval 129, 199), Non-Hodgkin's lymphoma (PMR=161, 95% confidence interval 112, 224) and leukemia (PMR=171, 95% confidence interval 118, 240).

A cohort study (score=39) of mortality in Florida professional firefighters concluded that "excess mortality risk from bladder cancer may be related to occupational exposure during firefighting. The thyroid cancer and breast cancer risk in males, as well as the excess risk of cardiovascular disease mortality noted in females warrant further investigation."(Ma, Fleming et al. 2005) The authors utilized certification information on 39,455 professional firefighters. Of those 36,813 (93.3%) were utilized in this report. A large proportion of the participants were male (n=34,769). Standardized mortality ratios (SMR) that were adjusted for age and calendar year were utilized to estimate risk for specific cancer sites and all sites combined. There were several statistically significant relationships between firefighting and mortality from cancer. These include increased risk for thyroid cancer (SMR=4.82, 95% confidence interval 1.30, 12.30, n=4 cases) and breast cancer (SMR=7.41, 95% confidence interval 1.99, 19.00, n=4 cases). There were statistically significantly protective relationships for buccal/pharyngeal cancer (SMR=0.42, 95% confidence interval 0.17, 0.87, n=7 cases), pancreatic cancer (SMR=0.57, 95% confidence interval 0.29, 0.99, n=12 cases) and total cancer (SMR=0.85, 95% confidence interval 0.77, 0.94, n=403 cases). The authors indicated that bladder cancer was statistically significantly increased, however the confidence interval given did not support that statement. There were 18 cancer sites that were analyzed that did not achieve statistical significance. Limitations include the reliance on death certificates for attribution of cause of death.

A standardized morbidity odds ratio (SMOR) study (score=38) using data from a database of 258,964 cancer cases in Massachusetts investigated the potential relationship between specific cancers and firefighters, as compared to police officers and all other occupations combined.(Dongmug Kang 2008) The authors reported statistically significantly higher relationships between firefighting and both colon and brain cancer as compared with police officers, but none as compared with all other occupations. The authors also reported statistically significantly protective relationships between firefighting and skin melanoma as compared to police officers and esophageal cancer as compared with all other occupations. After stratification by age there only colon cancer among those 75 years or older remained statistically significantly increased when comparing firefighters with police officers.

A cohort study of mortality of municipal-working fire fighters (Score=35) concluded that "the findings in our study regarding risk of mortality among fire fighters for cancers of the bladder, colon, and brain are intriguing and suggest that additional follow-up of this cohort, as well as the larger cohort described by Musk et al, and initiation of cancer morbidity studies among these populations would be helpful to further clarify the potential long-term effects of fire fighting on cancer risk." (Vena and Fiedler 1987) For this study 470 deaths among 32,858 person-years were investigated. 14 Cancer sites were analyzed for this study of which 2 were statistically significant. Both sites were increased risk for Colon cancer (Observed/Expected= 1.83, 95 % confidence interval 1.05, 2.97, n=16 cases) and Bladder cancer (Observed/Expected= 2.86, 95 % confidence interval 1.30, 5.40, n=9 cases).

A case control study (score=35) of race-specific cancer mortality in U.S. firefighters concluded that "this study evaluated cancer mortality risks by race among US firefighters in 24 states. Different cancer mortality patterns among male black and white firefighters were observed. Black firefighters have excess risks for cancers of the colon, brain, prostate, and nasopharynx, whereas whites have higher risks for cancers of the lip, bronchus and lung, pancreas, prostate, kidney and pelvis, melanoma, non-Hodgkins lymphoma, and Hodgkin's disease." (Ma, Lee et al. 1998) The authors utilized death certificate data from 1984 to 1993 to collect occupational titles from death certificates in 24 states, including Utah. There were 6607 deaths among male firefighters, with 1883 of those being attributed to cancer. For white male firefighters (n=1817) there were statistically significantly higher morbidity odds ratios (MORs) for all cancer sites combined (MOR=1.1, 95% confidence interval 1.1, 1.2), lip cancer (MOR=5.9, 95% confidence interval 1.9, 18.3), pancreas (MOR = 1.2, 95% confidence interval 1.0-1.5), bronchus and lung (MOR = 1.1, 95% confidence interval 1.0-1.2), soft tissue sarcoma (MOR = 1.6, 95% confidence interval 1.0-2.7), melanoma (MOR = 1.4, 95% confidence interval 1.0-1.9), prostate (MOR = 1.2, 95% confidence interval 1.0-1.3), kidney and renal pelvis (MOR = 1.3, 95% confidence interval 1.0-1.7), non-Hodgkin's lymphoma (MOR = 1.4, 95% confidence interval 1.1-1.7), and Hodgkin's disease (MOR = 2.4, 95% confidence interval 1.4-4.1). For black firefighters (n = 66), the excess risks were found for the cancer of brain and central nervous system (MOR = 6.9, 95% confidence interval 3.0-16.0), colon (MOR = 2.1, 95% confidence interval 1.1-4.0), prostate (MOR = 1.9, 95% confidence interval 1.2-3.2), and nasopharynx (MOR = 7.6, 95% confidence interval 1.3-46.4). Unfortunately researchers were unable to control for many potential confounding factors, including age and tobacco use. They also note that it is possible that some of these associations may be due to chance alone.

A registry based cohort study (score=35)of male cancer incidence by occupation concluded that “research appears to be warranted to further investigate associations of laryngeal cancer in firefighters.” (Firth, Cooke et al. 1996) Authors utilized a registry of 26,207 cancers in New Zealand between 1972 and 1984. When evaluating firefighters, there was an increased risk for cancer of the larynx based on 3 cases among men 19-54 (Standardized Incidence Ratio 1348, 95% confidence interval 254, 3991). Due to the small numbers and lack of controlling for confounding, these results should be viewed with some uncertainty.

A registry based case-control study (score=34) of cancer in California firefighters concluded that “use of other-cancer controls and lack of an occupational history may have biased relative risks towards the null. However, this study, which contained more firefighter cancers than any previous epidemiologic study, produced evidence supporting some prior hypotheses” including statistically higher rates of melanoma. (Bates 2007) Records from all male cancers registered with the California Cancer Registry (CCR) between 1988 and 2003 were obtained and filtered to remove those who did not report a primary occupation or were not between the ages of 21 and 80 years old. There were 3,659 cancer diagnoses which had identified firefighting as their main occupation. 800,448 cancer cases that had identified an occupation other than cancer were utilized as controls. Authors further removed controls in additional analyses by excluding cancers of the 1) lung and bronchus, 2) bladder and prostate, 3) colorectal cancers, and 4) skin melanoma. Without these exclusions, comparisons between firefighters and controls resulted in statistically significantly higher risk estimates for cancer of the esophagus (OR=1.37, 95% confidence interval 1.06, 1.76, 62 cases), melanoma of the skin (OR=1.44, 95% confidence interval 1.28, 1.62, 323), prostate cancer (OR=1.20, 95% confidence interval 1.12, 1.29, 1,144 cases) and testicular cancer (OR=1.34, 95% confidence interval 1.04, 1.74).

Also among this comparison group there was one estimate that was statistically significantly lower for firefighters, that being colorectal cancer (OR=0.84, 95% confidence interval 0.74, 0.94, 282 cases). When excluding the controls mentioned above, all of the significantly higher risks noted above remained statistically significant, including cancer of the esophagus (OR=1.47, 95% confidence interval 1.14, 1.91), melanoma of the skin (OR=1.50, 95% confidence interval 1.33, 1.70) prostate cancer (OR=1.22, 95% confidence interval 1.12, 1.33) and cancer of the testis (OR=1.54, 95% confidence interval 1.18, 2.02). Colorectal cancer became statistically insignificant and cancer of the brain became statistically significant (or=1.35, 95% confidence interval 1.06, 1.72, 71 cases). Authors stratified by year of diagnosis (between 1988 and 1995 or 1996 and 2003) and found that there were some differences in estimates but most estimates remained statistically significant, with the exception being cancer of the testis became statistically insignificant in the 1996 to 2003 strata, cancer of the esophagus became statistically insignificant in the 1988 to 1995 strata, and brain cancer became statistically significant (OR=1.63, 95% confidence interval 1.05, 2.52, 22 cases) in the 1988 to 1995 strata. Some weaknesses of this study include the lack of adjustment for some confounding variables and rough quantification of exposure. The authors did adjust for age, calendar period of diagnosis, race and an indicator of socioeconomic status. It is also likely that the controls selected for this study may be markedly different from the non-diseased general population and non-diseased firefighters.

A retrospective cohort study of mortality among fire fighters in metropolitan Toronto (Score=33) concluded that "fire fighters experience increased risk of death from cancer of the brain, and in suggesting increased risk for various other causes of death." Aronson (Aronson, Tomlinson et al. 1994) This study used firefighters who had been employed between 1950 and 1989 in six different fire departments located in Metropolitan Toronto, the total number of people included in these parameters was 5,995 there were 581 people excluded from the primary analysis for this study for various reasons leaving 5,414 people, however an additional 41 people were excluded from the cohort study for the analysis by duration of employment because the termination of employment was unknown. The author's analyzed the Standardized Mortality Ratio (SMR) for 22 cancer sites several sites were statistically significant. There was an increased risk for Brain and other nervous system (SMR= 201, 95 % confidence interval 110, 337, n=14 cases) other malignant neoplasms (SMR=238 95% confidence interval 145,367, n=20 cases).

A study (score=31) of cancer identification using a tumor registry versus death certificates concluded that "cohort studies of cancer incidence using population-based tumor registries can be a useful resource in the investigation of occupational cancer in the United States, especially for the study of cancers with good survival."(Demers, Vaughan et al. 1992) This study primarily investigated the relationship between tumor registries and death certificates. They report that in this population, there 142 persons who died of cancer during the study period, and 14% (n=20) had cancer site discrepancies between the tumor registry and the death certificate. Similarly, there were 22 deaths that were deemed outside the registry area and unknown diagnosis. This study compared standardized incidence ratios (SIR) and standardized mortality ratios (SMR) between Seattle and Tacoma firefighters and police officers. These analyses resulted in statistically significantly higher rates of prostate cancer incidence (SIR 1.37, 95% Confidence Interval 1.11, 1.69) and mortality from stomach cancer (SMR=2.04, 95% Confidence Interval 1.05, 3.56). Negative relationships were present for both SIR and SMR for cancers of the 1) oral/pharynx, 2) esophagus, 3) colon, 4) rectum, 5) pancreas, 6) larynx, 7) lung, 8) malignant melanoma, 9) bladder, 10) kidney and renal pelvis, 11) brain, l2) Leukemia and 13)other lymphatic and hematopoietic cancers. There are significant shortcomings from this study, including the choice of comparison group, police officers, which were likely chosen for their similarities with the other municipality employed individuals. The choice of police officers as a comparison my have introduced bias in to this analysis. There is also a potential, however relatively low, that there follow-up time of participants was disproportionately lower in older population strata. While the authors identify this and suggest that it would have little effect on the outcome, it should still be considered.

A cohort study of the mortality of firefighters (Score=30) concluded that “inhalation of carcinogenic and toxic compounds during firefighting may constitute an occupational cancer risk. It is suggested that the risk could be minimized by an extended consistent use of respiratory protective equipment.” (Hansen 1990) There was a total of 886 firefighters included in this study 57 who had died, 6 emigrated, and 823 living. Three different cancer sites were examined for four age groups using a standardized mortality ratio (SMR). The age groups were as follows 30-49, 50-59, 60-74, and 30-74. Out of the four age groups several were statistically significant. For the 30-49 age group there was an increased risk for Non-pulmonary cancer (SMR=575, 95% confidence interval 187, 1341) All Cancer sites (SMR=439, 95% confidence interval 142, 1024). In the group 60-74 there was an increased risk for Lung cancer (SMR=317 95% confidence interval 117, 691). Group 30-74 had an increased risk in All Cancer sites (SMR=173 95 % confidence interval 104-, 270).

A cohort study of mortality amongst Paris fire-fighters (Score=28) concluded that “the low overall SMR observed is consistent with the ‘healthy worker effect’. As for cause-specific SMRs, those for genitor-urinary, digestive and respiratory cancers and cerebrovascular diseases are higher than one, although not significant. Owing to a continued monitoring of this cohort, we will be able to see whether these results are confirmed over a longer time scale.” (Deschamps, Momas et al. 1995) The cohort study looked at 11,414 firefighters, out of this group there were 32 deaths. None of the cancer sites analyzed were statistically significant. Limitations for this study included a lack of knowledge of outside exposure, tobacco usage, exposure to radiation, diet, and workout habits.

A registry based case-control study (score=27) of cancer incidence among Massachusetts firefighters concluded that “it is possible that the observed bladder cancer excess is related to cigarette smoking, if firefighters smoke more than the police or state reference groups. Based on the limited smoking data available, the proportions of current and former smokers in the three groups differ only slightly.” (Sama, Martin et al. 1990) Participants with cancer were identified using the Massachusetts Cancer Registry (MCR) which began collecting data in 1982. Non cancer cases were identified from two groups, male cases reported to MCR during the 1982 to 1986 study period who were not firefighters, and those reported to the MCR during that time period who were identified as police officers. Authors calculated standardized morbidity odds ratios (SMOR) for 9 cancer types comparing firefighters to both police officers and the general state population. Data were age adjusted using six age categories. There were 321 cases of cancer among male firefighters utilized in this study. Cancer of melanoma of the skin (SMOR=292, 95% confidence interval 170, 503, 18 cases) and bladder cancer (SMOR=159, 95% confidence interval 102, 250, 26 cases) were statistically significant when comparing firefighters with the general state population. When comparing firefighters with police officers, there were statistically significantly higher SMORs for Non-Hodgkin's lymphoma (SMOR 327, 95% confidence interval 119, 898, 14 cases) and bladder cancer (SMOR 211, 95% confidence interval 107, 414). When stratifying by age, there were statistically significant relationships between firefighters and police officers among those aged 55 to 74 years for melanoma of the skin (SMOR 513, 95% confidence interval 150, 1,750) and lymphoma (SMOR 538, 95% confidence interval 150, 1,924). None of the other age strata or cancer sites were statistically significant. There are significant drawbacks to this study including choice of comparison group, lack of adjustment for confounding factors, dose response gradient, and exposure measurements.

A Proportionate Mortality Ratio (PMR) study of the risk of death among Honolulu fire fighters (Score=26) concluded that "an attempt has been made in our study to point out possible risk of death associated with fire fighting caused by exposure to known toxic chemicals and carcinogens present in incendiary smoke. We hope that this PMR study will lead to further investigation based on more detailed information." (Grimes, Hirsch et al. 1991) The authors of this study conducted a 20-year Proportionate Mortality Ratio (PMR) that included all male firefighters who had been employed for at least a year for the City of Honolulu Fire Department. There were 205 males that fit those requirements and whose mortality was evaluated for this study. Risk Ratios (RR) were tested for in 8 cancer sites of which several were statistically significant. This included an increased risk for genitourinary system (RR=2.28, 95% confidence interval 1.28, 4.06, n=5.37% of 205 cases) Prostate (RR=2.61, 95% confidence interval 1.38, 4.97, n= 4.39% of 205 cases) Brain and other CNS (RR=3.78, 95% confidence interval 1.22, 11.71, n=1.46% of 205 cases)

A review of occupational mortality among firefighters concluded that "it may seem excessive to insist on an approximate doubling of risk to be demonstrated in relevant population studies before a general presumption of risk is made. However, the logic of 'more likely than not', was used to assess the likelihood of causation."(Guidotti 1995) Authors utilized the published data on mortality among firefighters to express a conceptual framework for assessing the association between occupational exposures and mortality.

A review of occupational health concerns of firefighting concluded that "the demands and hazards of firefighting have changed over the past decades but the high quality and standard of service have remained the same. The use of highly sophisticated firefighting equipment and the introduction of innovative firefighting techniques, safer personal protective equipment, and better communications and information systems, as well as healthier life-styles, have helped meet public demands for service and, at the same time, have provided a safer and healthier working environment for the firefighter. In spite of these advances, firefighting continues to be a very hazardous occupation." (Guidotti and Clough 1992) This review article documents many potential exposures.

Firefighters Only: Other Outcomes

A publication (score=65) of additional analyses of a prospective cohort originally incepted to investigate relationships between cardiovascular issues and firefighters (Kales, Soteriades et al. 2002; Soteriades, Kales et al. 2002; Kales, Soteriades et al. 2003; Soteriades, Kales et al. 2003; Soteriades, Hauser et al. 2005; Kales, Soteriades et al. 2007) reports a relationship between obesity and disability found statistically significant trends with increasing obesity and disability after adjustment for many potential co-morbid factors.(Soteriades, Hauser et al. 2008) This article's authors conclude "male firefighters with obesity are more likely to develop job disability over time" with the largest statistical risk being nearly two fold higher in those with a Body Mass Index (BMI) ≥ 30.2 as compared to the reference group of BMI <27.2.(Soteriades, Hauser et al. 2008)

A recent publication by Saijo et al. (score=60) investigated the potential relationship between potential psychosocial factors and psychosocial outcomes of depressive symptoms and job satisfaction from cross sectional data from 1301 firefighters in Japan.(Saijo, Ueno et al. 2007) The authors reported statistically significant relationships between many personal and occupational variables and concluded that "several measures of the NIOSH generic job-stress questionnaire had significant associations with depressive symptoms and job dissatisfaction" suggesting a possible relationship.(Saijo, Ueno et al. 2007)

A cross-sectional study of respiratory function (Score=40) in active firefighters concluded that "firefighters are at risk for developing acute and chronic respiratory symptoms as well as obstructive airway changes." (Mustajbegovic, Zuskin et al. 2001) This Study looked at different respiratory problems associated with age, employment, and tobacco usage.

Both Police Officers and Firefighters: Cancer Incidence and Mortality

A case-control study (score=54) of multiple myeloma and occupation concluded that "this study lends further support to the findings of some previous studies concerning associations between multiple myeloma and employment" however firefighters and police officers are not indicated at increased risk.(Demers, Vaughan et al. 1993) The authors do note that there was a "suggestion" that firefighters may be at an increased risk with increasing risk of duration of employment; however these are based on small numbers. All odds ratios were adjusted for gender, age, race, and study area. Odds ratio for multiple melanoma for firefighters was based on 5 cases and 5 controls and had a point estimate of 1.9 (95% CI 0.5, 9.4). When evaluating only self reported cases, there were 4 cases and the point estimate increased to 2.8 yet remained not statistically significant (95% CI 0.5, 14.5). When stratifying by length of employment (less than 10 years vs. 10 or more years) there were 1 case and 2 controls in the less than 10 years strata with a point estimate of 0.9 (95% CI 0.0, 22.3) and four cases and three controls in the 10 or more years of employment with a point estimate of 2.9 (95% CI 0.4, 21.6). For police officers there were 20 cases and 54 controls which found a point estimate of 1.1 (95% CI 0.6, 2.1). When analyzing only self reported cases, there were 11 cases and the point estimate was 1.0 (95% CI0.4, 2.0). Data on cases and controls were from a study evaluating multiple myeloma and chronic lymphocytic leukemia. Cases were identified from tumor registries in Washington State, Utah, Georgia, and Michigan. Controls were "selected to be similar in age and sex to the cases" but are stated to be representative of the population in the regions. Selection included random digit dialing and random sampling of households. Data was collected on 89% of the cases and 83% of the controls.

A case-control study (score=53) of occupational risk for renal cell carcinoma (RCC) concluded that "both firefighters and painters may be at an increased risk of developing renal cell carcinoma, which is likely to be of significance as both occupational groups are frequently exposed to known carcinogens."(Delahunt, Bethwaite et al. 1995) This study looked at firefighters and police officers as sub groups of the service industry, which utilized 52 cases and 737 controls. It is unclear as to how many of the 52 cases were firefighters, police officers, hairdressers, dry-cleaning, or catering and lodging workers. The author reported statistically significantly increased risk estimates for RCC among firefighters with a risk estimate of 3.51 (95% Confidence Interval 2.09, 5.92). When stratifying by smoking history and age the risk estimate increased to 4.69 (95% Confidence Interval 2.47, 8.93) suggesting that removal of these confounders increased the risk estimate. Police officers had a statistically negative estimate of 1.78 (95% Confidence Interval 0.54, 5.93). A potential weakness of this study includes the fact that controls were selected from the same cancer registry, identified as individuals having cancer other than RCC. This choice of controls introduces the possibility of selection bias. Another weakness is that the study assumed that the occupation at the time of diagnosis is indicative of life-time occupation, which is more likely for firefighters that other occupations, but still presents a significant weakness.

A proportionate mortality study of mortality in police and firefighters in New Jersey (Score=51) concluded that "the groups did not differ from the New Jersey male population in the distribution of cause of death. Some trends with duration and latency, in particular a statistical increase in cardiovascular mortality among working police and firefighters, were observed." (Feuer and Rosenman 1986) This study analyzed the Proportionate Mortality Ratios (PMR) for the deaths of police officers and firefighters that were recorded by the PFRS during the years 1974 and 1980. There were a total of 901 deaths that were analyzed, 615 male police officers (48 non-white and 567 white) and 271 male firefighters (8 non-white and 263 white).The authors analyzed four cancer sites for white firefighters and white police officers based on U.S. PMRs for white males and PMRs for white males from New Jersey. Of the four cancer sites analyzed for firefighters only one was statistically significant, Skin cancer based on the PMRs of white U.S. males had an increased risk (PMR=2.70, P Value= $P<0.05$, n=4 cases). Of the four cancer sites analyzed for police officers two were statistically significant when they were based on white U.S. Males. Both had an increased risk for Digestive cancer (PMR=1.58, P Value= $P<0.05$, n=43 cases) and for Skin cancer (PMR=2.10, P Value= $P<0.05$, n=7 cases).

A cohort study (score=38) of leukemia incidence by searching hospital records and obtaining occupation in the Portland-Vancouver metropolitan area concluded that "leukemia incidence is a major occupational health problem in the health industry. The problem seems to have several independent components, all of which need further investigation, so that control may require considerable effort." (Morton and Marjanovic 1984) Analyses yielded statistically significantly higher age standardized incidence rates (SIR) for both male police officers (SIR for total leukemia 260, $p<0.01$) and male firefighters (SIR for total leukemia 346, $0.01<p<0.05$). These statistics were based on four cases each, with three of the four being non-lymphatic leukemia. There are weaknesses that should be noted, including the utilization of census data for standardization and reported rates in the population as a comparison.

A comparative study (score=31) of occupations and bowel cancer compared the United States with Great Britain concluded that "bowel cancer attacks more people in the U.S. than any other cancer except skin cancer, and only lung cancer kills more people. It is an environmental cancer, since the rates rise toward U.S. levels in groups who come to this country from low-incidence areas. This does not mean that there may not also be additional occupational factors, only that such factors and the resulting occupational cancers may not be conspicuous against a background of general high incidence."(Berg and Howell 1975) The authors evaluated standardized mortality ratios (SMRs) and proportionate mortality ratios (PMRs) and found that for 39 deaths from colonic and rectal cancers for males age 20-64 there were statistically significantly higher risk for firefighters (SMR=279 and PMR 172). Conversely, for policemen, sheriffs, and marshals, there were 46 deaths, but there were no statistically significantly elevated risks from colonic and rectal cancers. These data are based on data from death certificates who died in 1950 and applied to occupational groups as counted in the 1950 census population. Therefore, as the authors note, there could be a difference between the current occupation reported and the usual occupation reported in the death certificate. Therefore there may be over or under reporting of denominator data, which could adversely impact the ratio calculations.

A review of setting priorities for occupational cancer research and control concluded that "any attempt to reduce into one set of tables and variety of information contained in 12 disparate studies is fraught with problems. The approach presented here is only one of many possible approaches. This approach is, however, one that we believe is a reasonable attempt to take as much advantage as possible of the results of these large surveillance studies." (Dubrow and Wegman 1983) The authors identified five studies evaluating colon cancer among firefighters, with two being statistically significant. There were three studies evaluating multiple myeloma among firefighters, with none of them being statistically significant. There were three articles assessing the relationship between malignant melanoma among police officers, with only one being statistically significant.

Summary of evidence

There were 50 prior epidemiologic studies that evaluated factors associated with police officers, firefighters, or both police officers and firefighters, for a variety of outcomes, including cancer, mortality and cardiovascular disease. None of the police officer mortality studies specifically addressed methamphetamine exposures. Note that these groups are not mutually exclusive, e.g. the study by Violanti et al.[1] evaluated risks associated with police for many outcomes, including cardiovascular disease, cancer, and mortality. There are many studies that calculate a multitude of risk estimates associated with the occupations of police officers or firefighters, including odds ratios (OR), risk ratios (RR), proportionate morality ratios (PMR), standardized mortality ratios (SMR), and standardized incidence ratios (SIR). Although these studies differ in quality, we have attempted to summarize the risk estimates by statistical significance for those that reported on cancer (Table 2). Complete tables with reported risk estimates and confidence bounds or measures of statistical significance can be found in Appendix A.

Table 2. Number of risk estimates evaluating specific cancer sites and statistical significance of findings among firefighters.

Cancer Type	Total Studies [1]	Stat. Sig. Positive [2]	Stat. Sig. Negative - [3]	Not Stat. Sig. [4]	No Confidence Intervals or test for sig. [5]
					*
All hematopoietic cancer	2	*	1	1	*
All Lymphopoietic	2	*	*	2	*
Biliary passages, liver, gall bladder	9	*	*	9	*
Bladder and other urinary	17	2	2	12	1
Brain and nervous system	20	4	*	11	1
Breast	2	1	*	1	*
Buccal cavity and Pharynx	11	*	1	9	1
Cecum	2	*	*	2	*
Colon	14	3	*	11	*
Colon and rectum	7	3	1	3	*
Digestive organs and peritoneum	23	3	*	16	4
Esophageal cancer	13	3	*	9	1
Genitourinary cancer	16	3	1	10	2
Non-Hodgkins Lymphoma	10	4	*	5	1
Hodgkin's disease	4	1	*	3	*

Table 2 continued.

Cancer Type	Total Studies [1]	Stat. Sig. Positive [2]	Stat. Sig. Negative - [3]	Not Stat. Sig. [4]	No Confidence Intervals or test for sig. [5]
Intestinal cancer	3	*	*	3	*
Kidney and renal pelvis	16	1	1	13	1
Laryngeal cancer	7	*	*	7	*
Bones and joints	2	*	*	1	1
Leukemia	20	3	*	15	2
Table 2 continued.					
Respiratory system	13	*	*	9	4
Lung	21	*	*	20	1
Lymphatic system	10	2	*	7	1
Lymphosarcoma and reticulosarcoma	4	*	*	4	*
Malignant melanoma of skin	18	6	*	10	2
Multiple myeloma	11	1	*	10	*
Other and unspecified malignant Neoplasms	1	*	*	1	*
Other cancers	2	*	*	2	*
Other digestive cancer	1	*	*	1	*
Other lymphatic and hematopoietic	4	*	*	4	*
Other malignant neoplasms	3	1	*	1	1
Other skin	1	*	*	1	*
Pancreatic cancer	17	1	*	15	1
Prostate	17	5	1	10	1
Rectum and rectosigmoid junction	15	2	*	13	*
Thyroid	4	1	*	2	1
Total Cancer	20	4	*	13	3
Soft tissue sarcoma	1	*	*	*	1

* No Reports That Fit These Criteria
[1] Total Number of Studies reporting on that specific cancer
[2] Statistically Significantly Increased Risk Estimate
[3] Statistically Significantly Protective Risk Estimate
[4] Not Statistically Significant Risk Estimate
[5] No Confidence Interval or P-value, Could Not Determine Statistical Significance from Report

Summary

There is scant evidence evaluating the relationships between working as a police officer and cancer incidence or mortality. Of the six studies that evaluated the relationships between police officers and cancer, there were only six statistically significant relationships, and of those relationships, the increased risk estimate was generally below two fold increased risk, with few exceptions. Exceptions include non-lymphatic leukemia (SIR 342, p<0.05)(Morton and Marjanovic 1984), total leukemia (SIR 260, p<0.05)(Morton and Marjanovic 1984), and skin cancer (PMR 2.01, p<0.05)(Feuer and Rosenman 1986). There were two other studies that evaluated leukemia (Demers, Vaughan et al. 1992),(Feuer and Rosenman 1986) that did not find any significant relationship between police officers and leukemia. There were no clear trends apparent in the body of literature.

The relationship between firefighters and cancer is much better documented. We identified 27 studies that evaluated this relationship. For total cancers, there were 20 reported analyses, only four of which were statistically significant, and three did not report any statistical significance. All reports of significance had estimates very close to the null value with none being more than 1.2 fold increased risk. Of the individual cancer sites that were evaluated, there were generally higher relationships reported for colon and rectal cancers combined, malignant melanoma, non-Hodgkin's lymphoma (NHL), and prostate. When evaluating relationships between colon and rectum cancers three of the statistically significantly positive results were different analyses from the same data.(Berg and Howell 1975) Studies that reported colon and rectum separately had generally fewer significant results, which could be a result of underpowered analyses or it could be a more accurate representation of this relationship Malignant melanoma has one third (six out of 18) risk estimates that are statistically significantly positive and none that are statistically significantly protective. These estimates range from 1.5 fold to nearly 3 fold risk. We identified reported risk estimates of NHL, with four of them being statistically significantly increased risk and no statistically significantly protective estimates. Statistically significant estimates ranged from 1.32 fold to 5.60 fold increased risk. Of the 17 studies reporting risk estimates for prostate cancer, five had statistically significantly increased risk estimates ranging from 1.20 (Bates 2007) to 2.61 (Grimes, Hirsch et al. 1991). There was one report that stratified by race and reported increase risk among blacks at 1.9 while whites were 1.2.(Ma, Lee et al. 1998) The single statistically significantly protected relationship between firefighters and prostate cancer reported a risk estimate of 0.38, which equates to 2.63 fold decreased risk of having prostate cancer (Beaumont, Chu et al. 1991).

<u>Objectives of the Study</u>

<u>Goal</u>: Perform a retrospective cohort study for neoplasias among Police/Drug Enforcement Officers and Firefighters to quantify risks.

The objectives of this research project as originally proposed were:

1. Comprehensively summarize the research literature and data on the evidence for combustion products exposures and methamphetamine exposures and associations of adverse outcomes, including causal analyses, in firefighters and police/drug enforcement officers respectively.

2. Identification of whether there is evidence that Firefighters have experienced increased cancers (especially cancers of the brain, digestive system, kidney or bladder, leukemia, lymphoma, except for Hodgkin's disease, melanoma, multiple myeloma, and respiratory cancer**.**

3. Identification of whether there is evidence that Police/Drug Law Enforcement Officers have experienced increased cancers (particularly those on the same list).

4. Quantification of the burden of disease and the magnitude(s) of any and all increased risk(s) identified.

5. Prepare and deliver a timely report.

6. Describe how these findings compare with previously reported research results.

7. Identify potential reductions in exposures that may reduce adverse health risks.

<u>Hypothesis 1</u>: There is a relationship among Police/Drug Enforcement Officers between categories of Methamphetamine-related Exposures and the subsequent risk for neoplasias.

H_1 1A. There is a relationship between categories of Methamphetamine-related Exposures and the subsequent risk for specific neoplasias of interest (e.g., respiratory, brain, gastrointestinal, melanoma, kidney, bladder, leukemias, lymphomas, and multiple myeloma).

<u>Hypothesis 2</u>: There is a relationship among Firefighters between categories of Combustion-related Exposures and the subsequent risk for neoplasias.

H_1 2A. There is a relationship between categories of Combustion-related Exposures and the subsequent risk for specific neoplasias of interest (e.g., respiratory, brain, gastrointestinal, melanoma, kidney, bladder, leukemias, lymphomas, and multiple myeloma).

Police Officers and Drug Enforcement Officers.

There are continuing major health concerns on the part of NIOSH, among police officers, and at the recent NIOSH Town hall meeting in Salt Lake City (see www.rocky.utah.edu) with respect to potential adverse health effects of methamphetamines and the component chemicals used in illicit manufacturing. Interestingly, we are unaware of any other substantive epidemiological investigations of these specific workers. We are trying to address this gap in knowledge.

The Police/.Drug Enforcement Officers are potentially exposed to over 2 dozen chemicals, some proven to be carcinogenic (e.g., benzene, isosafrole). There are a number of different Public Safety employees with potential methamphetamine exposures include Drug Enforcement Officers, Police, and especially SWAT team members who respond to calls to uncontrolled or unexpected situations, and other personnel tasked with methamphetamine “lab” clean-up duties. Methamphetamine laboratories and exposures are basically chemical laboratories with over two dozen chemicals (Methamphetamines ingredients typically include: Ephedrine, Pseudoephedrine, Acetone, Alcohol, Toluene, Xylene, Ether, Sulfuric Acid, Red Phosphorus, Methanol, Salt, Lithium, Anhydrous Ammonia, Sodium Hydroxide, Muriatic Acid, and Iodine. “Cooking” Products typically include: Hydrogen chloride, Phosphine, Iodine, Hydroiodic acid, Naphthalene, Anhydrous ammonia, Trichloroethane, Sodium metal, Methylsulfonyl-methane (MSM), and Hydrochloric acid.) potentially involved in these exposures, somewhat dependent on the exact ‘recipe’ the user is utilizing. Other major concerns are that methamphetamines remain in the laboratory area for prolonged periods of time. Dispersal of methamphetamines is particularly worrisome for red phosphorus cooks, the chemicals may remain present in the area for 6 months or longer. Exposures to either methamphetamines or smoke are not well controlled, thus doses are not clear, and research studies into those exposures are limited. Police or particularly Drug law enforcement officers, who did not wear appropriate protective equipment, could have been exposed to respiratory occupational hazards such as chemicals used in illegal methamphetamine laboratories, particulates from illicit drugs, smoke from drug users, and other inhalants. There are no published systematic reviews of the scientific literature for either short or long term effects of methamphetamines or of the multiple agents used in production of which we are aware. Due to numerous chemicals involved, varying levels of exposure, different populations of concern, divergent durations of exposure, as well as uncontrolled exposures, this is a complex task. A few of these chemicals are considered carcinogenic (Benzene, Methylene Chloride, Isosafrole, Safrole). While evidence for Benzene is, by far, strongest, and its linkage with acute myelogenous leukemia is considered indisputable, the others are of concern as well (Health effects include: Central nervous system euphoria, Increased alertness, Psychotic schizophrenia and hallucinations, Paranoia, Decreased appetite, Insomnia, Headache, Irritability, Personality changes, Confusion, Tremors, Anxiety, Convulsions, Hyperthermia, Coma, Cerebral hemorrhage, Cough/respiratory tract irritation, Wheezing, Shortness of breath, Cardiovascular, Chest pain/angina, Myocardial infarction, Palpitations, Skin itching, Ulcers of lip and tongue, Atrophy of skin capillaries, Itching, Feelings of “creepy crawlies,” Impotence, Irritation of eyes, mucous membranes, and upper respiratory tract, Restricted air flow, Dizziness, and Fainting. Prenatal exposures to methamphetamines have been reported to result in: Pre-term labor, Placental Abruption, Fetal distress, Post partum hemorrhage, Infants, Abnormal sleep, Poor feeding, Irritability, and Tremors.) We have found over 700 articles on methamphetamines, although only 14 of them are epidemiological. This information does not include analyses for acute versus chronic effects, effects in children and adults, and interactions between the various chemicals. Many of these studies are in laboratory animals, thus effects in humans are quite unclear.

Methamphetamines will contaminate the Police/Drug Officer’s personal protective equipment. Higher exposures may also occur because workers enter a situation for which they were not prepared or aware of. Additional issues include inadequate personal protective equipment, a lack of policies on the use of such equipment, and Drug Enforcement Officers have reported to us that they did not use any personal protective equipment for many years. They also have reported to us that there were numerous exposures that were uncontrolled, including driving automobiles seized from felons who used them for manufacturing purposes, transporting paraphernalia for extended periods of time in their service vehicle, clouds of vapors, eating where manufacturing was occurring, spending hours of time in laboratories and developing symptoms after high dose exposures.

Firefighters.

There has been longstanding concern about risk for neoplasias among firefighters, yet to our knowledge, there has never been an assessment of risks among Utah's firefighters. At current count, there are some 20 states with laws of a presumption of work-relatedness of various cancers among firefighters. Yet, there have been few retrospective cohort studies of this population of workers (Howe and Burch 1990, Beaumont et al 1991, Haas et al 2003). There have been a number of other, weaker epidemiological cancer studies (Howe and Lindsay 1983, Feuer and Rosenman 1986, Vena and Fiedler 1987, Hansen 1990, Demers et al 1994). While there have been many mortality studies of firefighters over the years, in reviewing available information, it appears that very few have been cohorts with adjustments for major potential confounders. This means that the available information quantifying potential adverse health effects for either set of workers is weak and conclusions drawn from such data are somewhat tenuous. There are reported associations of increased cancers in various populations of U.S. firefighters, however, the cancers at reportedly increased risk are not consistently the same (Howe and Lindsay 1983, Feuer and Rosenman 1986, Vena and Fiedler 1987, Hansen 1990, Demers et al 1994, Moen and Ovrebo 1997, Haas et al 2003). As one example, a recent SMR study from Florida found only bladder cancer and no others at increased risk (Fangchao et al 2005). Another reported increased brain cancer (Demers et al 1994), and two reported elevated leukemia risks (Feuer and Rosenman 1986, Demers et al 1994). Several studies have not found elevated risks (Howe and Burch 1990). Yet, the retrospective cohort study from the San Francisco Fire Department found elevated risks for esophageal cancer (Beaumont et al 1991), which coincides with concerns among Utah firefighters.

Firefighters are exposed to hundreds of chemicals in the process of fighting fires, numerous thought to be carcinogenic (Moen and Ovrebo 1997, Austin et al 2001), although there are thought to be higher exposures in the process of post-fire cleanup, "Overhaul" (Bolstad-Johnson 2000, Burgess et al 2001). Exposures of concern prominently include: asbestos, silica, wood, many solvents, and products of combustion. There are numerous studies reported on firefighter's exposures, which have been characterized extensively over the years (Moen and Ovrebo 1997, A few References). One wrinkle is that residential and commercial fires have literally hundreds of combustion products, and the trend is towards increasing numbers of such exposures due to construction techniques that have utilized more plastics, composites and glues. Changes in home construction may also have altered exposures to firefighters.

In summary, the <u>strengths</u> in the available literature include: (i) Some studies from which to draw inferences, and (ii) Some associations between job exposure factors and some neoplasias. ***Specific <u>weaknesses</u> in the epidemiological literature include:*** (i) Few quality studies assessing specific neoplasms and almost none that are retrospective cohorts with adjustments for potential confounders, (ii) Almost no studies evaluating varying estimates of the degree of exposures, (iii) Almost total reliance on job titles for exposure status, (iv) Practically no data supporting dose-response relationships, and (vi) Inadequate controlling for known or suspected, potential confounders.

Experimental Plan and Methods

***Study Design**:* Retrospective Cohort Study with 553 Police and Drug Enforcement Officers and 549 Firefighters from all municipalities in the state of Utah. (The original proposal was to enroll from the Wasatch Front, however this was expanded based on success of implementing a distance-based enrollment process that facilitated enrollments from any distance electronic location 24 hours/day).

Specific Aims:

Retrospective Cohort Study

1. Incept a retrospective cohort study from 1980 to present among the participating municipalities.

2. Job Exposure Assessments (Job Exposure Assessment Team, blinded to Health Outcomes status)
   a. Measure select exposures that have not been well measured and reported elsewhere. (Access was not obtained.)
   b. Obtain questionnaire data on exposures
   c. Access administrative data on frequencies of drug interdiction efforts and fire responses and utilize these objective measures to the extent possible
   d. For those who are deceased, use surrogates of exposure status from the same station/job tasks and relying on the objective data whenever possible.
   e. Classify exposures for each subject into Low and High exposure categories

3. Health Outcomes Assessments (Health Outcomes Assessment Team, blinded to Job Exposure status):
   a. Obtain baseline questionnaires.
   b. Obtain medical records where necessary.
   c. Obtain records from the Utah Cancer Registry for histological typing.
   d. Classify health outcomes status, including type of cancer while blinded to exposure status.

4. Perform Statistical Analyses to assess relationships between the Job Exposures and the Health Outcomes separately for Police/Drug Enforcement Officers and for Firefighters (Statistical Analyses and Data Management Team)
   a. Measure the incidences of specific neoplasms.
   b. Assess exposure-disease relationships in aggregate and exposure-specific cancer relationships.

Mortality Study

5. Identify all Drug and Police Enforcement Officers and Firefighters in Utah from 1980-2005

Study Design Considerations

The study was designed as two retrospective cohort studies, one for each worker population [(1) Police/Drug Enforcement Officers and (2) Firefighters in Utah]. The methods are nearly identical for both studies, although the health effects studied did differ between groups due to variance in the exposures of concern. The objectives were to provide exposure classification on the estimated exposures for each worker participating in the study, along with objective disease status determinations that are used to calculate risks. In this study, the unit of analysis is each individual member of the cohort.

Study Subject Selection Rationale

This study included both high and low exposure populations. All participants (including surrogates) were required to complete informed consent documents prior to enrollment in the study. There were no exclusions for race/ethnicity or gender. All eligible subjects were invited to participate. However, the population was overweighed towards males due to it being a convenience sample that represented the natural composition of the underlying workforces. Overweighting the selection criteria towards females would not have been helpful as there are very few older females, which is the main age group of interest.

We included all full time, professional police officers and firefighters who worked for at least one year between 1980 and 2005 anywhere in Utah. All pilot testing sessions suggested that exposure may occur in all workers (e.g., many police officers not assigned to narcotics units may also have inadvertent exposures to drugs/methamphetamines labs), although subsequent workers enrolled contradicted that impression. For purposes of mortality calculations, we obtained the mortality data for all of these workers as well as from the entire state of Utah.

Also, by including these diverse groups with diverse job tasks, we were better able to develop a spectrum of exposures. For example, one comparison population was: those police officers who report they do not believe they have significant methamphetamines exposures or other interdiction-related activities or exposures.

The firefighters were similarly divided into one half with high combustion products exposures and one half with low combustion products exposures. This was preliminarily accomplished by selecting firefighting departments with more active firefighting activities and comparing them with those with little firefighting activities.

The following sections of "D. Experimental Plan and Methods" are divided into: D-1. Job Exposures Reconstructions; D-2. Health Outcomes Categorizations; D-3. Sample Size and Statistical Analyses; D-4. Innovations; D-5. Participant Recruitment Strategies; D-6. Exclusion/Inclusion Criteria; D-7. Quality Control/Quality Assurance; D-8. Participants Notification of Study Results; and D-9. Management Plan.

Job Exposures Reconstructions

We used both objective and subjective sources of information to classify exposure status. These are: (1) Administrative data on numbers of drug interdictions/fires fought, (2) data from Questionnaires, (3) Measurements of Exposure, and (4) prior publications. We relied on both prior published reports and self reported sources, as we understood that the objective data were likely to be of insufficient detail and potentially missing in some circumstances thus unavailable for all subjects.

Questionnaires and Questionnaire Development (see Appendix C for questionnaires)

All workers had a history obtained by a secure server access, internet-based Questionnaire (See Appendices, Police Officers Questionnaire and Firefighter Questionnaire, Surrogate Police Officer Questionnaire and Surrogate Firefighter Questionnaire). These questionnaires included:

1. Questions on Exposures history (length of service, frequency of actions, use of personal protective equipment)

2. Questions on Health Outcomes (e.g., specific cancers and heart disease)

3. Potential Confounders (e.g., age, tobacco, physical fitness)

Methamphetamine and Firefighting Combustion Products exposures histories include measures for both duration and intensity of exposures and also contained the health outcomes questions, although the Job Exposure Assessment Team and Health Outcomes Assessment Team did not have access to each others' information.

Our questionnaires were developed after literature searches were performed, NIOSH sources were consulted and we also utilized our existing questionnaires and knowledge to construct a preliminary questionnaire. Those questionnaires were then circulated to numerous key stakeholders. Changes were suggested and incorporated.

Preliminarily, we also compiled 4 focus groups (2 each for Police Officers and Firefighters) that provided critically important feedback for serial improvements in the questionnaires. Additionally, Drs. Hegmann and Larson accomplished a site visit at a firefighting simulation, and Dr. Hegmann attended a Hazmat simulation. These various informative sessions allowed for the questionnaires to be as precise, effective and easy to answer as possible

Enrollments

Enrollments were originally scheduled to be conducted primarily at precincts and stations. However, due to the late award to complete the study and the mandatory reporting requirements of October 2008, it was determined the only feasible mechanism for large scale enrollments to successfully complete the study in a timely manner was to computerize the questionnaire on a secure server for remote access at any point. Thus, the enrollment processes were adjusted to improve potential participation and administrations were not conducted on-site.

Every identifiable municipality was contacted for names of potential study subjects. Contacts were made variously by combinations of telephone calls, emails and letters. Legislators were contacted to assist with encouraging municipalities to allow for enrollments of their workers. A complete listing of participation by municipality is printed in Appendix B. The total municipalities identified and the number participating as of September 30th 2008 are listed below in Table 3. Nearly all eligible firefighting agencies agreed to allow workers to enroll and almost half of police agencies allowed workers to enroll.

Table 3. Municipality Participation

Job Category	Numbers of Identified and Participating Municipalities	Numbers of identified and participating workers
Police Officers	144 Identified 70 Permitted officers to participate	10,429 Identified, 553 Participated
Firefighters	29 Identified, 27 Permitted firefighters to participate	3,946 Identified, 549 Participated

After names of workers were obtained from agencies (usually without addresses as per request of the municipality), study subject identification numbers were assigned. Letters with enrollment information and the subject identification numbers were printed and sealed in envelopes with the workers' name affixed. These were delivered to the municipality for mailing. (For the small minority in which we were given complete information, we directly mailed the information to the officer.) There were some municipalities that refused to provide names. In those situations, the municipality compiled a list of eligible employees and assigned random identification numbers to those individuals. We then assigned study subject identification numbers to those random identification numbers, generated personalized letters of invitation to participate, sealed those letters in individual stamped envelopes with the random identification number on the front. Those were then returned to the municipality, which then put the name and address label over the random identification number and mailed the invitation letter.

Subjects were requested to telephone the Rocky Mountain Center for Occupational and Environmental Health to give their Social Security Number over the phone as the number is essential to obtaining the Utah Cancer Registry data which has unfortunately, but understandably, used SSN for the patient identification number for over 30 years. (In some cases, workers would only give the last 4 SSN numbers and in some cases, they would not give any number at all despite being informed that our data had not been compromised in a widely reported incident involving information on 2M people. This provides some weakness in the study that we believe we were largely able to subsequently account for through telephoning subjects whose data on reports of cancers did not match between the questionnaire and Utah Cancer Registry.)

After obtaining informed consent through electronic administration, the Questionnaires (please see Appendices) were administered to assess various questions on Exposures history (length of service, frequency of actions, use of personal protective equipment), questions on Health Outcomes (e.g., specific cancers and heart disease), and potential Confounders (e.g., age, tobacco, physical fitness). Computerization of questionnaires were successfully used in this study to increase the quality of data and reduce questionnaire administration time (specific format fields and skip sequences reduce errors and speed the process). In this case, a computerized questionnaire was particularly helpful, since the complexities of the job tasks have produced many skip-sequences in the questionnaire that computerization renders much easier for administration purposes. A paper version was also available; however, was rarely utilized. There were approximately 10 individuals who preferred to have a paper questionnaire. They were mailed the questionnaire with a stamped, return envelope. Those questionnaires were then hand entered. There were approximately 30 instances where participants completed the questionnaire through an orally administered questionnaire given through a trained interviewer at the Rocky Mountain Center. Participants typically selected this option because they either did not have access to a computer or the internet or were unfamiliar or uncomfortable with computers. Reportedly, no participants declined participation who did not want to complete the questionnaire through one of these 3 methods.

All invitation letters to municipalities and participants, consent forms, and questionnaires are located in Appendix C.

Exposures Assessments

Exposure assessments were accomplished by the Job Exposure Assessment Team (Dr. Larson, Dr. Pahler , Dr. Collingwood, Ms. Thatcher, and Mr. Call) while blinded to health outcomes. Exposures were assessed using both objective and subjective measures.

Objective Measures of Exposure
(1) *Length of Professional Service*.
(2) *Number of Drug Interdictions or Fires Fought.*
(3) *Personnel Training, including type and content of training*
(4) *Personal Protective Equipment, including type used and fit testing records*
(5) *Select measures of Exposures*

Subjective Measures of Exposure
(1) *Length of Professional Service.*
(2) *Worker history of Number of Drug Interdictions or Fires Fought*
(3) *Usage of Personal Protective Equipment*
(4) *Recalled symptoms from Exposures*

FIREFIGHTER EXPOSURE QUANTIFICATION

Because of the relative lack of exposure monitoring information for firefighters' exposures, the focus of this project was to reconstruct exposure estimates for firefighters from 1980-2000. To do this, a questionnaire was developed. The questionnaire was administered electronically, in order to be able to use a stochastic analysis of the data, as well as a deterministic one. The questions were divided into 4 sections based on activity: non-structural fires, structural fires, overhaul, and decontamination. The non-structural fires questions consisted of the following:

1. Total years as a firefighter
2. Number of non-structural fires per month
3. Time at the fire site in minutes
4. Whether the firefighter had ever had an unprotected exposure to a hazardous material
5. If the firefighter had ever had symptoms from exposure to a hazardous material

The structural fires section had similar questions:

6. Number of structural fires per month
7. Time at the fire site in minutes
8. How often, expressed as a percentage, the firefighter had entered the burn site
9. How long the firefighter remained on air after the fire
10. How long the firefighter was in the actual structure
11. How many times the firefighter had been in the fire without being on air
12. As a percentage, how often the firefighter wore SCBA, on average
13. The number of years as a firefighter without wearing an SCBA

The overhaul section was more brief, but had some of the same questions as the other sections:

14. How much time the firefighter spent on overhaul during an average month
15. How often the firefighter had worn an SCBA, on average, as a percentage
16. The number of years as a firefighter without wearing an SCBA

The decontamination section had one question:

17. The number of decontaminations the firefighter has had during his or her life

The combination of these questions best represented the possible ways that a firefighter could be exposed to emissions, approximate frequency of exposure potential, and duration of exposure to emissions that may contain potentially hazardous agents in his or her work assignments as a firefighter. The final questions are also listed in Appendix C, as is the exposure matrix that was developed and used for this study.

Algorithm Development

An algorithm was developed that quantified the firefighters' responses. Yes/no questions were assigned a 1 or a 2, where 1 was indicative of essentially no exposure. For example, if a firefighter responded "yes" when asked if he or she had ever experienced symptoms from an exposure, then he or she was given a 2 for that question. Percentage questions, such as the percentage of time that the firefighter generally wore his or her SCBA, were ranked 1 to 4, where 4 was the least percent amount of time wearing an SCBA, or 0-25%. 3 indicated a 26-50% percentage of SCBA usage, 2 was for 51-75%, and 1 for 76-100%. Blanks, except where indicated otherwise, were given a default value of 4 for least exposure.

Weighting factors were developed to categorize the relative risk of different activities as well as durations of exposure that were relevant to over-all exposure risk. These weighting factors were applied to several responses to characterize the potential exposure of the firefighter in specific activities to also evaluate potential methods (equipment and/or procedures) for reducing exposures. These factors were determined in three ways: First, by a careful review of literature to determine the contribution to exposure that the answer to a question gave, and if the answer was specific or general contribution to exposure. Second, when looking at the exposure matrix, some data very automatically separated into groups, especially the questions asking for a "yes" or "no" response. Finally, an overall calculation using all input data and associated factors as applicable was used evaluate acceptability of the weighting factors where applied. For example, weighting of the firefighter to gaseous and particulate emissions while resting near an active fire was given more weighting than a firefighter involved in overhaul after the primary fire has been extinguished. This was due to the combustion of most of the volatile chemical agents of concern for carcinogenic or specific organ toxicity. To achieve the appropriate weighting of each category, some factors were changed on individual questions as a result of this more in-depth analysis of relative risk of the various potential exposures.

Data Collection

Section A: Non-Structural Fires

First, it was assumed that all firefighters were active and not retired, as many did not respond to the question of whether or not they had retired. The year he or she started firefighting duties was estimated as the year he or she started wearing a helmet as there was not a question on the questionnaire that asked when the firefighter started fighting fires,. For question 2, “the number of non-structural fires per month,” weighting of the answers was based on the potential increase in exposure risk due to the frequency of fighting such fires. The weighting factors for this question were: 0 fires was reassigned as a 1, 1-10 was a 2, 11-50 was a 3, and greater than 50 was a 4. The time at the site of a non-structural fire in minutes was also re-categorized, with 1-30 minutes being a 1, 31-60 a 2, and greater than 60 a 3. See Figure 1 for 25 of the respondents' specific answers.

Section B: Structural Fires

Weighting of answers for question 6, “the number of structural fires,” was the same reassignment as occurred with question 2. That is, the answer for the number of structural fires was reassigned as a 1 for a 0 answer, 2 for 1-10, 3 for 11-50, and greater than 50 was given a 4. For question 7, “time at site in minutes,” a time period 1-60 minutes was assigned a 1, 61-120 a 2, 121-180 a 3, and greater than 180 a 4. Question 10, “amount of time in the burning structure,” was assigned a 1 for 1-30 minutes, a 2 for 31-60, and a 3 for greater than 60. This assignment of weighted numbers was due to less variability in answers than with question 7. For question 13, “the years as a firefighter without using SCBA” was obtained by subtracting the “helmet start date” from the “SCBA start date” and using the difference. 25 of the responses for structural fires are found in Figure 2.

Section C: Overhaul

Only question 14, “amount of time on overhaul,” was given a weighting factor on Section C. This weighting factor was the same as with question 10 in section B, (amount of time in the burning structure), where 1-30 minutes was assigned a 1, 31-60 a 2, and greater than 60 a 3. The column “years without SCBA on during overhaul” was obtained by subtracting the SCBA start date from the helmet start date and using the difference. It seems that this is a duplicate of question 13, years as a firefighter without wearing SCBA. However, many firefighters did not use SCBAs for overhaul as early in their careers as they did for structural fires.

It should be noted that in instances where the respondent left the percentage of SCBA use in question 15 blank, a 4 indicating “0 to 25% of the time” was entered as a default, as it is likely that he or she did not wear an SCBA for overhaul activities. The answers for 25 of the respondents for Section C are found in Figure 3.

Section D: Decontaminations

Question number 17, "the number of decontaminations a firefighter had undergone throughout his or her life," was weighted like question 2 (the number of non-structural fires), where an answer of 0 decontaminations was assigned a 1, 1-10 a 2, 11-50 a 3, and greater than 50 a 4. The results for 25 of the respondents are shown in Figure 4.

Total Algorithm

Algorithm for Section A: Non-Structural Fires:

The algorithm for section A is a multiplication of responses to Q2, number of non-structural fires, Q3, time at site in minutes, Q4, unprotected exposure to a hazardous material, and Q5, whether there were symptoms from an unprotected exposure to a hazardous material. Figure 5 shows the results for the total algorithm, as well as the raw data.

Algorithm for Section B: Structural Fires:

The algorithm for Section B consists of multiplying the responses to Q6 (number of structural fires), Q7 (time at site in minutes), and Q8 (how often, in %, the firefighter entered the burn site), adding a multiplication of the responses to Q10 (time in structure, in minutes), Q11 (how many times in fire without air), Q12 (SCBA use in %), and Q13 (years as a firefighter without using an SCBA), and subtracting the answer to Q9 (how long on air after the fire), as it is a protective factor.

Algorithm for Section C: Overhaul:

The algorithm for section C is a multiplication of responses from Q14 (time on overhaul), Q15 (SCBA use in %), and Q16 (years as a firefighter without using an SCBA for overhaul).

Algorithm for Section D: Decontaminations:

The algorithm for section D is the frequency of decontaminations, the answer to Q17.

Total Algorithm:

Results from partial algorithm for Section A (non-structural fires) + results from partial algorithm for Section B (structural fires) + results from partial algorithm for Section C (overhaul) + direct results from question 17, which is also Section D (decontaminations).

The resulting scores from the combination of these four sections were then separated into three categories of exposure: Low for numbers from 1-50, Medium for 51-100, and High for greater than 100. This separation was based in part on the indication of relative risk by these final scores due to the weighting of individual questions within each partial algorithm. Besides evaluating relative exposure risk to the firefighters, this information is able to be used to determine what further protection should take place, as well as the percentage of firefighters that were placed in each category of risk.

RESULTS for Exposure Estimation

Results for determining the effectiveness of using this algorithm approach for exposure estimation were obtained specifically for the subset of firefighter questionnaire responses (n=50). Results from the exposure matrix for these 50 responses from firefighters determined that 18% of firefighters were in the high risk category, with 24% in the medium risk category, and 58% in the low risk category.

The high risk category shows that the firefighter is more likely to develop adverse health outcomes than the medium and low categories. Although all firefighters should be educated about possible hazards of exposure, the high risk category shows those firefighters who should receive the greatest amount of education and training in order to mitigate the hazards they might face.

DISCUSSION of Exposure Estimation

Validity of the Algorithm

The use of an algorithm to quantify exposures of firefighters over a long-term basis is unique. Other research has utilized questionnaires, but these were often tied to mortality and morbidity records, instead of using an exposure matrix. Further, many of these studies were also focused on recent time periods, not the twenty years that this algorithm seeks to quantify. Finally, because this questionnaire is being administered electronically, a stochastic and deterministic analysis of the data can be utilized. Thus, although there is no sampling data to directly determine the accuracy of this algorithm, the results can be beneficial in many ways.

First, using an exposure matrix could be a useful tool for future research. Limited sampling data and a lack of adequate funding often preclude in-depth approaches to accurately monitor firefighters to determine their potential or actual exposures. Utilizing a matrix may help to reduce the amount of funding and time needed to analyze these possible exposures. Also, an exposure matrix could be used to determine potential historical exposures when there is no sampling data available.

Second, being placed in a “high” exposure category may help the firefighter to realize he or she needs to take extra precautions, such as wearing an SCBA and not removing it until leaving the immediate area of a structural fire or, using other, less inhibiting but adequately effective respiratory protection on activities such as overhaul, when there is not active fire but potential latent emissions.

Limitations of the Algorithm

There are several ways in which the algorithm is limited in its ability to completely characterize exposure data. The first of these was in using the helmet start date as a start date for becoming a firefighter. The question specific to start date was not included on the questionnaire. Although it is very likely that the helmet start date and the actual start date do not coincide, there is a potential for bias.

The second way the exposure data might be biased is in assuming that the firefighters are still active and not retired. If not correct, this has the potential to skew the results. In addition, the questionnaire did not ask if the firefighter took a leave from firefighting activities for some period of time between the indicated start and end dates (e.g., months or years due to a past illness).

Relative to the overhaul section, many respondents did not answer the question for how often they wore an SCBA for overhaul activities. The assumption was made that they probably never wore it or wore it for very short periods of time, but this could bias the exposure information.

Further, assuming a least exposure result when other blanks were found on the questionnaire might also introduce a bias into the exposure matrix.

Finally, there are several factors that are not accounted for in the algorithm, such as whether structural fires are business or residential fires, the age of buildings (which would impact the types of materials used in construction of the structures), and other risks that could play a large role in the potential exposure of a firefighter. Most of these data are not readily available for a time-limited study.

POLICE OFFICER EXPOSURE QUANTIFICATION

METHODS

Development of an Algorithm

An algorithm was designed in an effort to quantify the estimated exposures of police officers to hazards associated with methamphetamine laboratories. Various weights were given for differing degrees of exposure with the end result categorizing risk of exposure into low, medium, or high groups. Weighting factors were based largely on literature indicating relative risks of exposure associated with entering a laboratory during the various stages of active cooks and cleanup. Questions from the survey were grouped into categories whose sums were used as multipliers in support of the final product.

Group A

Length of employment as a police officer (addressed in questions 8, 9, and 12) is the main component of this group and is recorded in terms of months employed. Group one is a critical piece of the study, for obvious reasons, as extended time on the job indicates greater probability of exposure. Literature indicates that methamphetamine laboratories did not become popularized until the early 1980's. Such being the case, employment prior to 1978 was considered to be a non-risk factor and was assigned no value. Retirement date was also an important factor given that an officer may have had a full career yet may have retired prior to the influx of laboratory busts. Column 12b of the algorithm therefore provides, in months, only the length of employment between 1978 and retirement with 2008 being the default for non-retired officers.

Initially length of employment was to be converted from months to years and used as a multiplier; however, those values would have overwhelmed the final product. Consideration was then given to categorizing length of employment into ranges and assigning a value of 1-4. In doing this, a correlation was noted between the number of months and the category value. This correlation led to the decision that dividing the number of months of employment by 100 gave a similar output, yet likely with a more accurate representation of employment and an ancillary spread in the final output. Group A, then, is the length of employment between 1978 and retirement, or 2008, divided by 100. Thus, the Group A equation is as follows:

$$A = 12b/100$$

Group B

Group B (questions 13, 14, 15, 16, 17 and 20) gave officers an opportunity to attempt quantifying the amount of time spent in and around methamphetamine laboratories directly related with busts. The survey does not address stage of cook or even whether the cook was active during officer entry onto the site; therefore, for the purpose of this risk assessment it has been assumed that time spent in and around laboratories was during active cooks.

The three key questions in this group are question 13, which asks an officer if they had ever entered a methamphetamine laboratory; question 16, which indicates participation in busts as an approximate number per month; and question 20, which assesses the amount of time spent in the actual laboratory. Question 15 assesses the time amount of time spent “on site” but not in the laboratory. Because exposure to vapors and airborne particulates is still feasible this response was considered in the equation, but weighting was minimized as exposure levels would be significantly less.

The ‘yes’ or ‘no’ response to question 13 was assigned a 2 or 1 respectively with the value being used as a multiplier for Group B; hence, a 1 contributes no value to the final product with a 2 doubling risk of exposure. The responses to questions 15 and 16 were categorized based on time spent in or around the site (see Table 4 below).

The output for Group B was thus determined by multiplying the number of times in a laboratory (column 20) by the categorized number of busts per month. The categorized time spent “on-site” was then added to the product before being doubled by the response from question 13.

Question number 17 asked officers to indicate time spent, in minutes, at the laboratory which is very similar to question 15; time spent on site. Question 17 was not used in the product of this group in order to avoid weighting time spent in, on, or around the site too heavily. The question was however, used as a check in that the response for question 15 should not exceed the response for question 17.

Table 4. Group B Equation and conversion equations for time variables.

Group B
B = 13 x [(16 x 20) + 15]

Time in Minutes	
1-30	1
31-60	2
>60	3

Time in Minutes	
1-16	1
16-30	2
31-45	3
>45	4

Group C

The questions used in Group C focus on the use of Personal Protective Equipment (PPE) in methamphetamine laboratories. It is assumed once again that all laboratory activity is during an active cook; therefore, failure to don respiratory protection generates the greatest risk of exposure to the officer.

Question 22 was not categorized into ranges for two reasons. This question addressed the number of times an officer had entered a laboratory w/out respiratory protection. While an approximate number, it is likely a better indication of the total number of times in a lifetime that a laboratory was entered. In contrast, the questions in Group B only address the estimated days or time per month that was spent in a laboratory. If an officer has only entered a laboratory twice in one year, it is probable they would have suggested they averaged one time a month because a fraction was not given as an option. Furthermore, failure to don respiratory protection in an active cook generates the greatest amount of risk. For these reasons it was felt this response should be more heavily weighted then any other.

Questions 23, 25, 27, and 29 address the use of PPE while in a laboratory. Officers were able to respond to these questions with a 1-4 ranking describing a percentage of time in which PPE was used. In a worst-case scenario, an active cook, respiratory protection is the greatest measure of protection to the officer; therefore, responses to questions 23 and 25 were given more weight and were used as multipliers. Dermal contact with chemical residuals in and around the lab, as well as traces of contaminants in the air were considered to be of concern but in order for absorption into the body, an officer would have to have oral contact with the exposed body part; hence questions 27 and 29 were included in the output for Group C as additives. The output was determined by adding columns 27 and 29 and multiplying by columns 23, 25, and 22. The resulting equation is:
$C = 22\times[(23\times25)+(27+29)]$ (see Table 5 below). A non response in one of these groups was given a value for least amount of exposure.

Table 5. Group C Equation and conversion equations for frequency of use variable.

Group C
C = 22 x [(23 x 25) + (27 + 29)]

Frequency of PPE Use (columns 23-29)	
4	Rarely (0-25% of the calls)
3	Sometimes (26 - 50% of the
2	Often (51 - 75% of the calls)
1	Usually (more than 75% of the

Group D

The questions in this group focus on laboratory cleanup. Question 33 is a 'yes' or 'no' response indicating whether or not an officer has participated in cleanup with a value of 2 or 1 given respectively; a one contributing no value to the final product with a two doubling risk.

Much like the questions in Group C, questions 34, 35, 37, and 39 address the use of PPE while in a laboratory but in this instance, time spent in the laboratory is during cleanup only. Officers once again were able to respond to these questions with a 1-4 ranking describing a percentage of time in which PPE was used. Typically after an active bust, windows are opened and the contaminated area is well ventilated prior to the commencement of cleanup procedures. Respiratory exposure is no longer as great a threat and the most likely route of exposure is now dermal contact with chemical residuals on surfaces. During cleanup, officers are also much more likely to be handling contaminated materials; therefore, responses to questions 39 and 41 were given more weight in this group's outcome and were used as multipliers while questions 34 and 35 were used as additives. The output then was determined by adding columns 34 and 35 and multiplying by columns 39, 41, and 33 (See Table 6 below).

Table 6. Group D Equation and conversion equations for frequency of use variable.

Group D
D = 33 x [(39 x 41) + (35 + 37)]

Frequency of PPE Use (columns 35-41)	
4	Rarely (0-25% of the calls)
3	Sometimes (26 - 50% of the
2	Often (51 - 75% of the calls)
1	Usually (more than 75% of the

Group E

Questions 45, 47, and 48 indicate the officer's involvement in other types of Hazmat activities. This information is relevant to this assessment in that the officer's contact with other hazardous materials increases their exposure to various hazards.

Each of the questions in this group are 'yes' or 'no' with a value of 2 or 1 assigned respectively. In order to represent these exposures, the numbers in this column are included in the output of the total risk; however, they are added together and only used additively to minimize their weighting. The Group E equation is: E = 45+47+48.

Final Output

The length of time on the job and the estimated time spent busting laboratories were felt to be the most contributory factors assessed. In the final output thence, Group A was multiplied by Group B after which the products of groups C, D, and E were added. Group F was left out of the final output as it was not fitting to use that to take away from the risk of exposure in the attempt to be conservative. It is also unknown the specifics behind the decontamination being administered and its effectiveness. The final output equation for exposure to police officers is:

$(A \times B) + C + D + E$

The approach to assigning exposure categories to workers was analogous to that used to determine Threshold Limit Values (TLVs). I.e., there is an integrated approach that attempts to incorporate average as well as peak exposures.

The above objective and subjective measures of exposure were compiled into one file for each subject by Steven Oostema, the Study Coordinator. There were no personal identifiers, health outcomes data, and no other identifiers at all on the folder. The folder was given to one of the members of the Job Exposure Assessment Team (Drs. Larson, Pahler and Collingwood) in random order. The Team member classified each subject into Low, Medium and High levels of exposure initially based upon a preliminary protocol that was developed after the first five classifications. The files were then returned to the Research Assistant who removed the completed Job Exposure Classification Form, then gave the unmarked folder to one of the two remaining Team members for classification, followed by the third Team member. After the first 5 classifications were completed, the Job Exposure Assessment Team developed a Preliminary Protocol for Classification of Exposures. Then 25 classifications were performed in this exact same manner. After the first 25 classifications were completed, the Job Exposure Assessment Team met to revisit the Preliminary Protocol for Classification of Exposure. The methods to classify, change and finalize the Protocol for Classification of Exposure and the Job Exposure Classification Form were discussed.

After completing these preliminary classifications and finalizing the protocol and forms, the Job Exposure Assessment Team began the classification of all subjects, including those done in the preliminary classifications. The exposure histories of each individual were reviewed separately by each member of the Job Exposures Assessment Team. After categorization, the team members met to resolve problems concerning differences. The team was then given the final categorization of each worker into one of at least 3 occupational exposure categories (low, medium, high). These classifications were accomplished in random order, and blinding to health outcomes status was maintained throughout the study period until ALL classifications were completed.

Inter-Rater Reliability

Classifications by members of the Job Exposure Assessment Team were evaluated to determine inter-rater reliability. As noted above, the teams met after 25 determinations to work out the differences, and inter-rater reliability were measured at that point. It was also assessed at every successive 50 determinations until 200 were reached, and then after every successive 100. Drift was evaluated and the team will met to resolve differences in an effort to maintain inter-rater reliability. Intraclass correlation coefficients were calculated.

Health Outcomes Assessments

Health outcomes assessments were accomplished by the Health Outcomes Assessment Team (Drs. Wood and Edwards) while blinded to exposure status. Health Outcomes were assessed using primarily objective measures.

Objective Measures of Health Outcomes

(1) *Vital Status*. (Self reported by surviving spouse or offspring if appropriate)
(2) Histologically confirmed Carcinomas, especially those of interest. (Utah Cancer Registry)

Subjective Measures of Health Status

(1) *Self-reported diseases and disorders.*
(2) *Habits (Tobacco, exercise and health promotion/disease prevention measures)*
(3) *Perceptions of health status*

We budgeted for the collection of objective health outcomes data. We were well aware that this too would take major amounts of the Research Team's time. We expended that time and those resources. Much of this time was spent obtaining and analyzing information the Utah Cancer Registry, from which we obtained records on histological confirmation of neoplasms.

For neoplastic outcomes, we used only objective data. In cases where we were unable to obtain objective data, including contacting the individual to confirm cancer status, the health outcomes team made a determination of whether to incorporate subjective information to determine health outcomes status.

The above objective and subjective measures of health status were compiled by the Study Coordinator (Mr. Oostema) into one file for each subject. There were no personal identifiers on this folder. There was no exposure information contained in the folder. There were no other identifiers on the folder. The folder was given to one of the members of the Health Outcomes Assessment Team (Drs. Wood or Edwards) in random order. The Team member classified each subject into having a cancer versus not having had a cancer, and if so, what the histological type was (See Classification Form in the Appendices).

EXAMPLES of CASE DEFINITIONS (emphases below on 2SHB009)
(note that these are aggregate categories from 2SHB009)

Respiratory Cancers: Histologically confirmed cancer of the lung and bronchus. Includes ICD-9 classifications 165.0-165.9; 231.1,231.2.

Brain Cancer: Histologically confirmed cancer of the brain. Includes ICD-9 classifications 191.0-191.9.

Gastrointestinal Cancers: Histologically confirmed cancer of the esophagus 150.0-150.9, stomach 151.0-151.9, small intestine 152.0-152.9, large intestine, pancreas 157.0-157.9 and hepatobiliary system 155.1. Includes ICD-9 classifications for esophageal cancer.

Melanoma: Histologically confirmed melanoma. Includes ICD-9 classifications 172.0-172.9;

Kidney Cancer: Histologically confirmed cancer of the kidney. Includes ICD-9 classifications 223.0-223.9; 189.0-189.9.

Bladder Cancer: Histologically confirmed cancer of the bladder. Includes ICD-9 classifications 188.0-188.9.

Leukemias Cancer, excluding non-Hodgkin's: Histologically confirmed cancer of the lung and bronchus. Includes ICD-9 classifications 204.0-204.9; 205.0-205.9; 206.0-206.9; 207.0-207.9; 208.0-208.9.

Lymphomas Cancer: Histologically confirmed cancer of the lymphatic system. Includes ICD-9 classifications 200.0-200.2,200.8; 201.0-201.9; 202.0-202.9.

Multiple myeloma Cancer: Histologically confirmed cancer of the bone marrow involving these specific cells. Includes ICD-9 classifications 203.0,203.1.

Other Cancers: We collected information on all histologically confirmed neoplasias and utilized the ICD-9 classification system for purposes of categorizations.

In circumstances in which workers (or surrogates) reported a cancer but there were no Utah Cancer Registry data, the worker was contacted. In nearly all cases, the worker reported they had had a skin cancer that is not captured by the cancer registry (i.e., basal cell carcinoma or squamous cell carcinoma). In a few cases, it was determined the wrong data had been obtained from the Cancer Registry, generally due to lack of a complete Social Security Number combined with an identical common name (e.g., John Smith). Thus, the entire dataset of cancers was carefully compiled.

After completing these preliminary classifications and finalizing the protocol and forms, the Health Outcomes Assessment Team began the classifications of all subjects, including those done in the preliminary classifications. There were no differences between reported cancer classification and Utah Cancer Registry classifications. The team then gave the final categorization of each worker into one of several categories (no history of cancer, history of cancer with specific histological type of cancer). These classifications were accomplished in random order, and blinding to exposure status was maintained throughout the study period until, ALL the classifications were completed.

Deceased Subjects

Classifications of disease status for any cohort member who are deceased were based upon Utah Cancer Registry data for histological typing. We also contacted surviving surrogates (usually spouse) to administer those aspects of the Questionnaire that they are likely to be able to recall (e.g., tobacco, approximate years of service).

Statistical Analyses

The primary statistical analyses were comparisons of those with high and medium exposures to Methamphetamines or Combustion Products to those with low levels of exposure. We also made age adjusted comparisons with data for the entire population of the State of Utah.

There are two main statistical analyses: (1) cumulative incidence risk estimates for the retrospective cohort, and (2) standardized incidence rates.

We calculated cancer cumulative incidence rates and risk estimates for this retrospective cohort. We then calculated incidence rates through retrospective cohort techniques after assembling the cohorts. Multivariate logistic regression models were used to explore relationships between exposures to Methamphetamines or combustion products/smoke and the development of morbidity and mortality.

Key statistical analyses in this study included: **1) Evaluation of cancer-specific morbidity risks (e.g., all cancers noted in 2SHB0009, such as lung cancer, esophageal cancer, etc); 2) Evaluation of all cancers in aggregate.**

1. The unit of analysis in this study was individuals. Nearly all the major health outcomes of interest in this study, such as specific types of cancer or vital status, were binomial variables and were analyzed using logistic regression models.

2. Due to the limited number of responses, risk factors included in the model were exposure quantification and age. In addition to age many other non-occupational risk factors were analyzed, including past medical history, alcohol use, tobacco use, and psychosocial factors, but were not statistically significantly associated with cancers and therefore were not included in multivariate modeling.

3. Comparisons between predictor variables (including workplace records such as numbers of events responded to) and health outcomes were initially evaluated using univariate methods. Variables with meaningful evidence of association to the health outcomes (exhibiting at least a trend of association, around the magnitude $p < 0.10$) were included in multivariate models. Final multivariate models were evaluated for their ability to categorize the jobs in this study into three categories of hazard potential (low, medium, and high).

4. Based on the multivariate modeling, we determined the relative contributions of the predictor variables in explaining variance in the health outcomes.

INCIDENCE (MORTALITY) RATES

Due to the low response rate, mortality and incidence rates were not fully assessed. Our primary analyses were to evaluate cause-specific mortality rates, however there were very too few cases to create any estimates. Therefore, only incidence rates of cancers are reported. For binary or ordinal outcomes such as occurrence of a type of cancer, analyses consisted logistic regression modeling to generate risk estimates and corresponding 95% confidence intervals as well as Poisson regression using the generalized linear equations. Poisson regression is particularly useful for highly skewed data, such as cancer counts.

DROPOUTS AND MISSING DATA

While our initial sample size calculations assumed that an estimated 14% of subjects would be unobtainable and not used in the analysis, we tried to make use of all available information collected in the study, including data from 'dropouts.' The major statistical approaches we planned to use included survival analysis, mixed models, and generalized estimating equations (GEE). These all facilitated the use of available data in subjects whose status became unknown at some point ("drop outs"). The key issue was whether such analyses using all available study data would produce conclusions that were valid.

For assessing the appropriateness of analysis approaches, we evaluated whether dropout was independent of study outcome ("data missing completely at random, MCAR", Rubin 1976). If the MCAR assumption was tenable, then analyses making use of available data would generally produce valid inferences. Survival analysis methods facilitated the use of available follow-up data in subjects who dropped out of the study, under the assumption of noninformative censoring.

Due to the low response rate, we determined that we did not have significant power to attempt survival analyses, mixed models, or generalized estimating equations. Similarly, we believe that due to the low response rate the MCAR assumption is not valid.

STATISTICAL POWER / SAMPLE SIZES

This study included two retrospective cohort studies which were assessed the effects of levels of various work exposures on mortality. The total potential study population for each of the studies (fire and police) was greater than provided by prior educated guesses of others (i.e., labor, municipalities, insurers) of the eligible population, thus the potential statistical power of these studies would have been greater than originally estimated. However, this benefit was more than overcome by low participation rates that were experienced in both groups of workers and were unable to be overcome. Thus, the overall statistical power of the study was consequently reduced from that originally planned.

We had previously conservatively estimated that, despite incepting the cohort in 1980, there would be only approximately 15 years of follow-up per subject with approximately 1% annual dropout for relatively rare events of individuals leaving these reasonably well remunerated careers for other careers. Our power analyses, which used an alpha level of 0.05, assumed a uniform hazard rate throughout the study period. We were quite conservative in our estimates as we planned on substantially more follow-up data than 15 years, as the study went backwards 26 years in time. Power analyses shown below were performed using Egret SIZ (1997).

There were no prior methods for relating exposures to methamphetamine or combustion products and various disease states, including cancer. As there were no prior estimates or known estimates of effect for these relationships, we had provided several strata of relative risk (2.0, 4.0 and 6.0) for these relationships for follow up durations of 15 and 25 years. Power and Sample Size calculations were based on 1) Mortality Rates for all malignant neoplasms and selected individual malignant neoplasms (data from IBIS-PH for 2004, accessed 12 June 2006 at http://ibis.health.utah.gov/home/welcome.html) and 2) Incidence Rates for all cancers and selected individual cancers (data from IBIS-PH and Utah Cancer Registry for 2003, accessed 12 June 2006 at http://ibis.health.utah.gov/home/welcome.html). Table 6 shows the age adjusted mortality rates for various cancers by county for 2004, and Table 7 gives the sample size necessary to achieve 80% power for mortality from various cancers. Tables 8 and 9 show the sample size necessary to achieve 80% power for selected incidence of cancer for 15 and 25 years of follow up, respectively. It can be seen that even at the more conservative estimates of a 2 fold increase in risk and 15 years of follow up data, it was estimated to be likely that we would achieve significant power to detect differences for a broad range of cancer incidence, and likely achieve power to detect a difference in some neoplasm mortality outcome.

Table 6. Mortality Rates per 100,000 for Cancers in the Salt Lake, Davis, Utah and Weber Counties					
Causes of Death	**Davis**	**Salt Lake**	**Utah**	**Weber**	**Total**
Malignant neoplasm of esophagus	8.78	9.22	8.39	**	**
Malignant neoplasm of stomach	**	3.93	**	6.78	3.75
Malignant neoplasms of colon, rectum and anus	20.2	12.92	14.73	20	15.12
Malignant neoplasms of liver and intrahepatic bile ducts	**	4.84	**	**	4.04
Malignant neoplasm of pancreas	7.26	13.34	13.99	10.52	12.13
Malignant neoplasm of larynx	**	1.69		**	1.22
Malignant neoplasms of trachea, bronchus and lung	24.46	32.55	28.91	56.01	34.06
Malignant neoplasms of kidney and renal pelvis	**	4.25	**	**	3.95
Malignant neoplasm of bladder	6.4	6.62	7.52	7.1	6.88
Malignant neoplasms of brain and central nervous system	12.64	4.14	5.02	6.72	5.78
***The count or rate in certain cells of the table has been suppressed either because 1) the observed number of events is very small and not appropriate for publication, or 2) it could be used to calculate the number in a cell that has been suppressed.*					

Table 7. Sample Size Necessary to Achieve 80.0% Power for 15 Years of Follow Up for Mortality				
	Mortality Rate*	**Relative Risk=2.0**	**Relative Risk=4.0**	**Relative Risk=6.0**
All Neoplasms	169.94	2718	799	544
Lung and Bronchus Cancer	34.06	13563	3985	2714
Pancreatic Cancer	12.13	38083	11190	7620
Stomach Cancer	3.75	123185	36195	24649
* Age Adjusted Mortality Rate for Davis, Salt Lake, Utah and Weber Counties for 2004, per 100,000				

Table 8. Sample Size Necessary to Achieve 80.0% Power for 15 Years of Follow Up for Incidence				
Health Outcome	**Incidence Rate***	**Relative Risk=2.0**	**Relative Risk=4.0**	**Relative Risk=6.0**
All Cancers	515.86	597	105	51
Lung and Bronchus Cancer	42.42	7260	1280	623
Pancreatic Cancer	14.90	20669	3644	1772
Stomach Cancer	10.58	29108	5132	2496
Brain Cancer	7.15	43072	7593	3694
Oral Cavity and Pharynx Cancer	11.31	27229	4800	2335
Esophagus	4.62	66658	11752	5716
Colon	37.93	8119	1431	696
Bladder	36.71	8389	1479	719
*** Incidence for Males From Utah Cancer Registry 2003 for Salt Lake County, per 100,000**				

Table 9. Sample Size Necessary to Achieve 80.0% Power for 25 Years of Follow Up for Incidence				
Health Outcome	**Incidence Rate***	**Relative Risk=2.0**	**Relative Risk=4.0**	**Relative Risk=6.0**
All Cancers	515.86	358	63	31
Lung and Bronchus Cancer	42.42	4356	768	374
Pancreatic Cancer	14.90	12401	2186	1063
Stomach Cancer	10.58	17465	3079	1498
Brain Cancer	7.15	25843	4556	2216
Oral Cavity and Pharynx Cancer	11.31	16338	2880	1401
Esophagus	4.62	39995	7051	3430
Colon	37.93	4872	859	418
Bladder	36.71	5033	887	432
*** Incidence for Males From Utah Cancer Registry 2003 for Salt Lake County, per 100,000**				

Comparing low and high exposure categories, we estimated we would achieve significant power with the estimated 5000 participants for nearly all of the cancer incidence at a relative risk of 4 or greater and 25 years of follow up. The only exception was esophageal cancer, as it had such a low incidence rate in the Salt Lake County population. Findings appeared similarly strong for only 15 years of data. We estimated that we would not have sufficient power to detect effects between low and high exposure groups if there was less than a 2.0 increase in risk however, more refined exposure categorization findings could still be significant. For cancer mortality it appeared likely that we would be able to detect a difference between aggregate neoplasm mortality or mortality from lung and bronchus cancer.

Innovations

This research project incorporated the following innovations:

1. A state-wide retrospective cohort study of all professional police officers and firefighters with careful assessments of both exposures and diseases.

2. Completely separate Job Exposure Assessment and Health Outcomes Teams

3. Blinding of both the Health Outcomes and Job Exposure Assessment Teams, which to our knowledge had not been performed in the prior published scientific literature.

4. The extensive use of computerization to markedly improve quality of data collection.

5. Web-based questionnaire administrations

6. Telephone interviews with subjects desiring to not use computers

7. Method to account for varying levels of exposures.

8. Reliance on objective measures for exposures where available.

9. Potential to incorporate data from all available data sources, including prior exposure assessments as part of this research project.

Participant Recruitment Strategies

We had originally hypothesized that this study would be unlikely to have major problems with recruitments due to the substantial press and attention that these workers have received. However, we were incorrect in that assumption. We found low participation rates and worked diligently to rectify that problem from the first moment it was recognized. It is noteworthy that much time and attention was spent on that problem, which had been a priori unanticipated.
All of the following were utilized to attempt to encourage enrollments (we have maintained substantial documentation on much of this information):

- Contacts with police officer and firefighter chiefs
- Encouragement of police officer chiefs and firefighter chiefs to utilize email lists for encouragement
- Telephone calls to and from interested officers
- Phone calls to local and state elected representatives
- Letters and emails to local and state elected representatives
- Drafting letters for elected Utah State Senators to forward to encourage participation of municipalities
- Discussions with workers we encountered
- Press releases
- Press interviews

- Attending labor meetings
- Interviews with writers for labor periodicals
- Meetings with the Firefighters and Police Officers Health Study Advisory Committee

The above were used, typically multiple times, until interest appeared exhausted.

Inclusion/Exclusion Criteria

As this was a retrospective cohort study, we included all eligible workers, including retirees, in this study's sample, regardless of age, gender, race, ethnicity or religious preference. The exception was if they are unable to give informed consent, in which case the spouse or closest relative was used as the surrogate for the questionnaire.

Quality Control (QC) & Quality Assurance (QA) (Szklo & Nieto 2000)

Several key procedures were used for quality control and quality assurance including: 1) Blinding of both Job Exposure Assessment and Health Outcomes Assessment Teams, 2) Inter-rater reliability for exposure assessments, 3) Inter-rater reliability for Health Outcomes Assessments, and 4) Use of Pre-pilot testing and field pilot testing of questionnaires prior to finalization and implementation. Additionally, the following are utilized: 5) Policy and Procedure manuals (for Exposure Assessments and Health Outcomes Assessments), 6) Utilization of computerized questionnaires to control data entry with allowable fields, and/or required fields, 7) web-based administrations, 8) trained interviewers for those who did not desire completing a computerized questionnaire, and 9) Frequent separate meetings for each team as well as overall study meetings of Drs. Hegmann, Larson and Sheng to ascertain progress, consistency of procedures in the field and addressing questions/issues.

We routinely checked 10% of all hand entered data. We checked 100% of all diagnostic codes entered. We have experience with hand entered data and our recent cohort study data have documented error rates of only 0.07%.

Participants Notification of Study Results

We notified all participants of the results of these studies through at least 2 mechanisms. We reported the progress on a more than quarterly basis (quarterly progress reports plus emails, telephone calls and verbal reports). We have offered to present the findings to a meeting of the Labor Commission's Workers Compensation Advisory Council, as per the requirements of 2SHB0009. We will also be posting the final study report document on the Rocky Mountain Center for Occupational and Environmental Health website after the above presentation are completed. We worked with the Study Advisory Committee. We continue to welcome the opportunity to present the results in group settings, e.g., union meetings, municipalities risk managers, etc. Only aggregate study results, not information with individual identifiers, have been or will be communicated.

Also, while not the direct purpose of this research project, to the extent possible, we have used our faculty's expertise to identify and recommend preventive means.

Management

Kurt T. Hegmann served as PI and coordinated the study. He coordinated the Health Outcomes Assessment Team. Rod Larson, PhD, CIH served as co-PI and was responsible for coordinating all Exposure Assessments. Matthew S. Thiese, PhD coordinated all aspects of statistical analyses, including the work of the Statistical Analyses Team.

Results

Demographics

This study consists of four separate groups of people who responded to the online questionnaire. These groups are firefighters, police officers, spouses of firefighters and spouses of police officers. The two groups consisting of spouses answered a smaller set of questions and the demographic information given in these two groups in based on their spouse who was a firefighter or police officer, but is now deceased or otherwise unable to answer the questionnaire. The following descriptions and tables contain the demographic data for these 4 groups individually, and combined by occupation.

Firefighters

A summary of demographic data for the police officers enrolled in this study is shown below in Table 10. There were 583 firefighters who started the online questionnaire (559 completed the questionnaires, and data analysis was completed on 541). Graphs of these data are in Appendix D (graphs 1-9). There were five individuals who called in and provided information, including social security number, but never completed the questionnaire.

Gender

Of the 541 firefighters whose data were analyzed, 526 (97.23 %) were males and 15 (2.77%) were females. A pie chart illustrating the distribution of firefighters by gender is found in Appendix D, Graph 1.

Age

The mean age was 43.53 years old with a standard deviation of 11.47 years. A distribution of the ages by age category can be found in Appendix D, Graph 2.

BMI

The body mass index (BMI), which is defined as 1 kilogram/meter squared (kg/m^2), was determined by utilizing self reported height and weight from the questionnaire. The mean BMI for firefighters was 28.45 kg/m^2 with a standard deviation of 4.49 kg/m^2. Over ¾ of the respondents were categorized as overweight or obese (BMI $\geq$ 30.0 kg/m^2). Approximately 20% (n = 111) respondents were classified as normal weight. There was 1 (0.18%) underweight firefighter and 5 (0.92%) missing responses. A graphical representation of the percent distribution of BMI for the firefighters is found in Appendix D, Graph 3.

Race / Ethnicity

Over 73% of the respondents classified themselves as white (Caucasian). Ten (1.82%) firefighters classified themselves as Hispanic, 4 (0.73%) as African American, 2 (0.36%) as Pacific Islander or Native Hawaiian, and 18 (3.28%) as other. It should be noted, however, that 111 (20.52%) of those who started the questionnaire, opted to not answer this question. A pie chart illustrating the distribution of firefighters by race / ethnicity is found in Appendix D, Graph 4.

Level of Education

Over 90% of the firefighters who answered the questionnaire have been to college (some college or a college graduate), with 125 (23.11%) of those earning a bachelors degree or higher. Forty-seven (8.69%) have a high school diploma or general education diploma, only. One (0.18%) respondent listed having only some high school education. There were 4 (0.74%) firefighters who did not respond to this question. A graphical representation of the percent distribution of level of education for the firefighters is found in Appendix D, Graph 5.

Marital Status

More than 85% (n = 462) of firefighters were married. Approximately 7% (n = 40) were divorced and 28 (5.18%) listed single to round out the three highest marital status categories. Of the remaining 11 participants, 5 (0.92%) were separated, 1 (0.18%) was widowed, and 5 (0.92%) were missing data for this demographic variable. A graphical representation of the percent distribution of marital status for the firefighters is found in Appendix D, Graph 6.

Current Smoking Status

Almost 99% (n = 535) of the firefighters are currently non-smokers, with 371 (68.58%) having never smoked. There were 21 (3.88%) current smokers. There were 5 (0.92%) respondents who did not answer this demographic question. See Appendix D, Graph 7 for a graphical representation of the percent distribution of current smoking status for firefighters.

Chewing or Smokeless Tobacco

Of the 541 respondents, 414 (76.52%) have never used smokeless tobacco and an additional 94 (17.38%) no longer use smokeless tobacco. There were 28 (5.18%) firefighters who listed that they were current users of smokeless tobacco. Five (0.92%) respondents did not answer this demographic question. See Appendix D, Graph 8 for a graphical representation of the percent distribution of smokeless tobacco users for firefighters.

Alcohol Use

There were 186 (34.38%) firefighters who have never used alcohol. Eighty-nine (16.45%) respondents listed having consumed alcohol in the past, but have since ceased consuming alcohol. Just under 50% (n = 261) of firefighters consume alcohol. Five (0.92%) respondents did not answer this demographic question. See Appendix D, Graph 9 for a graphical representation of the percent distribution of firefighters who drink alcohol.

Missing Answers

Missing answers accounted for less than 1% of the percent distribution for a given demographic question, except for race / ethnicity, which had over 20% of the answers missing. Appendix D contains graphs for the demographic variables listed in Table 1.

Table 10. Demographic Summary for Firefighters

Variable	**Firefighter (N=541)**	
	Mean	**Standard Deviation**
Age (years)*	**43.53**	**11.47**
BMI (kg/m^2)†	**28.45**	**4.49**
Variable	**N**	**Percent**
Gender		
Male	526	97.23
Female	15	2.77
Total	**541**	**100**
BMI (kg/m^2) by Category		
Underweight	1	0.18
Normal Weight	111	20.52
Overweight	263	48.61
Obese	161	29.76
Missing	5	0.92
Total	**541**	**100**
Race		
White	396	73.20
Hispanic	4	0.74
Black	10	1.85
Pacific Islander or Native Hawaiian	0	0.00
Asian	2	0.37
Other	18	3.33
Missing	111	20.51
Total	**541**	**100**

Table 10 cont.

Variable	N	Percent
Marital Status		
Never Married	28	5.18
Married	462	85.40
Separated	5	0.92
Divorced	40	7.39
Widowed	1	0.19
Missing	5	0.92
Total	**541**	**100**
Highest Grade in School		
Some high school	1	9.82
High school graduate	47	8.69
Some college	364	67.28
College graduate (Bachelor's degree or higher)	125	23.11
Missing	4	0.74
Total	**541**	**100**
Smoking Status		
Never	371	68.58
Yes, but I quit	144	26.62
Yes, currently	21	3.88
Missing	5	9.82
Total	**541**	**100**
Chewing or Smokeless Tobacco Use		
Never	414	76.52
Yes, but I quit	94	17.38
Yes, currently	28	5.18
Missing	5	0.92
Total	**541**	**100**
Alcohol		
Never	186	34.38
I used to, but I quit	89	16.45
Yes	261	48.24
Missing	5	0.92
Total	**541**	**100**

* Based on n = 541 participants

† Based on n = 536 participants

Police Officers

A summary of demographic data for the police officers enrolled in this study is shown below in Table 11. There were 540 police officers who started the online questionnaire (481 completed the online questionnaire). Graphs of these data can be found in Appendix D, Graphs 10-18.

Gender

Of the 540 police officers who started the online questionnaire, 507 (93. 9%) were males and 33 (6.1%) were females. A pie chart illustrating the distribution of police officers by gender is found in Appendix D, Graph 10.

Age

The mean age was 47.64 years old with a standard deviation of 10.48 years. A distribution of the ages by age category can be found in Appendix D, Graph 11.

BMI

The mean BMI for police officers was 29.20 kg/m^2 with a standard deviation of 4.57 kg/m^2. More than ¾ of the respondents were categorized as overweight or obese. Fifteen percent (n = 81) of police officers were identified as normal weight base on their self reported height and weight. A graphical representation of the percent distribution of BMI for the police officers is found in Appendix D, Graph 12.

Race / Ethnicity

Eighty-five percent (n = 459) of the police officers classified themselves as white (Caucasian). Four (0.74%) officers identified themselves as Asian, 8 (1.48%) as Hispanic, 1 (0.19%) each as Black and as Pacific Islander / Native Hawaiian, and 12 (2.22%) as Other. More than 10% (n = 55) of the officers declined to provide their Race / Ethnicity. A pie chart of the percent distribution of race / ethnicity for the police officers is found in Appendix D, Graph 13.

Marital Status

There were 384 (71.11%) police officers who identified themselves as married. Three (0.56%) were separated, 33 (6.11%) were divorced, and 2 (0.37%) were widowed. There were 64 (11.85%) police officers who identified themselves as single. Ten percent (n = 54) of the officers did not respond to the question on marital status. See Appendix D, Graph 14, for a graphical representation of the percent distribution of marital status for the police officers.

Level of Education

Over 72% (n = 392) of police officers have had at least some college, with just under 1/3 (n = 176) of officers having obtained a college degree. Approximately 10% (53) did not graduate high school or receive a general education diploma. Forty-three (7.96%) claim have a high school or general education diploma. See Appendix D, Graph 15, for a graphical representation of the percent distribution of smoking status for the police officers.

Current Smoking Status

Approximately 86% (n = 463) of police officers were currently reported as non-smokers, of which 338 (62.59%) of the police officers have never smoked. There were 24 (4.44%) current smokers. Fifty-three (9.82%) officers did not give an answer for current smoking status. See Appendix D, Graph 16, for a graphical representation of the percent distribution of smoking status for the police officers.

Current Use of Smokeless Tobacco

At the time of taking the questionnaire, 395 (73.15%) of officers have never used smokeless tobacco. An additional 73 (13.52%) had at one time, but quit prior to taking the questionnaire. Eighteen (3.33%) were current smokeless tobacco users. Fifty-four officers (10%) did not answer this demographic question. A distribution of the use of smokeless tobacco by officers can be found in Appendix D, Graph 17.

Current Alcohol Use

Over 39% (n = 211) of the officers reported having never used alcohol. Ninety-seven (17.96%) previously used alcohol, but reported having quit. Approximately 1/3 (n = 177) of the officers were current consumers of alcohol. Graph 18, in Appendix D, illustrates the distribution of police officers by their current use of alcohol.

Missing Data

Missing answers accounted for approximately between 9% and 10% of the distribution for a given demographic question. Race had the largest percentage (10.19%) of missing answers for officers, with a total of 55 officers leaving this question empty.

Table 11. Demographic Summary for Police Officers.

Variable	**Police Officer N = 540**	
	Mean	**Std Dev**
Age (years)*	**47.64**	**10.48**
BMI (kg/m^2)†	**29.20**	**4.57**
Variable	**N**	**Percent**
Gender		
Male	507	93.89
Female	33	6.11
Total	**540**	**100**

Table 11 cont.

Variable	N	Percent
BMI (kg/m^2) by Category		
Underweight	0	0.00
Normal Weight	81	15.00
Overweight	226	41.85
Obese	180	33.33
Missing	53	9.82
Total	**540**	**100**
Race		
White	459	85.00
Black	1	0.19
Hispanic	8	1.48
Asian	4	0.74
Pacific Islander / Native Hawaiian	1	0.19
Other	12	2.22
Missing	55	10.18
Total	**540**	**100**
Marital Status		
Never Married	64	11.85
Married	384	71.11
Separated	3	0.56
Divorced	33	6.11
Widowed	2	0.37
Missing	54	10.00
Total	**540**	**100**
Highest Grade in School		
Some high school	53	9.82
High school graduate	43	7.96
Some college	216	40.00
College graduate (Bachelor's degree or higher)	176	32.59
Missing	52	9.63
Total	**540**	**100**

Table 11 continued.

Variable	N	Percent
Smoking Status		
Never	338	62.59
Yes, but I quit	125	23.15
Yes, currently	24	4.44
Missing	53	9.82
Total	**540**	**100**
Chewing or Smokeless Tobacco Use		
Never	395	73.15
Yes, but I quit	73	13.52
Yes, currently	18	3.33
Missing	54	10.00
Total	**540**	**100**
Alcohol		
Never	211	39.07
Yes, but I quit	97	17.96
Yes, currently	177	32.78
Missing	55	10.19
Total	**540**	**100**

* Based on n = 535 participants

† Based on n = 487 participants

Firefighters by Proxy

The following demographic Data are for those firefighters who were enrolled in this study by a surrogate or proxy (typically the surviving spouse of the deceased firefighter), and is summarized in Table 12. All summary information refers to the deceased firefighter and not to the surrogate who entered the data. Appendix D, Graphs 19-23.

Gender

Of the 8 firefighters entered by surrogate, all were males.

Age

The mean age at time of death 66.50 years old with a standard deviation of 13.59 years. Two (25%) subjects were missing from the age variable.

BMI

The mean BMI was 28.94 kg/m^2 with a standard deviation of 5.46 kg/m^2. Three (37.50%) subjects were missing the required information needed to compute BMI. A graphical representation of the percent distribution of BMI for the firefighters is found in Appendix D, Graph 19.

Race / Ethnicity

All 5 (62.50%) subjects reporting a race / ethnicity chose white (Caucasian). Three (37.50%) respondents did not choose a race or ethnicity.

Level of Education

Three (37.50%) respondents reported the highest level of education obtained was some high school. Two (25.00%) firefighters were reported as having had some college. Three (37.50%) respondents did not answer this demographic question. A graphical representation of the percent distribution of Level of Education for these firefighters is found in Appendix D, Graph 20.

Smoking Status at Time of Death

Of the 8 firefighters enrolled by proxy, 5 (62.50%) were non-smokers at the time of death. Three (37.50%) had never smoked. No firefighters were smokers at the time of their death. Three (37.50%) of the subjects were missing data for this demographic variable. See Appendix D, Graph 21 for a graphical representation of smoking status prior to death for firefighters enrolled by proxy.

Chewing or Smokeless Tobacco

Of the 8 firefighters enrolled by proxy, 5 (62.50%) were not users of smokeless tobacco at the time of death. Four (50.00%) had never used smokeless tobacco. No firefighters were users of smokeless tobacco at the time of their death. Three (37.50%) of the subjects were missing data for this demographic variable. See Appendix D, Graph 22 for a graphical representation of the percent distribution of smokeless tobacco use prior to death for firefighters enrolled by proxy.

Alcohol Use

Three (37.50%) firefighters were reported as having never consumed alcohol prior to death. Two (25.00%) firefighters were reported as current consumers. Three (37.50%) respondents were missing data for this demographic variable. A graphical representation of the percent distribution of BMI for the firefighters is found in Appendix D, Graph 23.

Missing Data

A substantial amount of data were missing for 3 (37.50%) of the firefighters enrolled by surrogates. As such, race, level of education, smoking status at time of death, alcohol use, and use of smokeless tobacco only have data for 5 (62.5%) participants.

Table 12. Demographic Variables for Firefighters Enrolled by a Surrogate

Variable	**Firefighter by Proxy (N=8)**	
	Mean	**Std Dev**
Age (years)*	**66.50**	**13.59**
BMI (kg/m^2)†	**28.94**	**5.46**
Variable	**N**	**Percent**
Gender		
Male	8	100
Female	0	0
Total	**8**	**100**
BMI (kg/m^2) by Category		
Underweight	0	0.00
Normal Weight	1	12.50
Overweight	3	37.50
Obese	1	12.50
Missing	3	37.50
Total	**8**	**100**
Race		
White	5	62.50
Hispanic	0	0.00
Black	0	0.00
Pacific Islander or Native Hawaiian	0	0.00
Asian	0	0.00
Other	0	0.00
Missing	3	37.50
Total	**8**	**100**
Highest Grade in School		
Some high school	3	37.50
High school graduate	0	0.00
Some college	2	25.00
College graduate (Bachelor's degree or higher)	0	0.00
Missing	3	37.50
Total	**8**	**100**

Table 12 cont.

Variable	N	Percent
Smoking Status		
Never	3	37.50
Yes, but I quit	2	25.00
Yes, at time of death	0	0.00
Missing	3	37.50
Total	**8**	**100**
Chewing or Smokeless Tobacco Use		
Never	4	50.00
Yes, but I quit	1	12.50
Yes, at time of death	0	0.00
Missing	3	37.50
Total	**8**	**100**
Alcohol		
Never	3	37.50
He used to, but he quit prior to death	0	0.00
Yes	2	25.00
Missing	3	37.50
Total	**8**	**100**

* Based on n = 6 participants

† Based on n = 5 participants

Police Officers by Proxy

There were 13 police officers who were enrolled in this study by a surrogate or proxy. The demographic data for these officers is summarized in Table 13. All summary information refers to the police officer and not to the surrogate who entered the data. Appendix D, Graphs 24-29.

Age

The mean age for the police officer surrogate data were 58.92 years old with a standard deviation of 16.23 years. We were unable to collect the age for 1 (7.69%) participant.

Gender

Of the 13 police officers entered by surrogate, all were males.

BMI

The mean BMI was 29.23 kg/m^2 with a standard deviation of 3.64 kg/m^2. Of the 13 police officers enrolled by surrogates, more than 2/3 (n = 9) were classified as overweight or obese. Two (15.35%) officers were classified as normal weight, when they passed away. Two (15.38%) subjects were missing the required information needed to compute BMI. A graphical representation of the percent distribution of BMI for these police officers is found in Appendix D, Graph 24.

Race / Ethnicity

Eleven of 13 (84.62%) police officers in this demographic data set were white (Caucasian). The only other know ethnicity was Hispanic, which had 1 (7.69%) individual. One (7.69%) participant was missing data for the race/ethnicity demographic. A graphical representation of the percent distribution of race / ethnicity for these police officers is found in Appendix D, Graph 25.

Marital Status

All 13 police officers in this category were married at time of death.

Level of Education

Eight (61.54%) of police officers enrolled by proxy have had at least some college, 3 (23.08%) of which obtained a college degree prior to death. Three (23.08%) did not graduate high school or receive a general education diploma. One (7.69%) had a high school or general education diploma listed as the highest level of education. One (7.69%) participant was missing from this demographic variable. A graphical representation of the percent distribution of highest level of education for these police officers is found in Appendix D, Graph 26.

Smoking Status

Of the 13 police officers enrolled by proxy, 12 (92.31%) were non-smokers at the time of death. Eleven (84.62%) had never smoked. No police officers were smokers at the time of their death. One (7.69%) of the subjects was missing data for this demographic variable. A graphical representation of the percent distribution of the smoking status prior to death for these police officers is found in Appendix D, Graph 27.

Smokeless Tobacco

There were 11 (84.62%) officers who had never used smokeless (chewing) tobacco. An additional 1 (7.69%) stopped using smokeless tobacco prior to his death. No police officers currently used smokeless tobacco at the time of their death. One (7.69%) of the participants was missing data for this demographic variable. A graphical representation of the percent distribution of the use of smokeless tobacco prior to death for these police officers is found in Appendix D, Graph 28.

Alcohol

More than 75% (n = 10) of the police officers enrolled by a surrogate were not current consumers of alcohol when they died. Of the 13 police officers enrolled, 8 (61.54%) had never used alcohol and 2 (15.38%) used to, but no longer drank alcohol. Two (15.38%) of all police officers were current consumers of alcohol prior to passing away. One (7.69%) of the participants was missing data for this demographic variable. A graphical representation of the percent distribution of the use of alcohol prior to death for these participants is found in Appendix D, Graph 29.

Table 13. Demographic Variables for Police Officers Enrolled by a Surrogate

Variable	**Police Officers by Proxy (N=13)**	
	Mean	**Std Dev**
Age (years)*	**58.92**	**16.23**
BMI (kg/m^2)†	**29.23**	**3.64**
Variable	**N**	**Percent**
Gender		
Male	13	100
Female	0	0
Total	**13**	**100**
BMI (kg/m^2) by Category		
Underweight	0	0.00
Normal Weight	2	15.38
Overweight	5	38.47
Obese	4	30.77
Missing	2	15.38
Total	**13**	**100**
Race		
White	11	84.62
Black	0	0.00
Hispanic	1	7.69
Asian	0	0.00
Pacific Islander / Native Hawaiian	0	0.00
Other	0	0.00
Missing	1	7.69
Total	**13**	**100**
Marital Status		
Never Married	0	0.00
Married	13	100.00
Separated	0	0.00
Divorced	0	0.00
Widowed	0	0.00
Missing	0	0.00
Total	**13**	**100**

Table 13 cont.

Variable	N	Percent
Level of Education		
Some high school	3	23.08
High school graduate	1	7.69
Some college	5	38.46
College graduate (Bachelor's degree or higher)	3	23.08
Missing	1	7.69
Total	**13**	**100**
Smoking Status		
Never	11	84.62
Yes, but quit before passing away	1	7.69
Yes, current user at time of death	0	0.00
Missing	1	7.69
Total	**13**	**100**
Chewing or Smokeless Tobacco Use		
Never	11	84.62
Yes, but quit before passing away	1	7.69
Yes, current user at time of death	0	0.00
Missing	1	7.69
Total	**13**	**100**
Alcohol Use		
Never	8	61.54
Yes, but quit before passing away	2	15.38
Yes, current user at time of death	2	15.38
Missing	1	7.70
Total	**13**	**100**

* Based on n = 12.
† Based on n = 11.

Combined Firefighters and Firefighters by Proxy

The total number of firefighters participating in this study, via self-report or by proxy, was 549. The demographic data for the combined total of all firefighters participating in this study are summarized in Table 14. All summary information gained from proxy reports refers to the firefighter and not to the surrogate who entered the data. Graphs of these data can be found in Appendix D, Graphs 30-38.

Age

The mean age for the firefighters (age at time of death for surrogate data) was 43.78 years old with a standard deviation of 11.73 years. We were unable to collect the age for 2 (0.36%) participants. A distribution of the ages by age category can be found in Appendix D, Graph 30.

Gender

Of the 549 firefighters, 534 (97.27%) were males and 15 were females (2.73%). A pie chart illustrating the distribution of all firefighters by gender is found in Appendix D, Graph 31.

BMI

The mean BMI was 28.45 kg/m^2 with a standard deviation of 4.49 kg/m^2. Over 75% of firefighters in this study are overweight or obese using BMI as the measure of overweight. Approximately 20% (n = 112) of firefighters were classified in the normal weight category for BMI. Eight (1.46%) participants were missing the required information needed to compute BMI. A graphical representation of the percent distribution of BMI for this combined set of Data are found in Appendix D, Graph 32.

Race / Ethnicity

Approximately 73% (n = 401) of the firefighters classified themselves as white (Caucasian). Ten (1.63%) firefighters classified themselves as Hispanic, 4 (0.73%) as Black, 2 (0.36) Pacific Islander / Native Hawaiian However, 0 as Asian, and 18 (3.28%) as Other. Over 20% (n = 114) of those in the study did not put an answer for what race they considered themselves to be, making it impossible to get the true breakdown of race / ethnicity for the respondents of the questionnaire. A graph of the percent distribution of all firefighters by race / ethnicity can be found in Appendix D, Graph 33.

Marital Status

Of those firefighters who answered the marital status question, approximately 85% (n = 462) were currently married (includes 8 currently married at time of death for questionnaires answered by a surrogate). Forty (7.39%) firefighters answered divorced, which was the second largest marital status group for firefighters. Twenty-eight (5.18%) individuals answered single, or never married, 5 (0.92%) separated, and 1 (0.18%) widowed. Information on level of education is missing for 5 (0.92%) firefighters. See Appendix D, Graph 34 for a graphical representation of the percent distribution of all firefighters by marital status.

Level of Education

Just under 90% (n = 491) of firefighters have had at least some college, with 125 (22.77%) of all firefighters having obtained a college degree. Four (0.73%) did not graduate high school or receive a general education diploma. Forty-seven (8.56%) claim have a high school or general education diploma. Information on level of education is missing for 7 (1.28%) firefighters. A graph of the percent distribution of all firefighters by level of education can be found in Appendix D, Graph 35.

Smoking Status

Of the 549 firefighters analyzed in the study, 520 (94.72%) are currently non-smokers. Of this number, over 2/3 (n = 374) have never smoked. 21 (3.83%) firefighters considered themselves to be current smokers. Eight (1.46%) firefighters did not give a smoking status. A graph of the percent distribution of all firefighters by current smoking status can be found in Appendix D, Graph 36.

Smokeless Tobacco

There were 418 (75.14%) firefighters who said they had never used smokeless (chewing) tobacco. An additional 95 (17.30%) claimed to have stopped using smokeless tobacco. Twenty-eight (3.25%) firefighters currently use smokeless tobacco. Data are missing for 8 (1.46%) firefighters for this demographic variable. See Appendix D, Graph 37 for a graphical representation of the percent distribution of use of smokeless tobacco by all firefighters.

Alcohol

Approximately half (n = 278) of all firefighters were not current users of alcohol. Of the 549 firefighters in the study, 189 (34.43%) have never used alcohol and 89 (16.21%) used to, but no longer drink alcohol. There were 263 (47.91%) firefighters in the study listing they were current alcohol consumers. Eight (1.46%) did not put an answer for this demographic question. A graph of the percent distribution of all firefighters by current alcohol use can be found in Appendix D, Graph 38.

Table 14. Firefighters and Surrogates Combined

Variable	**Firefighters (Combined) (N=549)**	
	Mean	**Std Dev**
Age (years)*	**43.78**	**11.73**
BMI (kg/m^2)†	**28.45**	**4.49**
Variable	**N**	**Percent**
Gender		
Male	534	97.27
Female	15	2.73
Total	**549**	**100**

Table 14 cont.

Variable	N	Percent
BMI (kg/m^2) by Category		
Underweight	1	0.18
Normal Weight	112	20.40
Overweight	266	48.45
Obese	162	29.51
Missing	8	1.46
Total	**549**	**100**
Race		
White	401	73.04
Black	4	0.73
Hispanic	10	1.82
Asian	0	0.00
Pacific Islander / Native Hawaiian	2	0.36
Other	18	3.28
Missing	114	20.77
Total	**549**	**100**
Marital Status		
Never Married (Single)	28	5.10
Married	470	85.61
Separated	5	0.91
Divorced	40	7.29
Widowed	1	0.18
Missing	5	0.91
Total	**549**	**100**
Highest Grade in School		
Some high school	4	9.82
High school graduate or GED	47	8.56
Some college	366	66.67
College graduate (Bachelor’s degree or higher)	125	22.77
Missing	7	1.28
Total	**549**	**100**
Smoking Status		
Never	374	68.12
Yes, but I quit	146	26.59
Yes, currently	21	3.83
Missing	8	1.46
Total	**549**	**100**

Table 14 continued.

Variable	N	Percent
Chewing or Smokeless Tobacco Use		
Never	418	76.14
Yes, but I quit	95	17.30
Yes, currently	28	5.10
Missing	8	1.46
Total	**549**	**100**
Alcohol		
Never	189	34.43
Yes, but I quit	89	16.21
Yes, currently	263	47.90
Missing	8	1.46
Total	**549**	**100**

* Based on n = 547

† Based on n= 541

Combined Police Officers and Police Officers by Proxy

The total number of police officers analyzed in this study, via self-report or by proxy, was 553. The demographic data for the combined total of all officers participating in this study is summarized in Table 15. All summary information gained from proxy reports refers to the police officer and not to the surrogate who entered the data. Graphs of these data can be found in Appendix D, Graphs 39- 47.

Age

The mean age for the police officers (age at time of death for surrogate data) was 47.89 years old with a standard deviation of 10.74 years. We were unable to collect the age for 6 (1.08%) participants. A distribution of the ages by age category can be found in Appendix D, Graph 39.

Gender

Of the 553 police officers analyzed, 520 (94.03%) were males and 33 were females (5.97%). A pie chart representing the percent distribution of gender for all police officers is found in Appendix D, Graph 40.

BMI

The mean BMI was 29.20 kg/m^2 with a standard deviation of 4.55 kg/m^2. Approximately 75% of police officers in this study are overweight or obese when using BMI as the measure. Eighty-three (15.01%) police officers were classified in the normal weight category for BMI. Fifty-five (9.95%) participants were missing the required information needed to compute BMI. A graphical representation of the percent distribution of BMI for this combined set of data are found in Appendix D, Graph 41.

Race / Ethnicity

Almost 85% (n = 470) of the officers classified themselves as white (Caucasian). Nine (1.63%) officers classified themselves as Hispanic, 4 (0.72%) as Asian, 1 (0.18%) each as Black and Pacific Islander / Native Hawaiian However, and 12 (2.17%) as Other. Over 10% (n = 57) of those in the study did not put an answer for what race they considered themselves to be. A graphical representation of the percent distribution of race / ethnicity for this combined set of data are found in Appendix D, Graph 42.

Marital Status

Of those officers who answered the marital status question, almost 85% (n = 469) were currently married (includes 13 currently married at time of death for questionnaires answered by a surrogate). Sixty-four (11.57%) individuals answered single, or never married, as the second largest marital status group of police officers. A graphical representation of the percent distribution of marital status for this combined set of data are found in Appendix D, Graph 43.

Level of Education

Over 72% (n = 400) of police officers attended at least some college, with roughly 1/3 (n = 179) of all officers having obtained a college degree. Approximately 10% (56) did not graduate high school or receive a general education diploma. Forty-four (7.96%) claim have a high school or general education diploma. A graphical representation of the percent distribution of the highest level of education for this combined set of police officers is found in Appendix D, Graph 44.

Smoking Status

Of the 553 police officers in the study, 475 (85.90%) are currently non-smokers. Of this number, approximately 1/3 (n = 349) have never smoked. Twenty-four (4.34%) police officers considered themselves to be current smokers. A graphical representation of the percent distribution of the smoking status for all police officers is found in Appendix D, Graph 45.

Smokeless Tobacco

There were 406 (73.42%) officers who said they had never used smokeless (chewing) tobacco. An additional 74 (13.38%) claimed to have stopped using smokeless tobacco. Eighteen (3.25%) police officers currently used smokeless tobacco. A graphical representation of the percent distribution of the use of smokeless tobacco for all police officers is found in Appendix D, Graph 46.

Alcohol

More than half of all police officers were not current users of alcohol. Of the 553 police officers in the study, 219 (39.6%) have never used alcohol and 99 (17.90%) used to, but no longer drink alcohol. Approximately 1/3 (n = 179) of all police officers in the study were current alcohol consumers. A graphical representation of the percent distribution of the use of alcohol for all police officers is found in Appendix D, Graph 47.

A substantial amount of data were missing for approximately 10% of all of the 553 police officers enrolled. Demographic data for BMI, race, level of education, smoking status, alcohol use, and use of smokeless tobacco is limited to those participants completed the demographic portions of the questionnaire.

Table 15. Police Officers and Surrogates Combined

Variable	**Police Officers by Proxy (N=553)**	
	Mean	**Std Dev**
Age (years)*	**47.88**	**10.74**
BMI (kg/m^2)†	**29.20**	**4.55**
Variable	**N**	**Percent**
Gender		
Male	520	94.03
Female	33	5.97
Total	**553**	**100**
BMI (kg/m^2) by Category		
Underweight	0	0.00
Normal Weight	83	15.01
Overweight	231	41.77
Obese	184	33.27
Missing	55	9.95
Total	**553**	**100**
Race		
White	470	84.99
Black	1	0.18
Hispanic	9	1.63
Asian	4	0.72
Pacific Islander / Native Hawaiian	1	0.18
Other	12	2.17
Missing	56	10.13
Total	**553**	**100**

Table 15 continued.

Variable	N	Percent
Marital Status		
Never Married (Single)	64	11.57
Married	397	71.79
Separated	3	0.54
Divorced	33	5.97
Widowed	2	0.37
Missing	54	9.76
Total	**553**	**100**
Highest Grade in School		
Some high school	56	10.13
High school graduate or GED	44	7.96
Some college	221	39.96
College graduate (Bachelor's degree or higher)	179	32.37
Missing	53	9.58
Total	**553**	**100**
Smoking Status		
Never	349	63.11
Yes, but I quit	126	22.79
Yes, currently	24	4.34
Missing	54	9.76
Total	**553**	**100**
Chewing or Smokeless Tobacco Use		
Never	406	73.42
Yes, but I quit	74	13.38
Yes, currently	18	3.25
Missing	55	9.95
Total	**553**	**100**
Alcohol		
Never	219	39.60
Yes, but I quit	99	17.90
Yes, currently	179	32.37
Missing	56	10.13
Total	**553**	**100**

* Based on n = 535

† Based on n= 547

Exposure Variables

As stated above, exposure was quantified and then classified into High, Medium, and Low. We also created a binary measure of exposure where we combined Medium and High. Analyses are presented for both exposure measures.

Table 16. Percentage of Firefighters and Police Officers in each exposure category.

Exposure Category	Police Officer (%)	Firefighter (%)
Low	62.50%	55.03%
Medium	17.21%	23.37%
High	20.29%	21.21%
Binary Exposure Category	Police Officer (%)	Firefighter (%)
Low	62.50%	55.03%
Medium-High	37.50%	44.97%

Treatment of Surrogate Responses

As part of this research it was deemed that surrogate responses (spouse) for deceased police officers and firefighters would not be able to give accurate quantification of occupational exposures to quantify an exposure for each individual as noted above. We decided to analyze data two ways, one excluding surrogate responses due to the inability to quantify exposure, and second to include surrogate responses in analyses with an assignment of high exposure. By excluding surrogate responses, we have a very conservative estimate. When including surrogate responses in analyses and assigning a high exposure value, estimates would be more aggressive. We then evaluated the differences in these risk estimates and concluded that there were no significant differences. Therefore we reported analyses that included surrogate responses.

Cancer Risk Estimates Among Police Officers

Unadjusted Risk Estimates For Any Reported Specific Cancers Among Police Officers by High, Medium and Low Exposures

Thyroid cancer the risk estimates for medium versus low exposure the model was unable to generate an estimate but for high versus low exposure the risk estimate was 1.56 (95% Confidence Interval 0.14, 17.36). For Esophageal cancer the risk estimate for both medium versus low and high versus low the model was unable to generate an estimate. For Other cancer the risk estimate for medium versus low exposure the model was unable to generate an estimate but for high versus low exposure the risk estimate was 3.15 (95% Confidence Interval 0.44, 22.61). Rectal cancer the risk estimates for medium versus low was 3.66 (95% Confidence Interval 0.23, 59.06) and for high versus low exposure the risk estimate was 3.13 (95% Confidence Interval 0.19, 50.41). NHL cancer risk estimates for medium versus low was 7.40 (95% Confidence Interval 0.66, 82.48) and for high versus low exposure the risk estimate was 6.31 (95% Confidence Interval 0.57, 70.24). For Testis cancer the risk estimates for medium versus low exposure the model was unable to generate an estimate but for high versus low exposure the risk estimate was 3.15 (95% Confidence Interval 0.44, 22.61).

Melanoma cancer the risk estimates for medium versus low was 5.59 (95% Confidence Interval 0.92, 33.97) and for high versus low exposure the risk estimate was 4.76 (95% Confidence Interval 0.79, 22.88). For Colon cancer the risk estimates for medium versus low exposure the model was unable to generate an estimate but for high versus low exposure the risk estimate was 3.12 (95% Confidence Interval 0.19, 50.41). Colorectal cancer risk estimates for medium versus low exposure was 1.82 (95% Confidence Interval 0.16, 20.34) and for high versus low exposure the risk estimate was 3.14 (95% Confidence Interval 0.44, 22.61). Prostate cancer risk estimates for medium versus low exposure was 1.58 (95% Confidence Interval 0.40, 6.21) and for high versus low exposure the risk estimate was 0.89 (95% Confidence Interval 0.18, 4.33). **Lymphoma cancer risk estimates for medium versus low exposure was 11.22 (95% Confidence Interval 1.15, 109.10)** and for high versus low exposure the risk estimate was 3.13 (95% Confidence Interval 0.19, 50.41). Skin cancer risk estimates for medium versus low exposure was 1.23 (95% Confidence Interval 0.47, 3.18) and for high versus low exposure the risk estimate was 1.04 (95% Confidence Interval 0.40, 2.68). **Total cancer risk estimates for medium versus low exposure was 2.12 (95% Confidence Interval 1.01, 4.47) and for high versus low exposure the risk estimate was 3.43 (95% Confidence Interval 1.80, 6.51).** For Hodgkin's Lymphoma cancer, Breast cancer, Lung and Bronchus cancer, Stomach cancer, Bladder cancer, Hepatic cancer, Leukemia cancer, and Renal cancer risk estimates for medium versus low exposure the model was unable to generate an estimate and for high versus low exposure the model was unable to generate an estimate.

Table 17. Unadjusted Risk Estimates For Any Reported Specific Cancers Among Police Officers by High, Medium and Low Exposures

1) HODGKIN'S LYMPHOMA			
Variables	Risk Estimates	95% Confidence Interval	
Exposure			
Low	1.00 (Ref.)		
Medium	<0.001	<0.001	>999.999
High	<0.001	<0.001	>999.999
2) THYROID			
Variables	Risk Estimates	95% Confidence Interval	
Exposure			
Low	1.00 (Ref.)		
Medium	<0.001	<0.001	>999.999
High	1.56	0.14	17.36
3) ESOPHAGEAL			
Variables	Risk Estimates	95% Confidence Interval	
Exposure			
Low	1.00 (Ref.)		
Medium	0.65	<0.001	>999.999
High	>999.999	<0.001	>999.999

Table 17 cont.

4) BREAST

Variables	Risk Estimates	95% Confidence Interval	
Exposure			
Low	1.00 (Ref.)		
Medium	<0.001	<0.001	>999.999
High	<0.001	<0.001	>999.999

5) OTHER

Variables	Risk Estimates	95% Confidence Interval	
Exposure			
Low	1.00 (Ref.)		
Medium	<0.001	<0.001	>999.999
High	3.15	0.44	22.61

6) LUNG AND BRONCHUS

Variables	Risk Estimates	95% Confidence Interval	
Exposure			
Low	1.00 (Ref.)		
Medium	0.65	<0.001	>999.999
High	>999.999	<0.001	>999.999

7) RECTUM

Variables	Risk Estimates	95% Confidence Interval	
Exposure			
Low	1.00 (Ref.)		
Medium	3.66	0.23	59.06
High	3.13	0.19	50.41

8) NHL

Variables	Risk Estimates	95% Confidence Interval	
Exposure			
Low	1.00 (Ref.)		
Medium	7.40	0.66	82.48
High	6.31	0.57	70.24

9) STOMACH

Variables	Risk Estimates	95% Confidence Interval	
Exposure			
Low	1.00 (Ref.)		
Medium	0.65	<0.001	>999.999
High	>999.999	<0.001	>999.999

Table 17 cont.

10)TESTIS

Variables	Risk Estimates	95% Confidence Interval	
Exposure			
Low	1.00 (Ref.)		
Medium	<0.001	<0.001	>999.999
High	3.15	0.44	22.61

11) MELANOMA

Variables	Risk Estimates	95% Confidence Interval	
Exposure			
Low	1.00 (Ref.)		
Medium	5.59	0.92	33.97
High	4.76	0.79	28.88

12) BLADDER

Variables	Risk Estimates	95% Confidence Interval	
Exposure			
Low	1.00 (Ref.)		
Medium	0.65	<0.001	>999.999
High	>999.999	<0.001	>999.999

13) COLON

Variables	Risk Estimates	95% Confidence Interval	
Exposure			
Low	1.00 (Ref.)		
Medium	<0.001	<0.001	>999.999
High	3.13	0.19	50.41

14) COLORECTAL

Variables	Risk Estimates	95% Confidence Interval	
Exposure			
Low	1.00 (Ref.)		
Medium	1.82	0.16	20.34
High	3.15	0.44	22.61

15) PROSTATE

Variables	Risk Estimates	95% Confidence Interval	
Exposure			
Low	1.00 (Ref.)		
Medium	1.58	0.40	6.21
High	0.89	0.18	4.33

Table 17 cont.

16) HEPATIC

Variables	Risk Estimates	95% Confidence Interval	
Exposure			
Low	1.00 (Ref.)		
Medium	0.65	<0.001	>999.999
High	>999.999	<0.001	>999.999

17) LEUKEMIA

Variables	Risk Estimates	95% Confidence Interval	
Exposure			
Low	1.00 (Ref.)		
Medium	0.65	<0.001	>999.999
High	>999.999	<0.001	>999.999

18) RENAL

Variables	Risk Estimates	95% Confidence Interval	
Exposure			
Low	1.00 (Ref.)		
Medium	>999.999	<0.001	>999.999
High	>999.999	<0.001	>999.999

19) LYMPHOMA

Variables	Risk Estimates	95% Confidence Interval	
Exposure			
Low	1.00 (Ref.)		
Medium	11.22	1.15	109.10
High	3.13	0.19	50.41

20) SKIN

Variables	Risk Estimates	95% Confidence Interval	
Exposure			
Low	1.00 (Ref.)		
Medium	1.23	0.47	3.18
High	1.04	0.40	2.68

21) TOTAL

Variables	Risk Estimates	95% Confidence Interval	
Exposure			
Low	1.00 (Ref.)		
Medium	2.12	1.01	4.47
High	3.43	1.80	6.51

Unadjusted Risk Estimates For Specific Confirmed Cancers Among Police Officers by High, Medium and Low Exposures

Thyroid cancer the risk estimates for medium versus low exposure the model was unable to generate an estimate but for high versus low exposure the risk estimate was 3.10 (95% Confidence Interval 0.19, 49.96). For Esophageal cancer the risk estimate for both medium versus low and high versus low the model was unable to generate an estimate. For Other cancer the risk estimate for medium versus low exposure the model was unable to generate an estimate but for high versus low exposure the risk estimate was 6.26 (95% Confidence Interval 0.56, 69.64). Rectal cancer the risk estimates for medium versus low was 3.66 (95% Confidence Interval 0.23, 59.06) and for high versus low exposure the risk estimate was 3.10 (95% Confidence Interval 0.19, 49.96). NHL cancer risk estimates for medium versus low was 7.40 (95% Confidence Interval 0.66, 82.48) and for high versus low exposure the risk estimate was 6.25 (95% Confidence Interval 0.56, 69.64). For Testis cancer the risk estimates for medium versus low exposure the model was unable to generate an estimate but for high versus low exposure the risk estimate was 3.10 (95% Confidence Interval 0.19, 49.96). Melanoma cancer the risk estimates for medium versus low was 7.40 (95% Confidence Interval 0.66, 82.48) and for high versus low exposure the risk estimate was 6.25 (95% Confidence Interval 0.56, 69.64). For Colon cancer the risk estimates for medium versus low exposure the model was unable to generate an estimate but for high versus low exposure the risk estimate was 3.10 (95% Confidence Interval 0.19, 49.96). Colorectal cancer risk estimates for medium versus low exposure was 1.82 (95% Confidence Interval 0.16, 20.34) and for high versus low exposure the risk estimate was 3.12 (95% Confidence Interval 0.44, 22.40). Prostate cancer risk estimates for medium versus low exposure was 1.84 (95% Confidence Interval 0.46, 7.51) and for high versus low exposure the risk estimate was 0.50 (95% Confidence Interval 0.06, 4.27). Total cancer risk estimates for medium versus low exposure was 2.02 (95% Confidence Interval 0.83, 4.93) and for **high versus low exposure the risk estimate was 3.67 (95% Confidence Interval 1.48, 7.67).** No data were obtained from Leukemia cancer, Renal cancer or Skin cancer from our database. For Hodgkin's Lymphoma cancer, Breast cancer, Lung and Bronchus cancer, Stomach cancer, Bladder cancer, Hepatic cancer, and Lymphoma cancer risk estimates for medium versus low exposure the model was unable to generate an estimate and for high versus low exposure the model was unable to generate an estimate.

Table 18 Unadjusted Risk Estimates For Specific Confirmed Cancers Among Police Officers by High, Medium and Low Exposures

1) HODGKIN'S LYMPHOMA (Confirmed)

Variables	Risk Estimate	95% Confidence Interval	
Exposure			
Low	1.00 (Ref.)		
Medium	NA	NA	NA
High	NA	NA	NA

Table 18 cont.

2) THYROID (Confirmed)

Variables	Risk Estimate	95% Confidence Interval	
Exposure			
Low	1.00 (Ref.)		
Medium	NA	NA	NA
High	3.10	0.19	49.96

3)ESOPHAGEAL (Confirmed)

Variables	Risk Estimate	95% Confidence Interval	
Exposure			
Low	1.00 (Ref.)		
Medium	0.65	<0.001	>999.999
High	NA	NA	NA

4) BREAST (Confirmed)

Variables	Risk Estimate	95% Confidence Interval	
Exposure			
Low	1.00 (Ref.)		
Medium	NA	NA	NA
High	NA	NA	NA

5) OTHER (Confirmed)

Variables	Risk Estimate	95% Confidence Interval	
Exposure			
Low	1.00 (Ref.)		
Medium	NA	NA	NA
High	6.26	0.56	69.64

6) LUNG AND BRONCHUS (Confirmed)

Variables	Risk Estimate	95% Confidence Interval	
Exposure			
Low	1.00 (Ref.)		
Medium	NA	NA	NA
High	0.65	<0.001	>999.999

7) RECTUM (Confirmed)

Variables	Risk Estimate	95% Confidence Interval	
Exposure			
Low	1.00 (Ref.)		
Medium	3.66	0.23	59.06
High	3.10	0.19	49.96

Table 18 cont.

8) NHL (Confirmed)

Variables	Risk Estimate	95% Confidence Interval	
Exposure			
Low	1.00 (Ref.)		
Medium	7.40	0.66	82.48
High	6.25	0.56	69.64

9) STOMACH (Confirmed)

Variables	Risk Estimate	95% Confidence Interval	
Exposure			
Low	1.00 (Ref.)		
Medium	0.65	<0.001	>999.999
High	NA	NA	NA

10) TESTIS (Confirmed)

Variables	Risk Estimate	95% Confidence Interval	
Exposure			
Low	1.00 (Ref.)		
Medium	NA	NA	NA
High	3.10	0.19	49.96

11) MELANOMA (Confirmed)

Variables	Risk Estimate	95% Confidence Interval	
Exposure			
Low	1.00 (Ref.)		
Medium	7.40	0.66	82.48
High	6.25	0.56	69.64

12) BLADDER (Confirmed)

Variables	Risk Estimate	95% Confidence Interval	
Exposure			
Low	1.00 (Ref.)		
Medium	0.65	<0.001	>999.999
High	NA	NA	NA

13) COLON (Confirmed)

Variables	Risk Estimate	95% Confidence Interval	
Exposure			
Low	1.00 (Ref.)		
Medium	NA	NA	NA
High	3.10	0.19	49.96

Table 18 cont.

14) COLORECTAL (Confirmed)			
Variables	Risk Estimate	95% Confidence Interval	
Exposure			
Low	1.00 (Ref.)		
Medium	1.82	0.16	20.34
High	3.12	0.43	22.40
15) PROSTATE (Confirmed)			
Variables	Risk Estimate	95% Confidence Interval	
Exposure			
Low	1.00 (Ref.)		
Medium	1.84	0.45	7.51
High	0.51	0.06	4.27
16) HEPATIC (Confirmed)			
Variables	Risk Estimate	95% Confidence Interval	
Exposure			
Low	1.00 (Ref.)		
Medium	0.65	<0.001	>999.999
High	NA	NA	NA
17) LEUKEMIA (Confirmed)			
Variables	Risk Estimate	95% Confidence Interval	
Exposure			
Not applicable	NA	NA	NA
18) RENAL (Confirmed)			
Variables	Risk Estimate	95% Confidence Interval	
Exposure			
Not applicable	NA	NA	NA
19) LYMPHOMA (Confirmed)			
Variables	Risk Estimate	95% Confidence Interval	
Exposure			
Low	1.00 (Ref.)		
Medium	NA	NA	NA
High	NA	NA	NA
20) SKIN (Confirmed)			
Variables	Risk Estimate	95% Confidence Interval	
Exposure			
Not applicable	NA	NA	NA

21) TOTAL (Confirmed)			
Variables	Risk Estimate	95% Confidence Interval	
Exposure			
Low	1.00 (Ref.)		
Medium	2.02	0.83	4.93
High	3.67	1.48	7.69

Risk Estimates Adjusted for Age for Any Reported Specific Cancers Among Police Officers by High, Medium and Low Exposures

Thyroid cancer the risk estimates for medium versus low exposure the model was unable to generate an estimate but for high versus low exposure the risk estimate was 1.74 (95% Confidence Interval 0.15, 20.40). For Other cancer the risk estimate for medium versus low exposure the model was unable to generate an estimate but for high versus low exposure the risk estimate was 3.28 (95% Confidence Interval 0.44, 24.45). Rectal cancer the risk estimates for medium versus low was 3.64 (95% Confidence Interval 0.22, 59.79) and for high versus low exposure the risk estimate was 2.71 (95% Confidence Interval 0.17, 43.93). NHL cancer risk estimates for medium versus low was 8.82 (95% Confidence Interval 0.73, 106.30) and for high versus low exposure the risk estimate was 5.63 (95% Confidence Interval 0.49, 64.39). For Testis cancer the risk estimates for medium versus low exposure the model was unable to generate an estimate but for high versus low exposure the risk estimate was 2.86 (95% Confidence Interval 0.39, 20.73). Melanoma cancer the risk estimates for medium versus low was 5.60 (95% Confidence Interval 0.91, 34.60) and for high versus low exposure the risk estimate was 1.15 (95% Confidence Interval 0.68, 25.40). For Colon cancer the risk estimates for medium versus low exposure the model was unable to generate an estimate but for high versus low exposure the risk estimate was 2.78 (95% Confidence Interval 0.17, 46.47). Colorectal cancer risk estimates for medium versus low exposure was 1.97 (95% Confidence Interval 0.17, 22.80) and for high versus low exposure the risk estimate was 2.74 (95% Confidence Interval 0.38, 20.01). Prostate cancer risk estimates for medium versus low exposure was 4.26 (95% Confidence Interval 0.81, 22.51) and for high versus low exposure the risk estimate was 1.42 (95% Confidence Interval 0.24, 8.54). For **Lymphoma cancer the risk estimates for medium versus low exposure was 12.53 (95% Confidence Interval 1.21, 129.86)** and for high versus low exposure the risk estimate was 2.71 (95% Confidence Interval 0.17, 44.30). Skin cancer the risk estimates for medium versus low exposure was 1.28 (95% Confidence Interval 0.48, 3.43) and for high versus low exposure the risk estimate was 0.86 (95% Confidence Interval 0.32, 2.31).**Total cancer risk estimates for medium versus low exposure was 2.71 (95% Confidence Interval 1.22, 6.00) and for high versus low exposure the risk estimate was 3.92 (95% Confidence Interval 1.96, 1.89).** No data were obtained from Hodgkin's Lymphoma cancer or Esophageal cancer from our database. For Breast cancer, Lung and Bronchus cancer, Stomach cancer, Bladder cancer, Hepatic cancer, Leukemia, and Renal cancer the risk estimate for both medium versus low and high versus low the model was unable to generate an estimate.

Table 19. Adjusted Risk Estimates For Any Reported Specific Cancers Among Police Officers by High, Medium and Low Exposures

1) HODGKIN'S LYMPHOMA

Variables	Risk Estimates	95% Confidence Interval	
Exposure			
Not applicable	NA	NA	NA
Age	NA	NA	NA

2) THYROID

Variables	Risk Estimates	95% Confidence Interval	
Exposure			
Low	1.00 (Ref.)		
Medium	<0.001	<0.001	>999.999
High	1.74	0.15	20.40
Age	0.97	0.87	1.09

3) ESOPHAGEAL

Variables	Risk Estimates	95% Confidence Interval	
Exposure			
Not applicable	NA	NA	NA
Age	NA	NA	NA

4) BREAST

Variables	Risk Estimates	95% Confidence Interval	
Exposure			
Low	1.00 (Ref.)		
Medium	<0.001	<0.001	>999.999
High	<0.001	<0.001	>999.999
Age	1.06	0.95	1.18

5) OTHER

Variables	Risk Estimates	95% Confidence Interval	
Exposure			
Low	1.00 (Ref.)		
Medium	<0.001	<0.001	>999.999
High	3.28	0.44	24.45
Age	0.99	0.90	1.09

Table 19 cont.

6) LUNG AND BRONCHUS

Variables	Risk Estimates	95% Confidence Interval	
Exposure			
Low	1.00 (Ref.)		
Medium	1.02	<0.001	>999.999
High	>999.999	<0.001	>999.999
Age	1.18	0.97	1.45

7) RECTUM

Variables	Risk Estimates	95% Confidence Interval	
Exposure			
Low	1.00 (Ref.)		
Medium	3.64	0.22	59.79
High	2.71	0.17	43.93
Age	1.06	0.96	1.18

8) NHL

Variables	Risk Estimates	95% Confidence Interval	
Exposure			
Low	1.00 (Ref.)		
Medium	8.82	0.73	106.30
High	5.63	0.49	64.38
Age	1.10	1.01	1.20

9) STOMACH

Variables	Risk Estimates	95% Confidence Interval	
Exposure			
Low	1.00 (Ref.)		
Medium	7.65	<0.001	<0.001
High	>999.999	<0.001	>999.999
Age	0.62	0.30	1.28

10) TESTIS

Variables	Risk Estimates	95% Confidence Interval	
Exposure			
Low	1.00 (Ref.)		
Medium	<0.001	<0.001	>999.999
High	2.86	0.39	20.73
Age	1.03	0.94	1.12

Table 19 cont.

11) MELANOMA

Variables	Risk Estimates	95% Confidence Interval	
Exposure			
Low	1.00 (Ref.)		
Medium	5.60	0.91	34.60
High	1.15	0.68	25.39
Age	1.06	1.00	1.14

12) BLADDER

Variables	Risk Estimates	95% Confidence Interval	
Exposure			
Low	1.00 (Ref.)		
Medium	>999.999	<0.001	>999.999
High	>999.999	<0.001	>999.999
Age	3.01	0.32	28.52

13) COLON

Variables	Risk Estimates	95% Confidence Interval	
Exposure			
Low	1.00 (Ref.)		
Medium	<0.001	<0.001	>999.999
High	2.78	0.17	46.47
Age	1.12	0.99	1.26

14) COLORECTAL

Variables	Risk Estimates	95% Confidence Interval	
Exposure			
Low	1.00 (Ref.)		
Medium	1.97	0.17	22.80
High	2.74	0.38	20.01
Age	1.09	1.01	1.18

15) PROSTATE

Variables	Risk Estimates	95% Confidence Interval	
Exposure			
Low	1.00 (Ref.)		
Medium	4.26	0.81	22.51
High	1.42	0.24	8.54
Age	1.15	1.07	1.23

Table 19 cont.

16) HEPATIC

Variables	Risk Estimates	95% Confidence Interval	
Exposure			
Low	1.00 (Ref.)		
Medium	0.71	<0.001	>999.999
High	>999.999	<0.001	>999.999
Age	0.99	0.85	1.14

17) LEUKEMIA

Variables	Risk Estimates	95% Confidence Interval	
Exposure			
Low	1.00 (Ref.)		
Medium	0.81	<0.001	>999.999
High	>999.999	<0.001	>999.999
Age	1.15	0.95	1.38

18) RENAL

Variables	Risk Estimates	95% Confidence Interval	
Exposure			
Low	1.00 (Ref.)		
Medium	>999.999	<0.001	>999.999
High	>999.999	<0.001	>999.999
Age	0.97	0.85	1.11

19) LYMPHOMA

Variables	Risk Estimates	95% Confidence Interval	
Exposure			
Low	1.00 (Ref.)		
Medium	12.53	1.21	129.86
High	2.71	0.17	44.30
Age	1.09	1.00	1.19

20) SKIN

Variables	Risk Estimates	95% Confidence Interval	
Exposure			
Low	1.00 (Ref.)		
Medium	1.28	0.48	3.43
High	0.86	0.32	2.31
Age	1.09	1.06	1.13

Table 19 cont.

21) TOTAL

Variables	Risk Estimates	95% Confidence Interval	
Exposure			
Low	1.00 (Ref.)		
Medium	2.71	1.22	6.00
High	3.92	1.95	1.88
Age	1.08	1.05	1.11

Risk Estimates Adjusted for Age for Specific Confirmed Cancers Among Police Officers by High, Medium and Low Exposures

Thyroid cancer the risk estimates for medium versus low exposure the model was unable to generate an estimate but for high versus low exposure the risk estimate was 2.90 (95% Confidence Interval 0.18, 47.75). For Other cancer the risk estimate for medium versus low exposure the model was unable to generate an estimate but for high versus low exposure the risk estimate was 5.67 (95% Confidence Interval 0.51, 64.02). Rectal cancer the risk estimates for medium versus low was 3.64 (95% Confidence Interval 0.22, 59.83) and for high versus low exposure the risk estimate was 1.97 (95% Confidence Interval 0.17, 43.70). NHL cancer risk estimates for medium versus low was 8.83 (95% Confidence Interval 0.73, 106.46) and for high versus low exposure the risk estimate was 5.62 (95% Confidence Interval 0.50, 64.23). For Testis cancer the risk estimates for medium versus low exposure the model was unable to generate an estimate but for high versus low exposure the risk estimate was 2.76 (95% Confidence Interval 0.17, 44.80). Melanoma cancer the risk estimates for medium versus low was 9.06 (95% Confidence Interval 0.75, 110.25) and for high versus low exposure the risk estimate was 5.70 (95% Confidence Interval 0.50, 64.93). For Colon cancer the risk estimates for medium versus low exposure the model was unable to generate an estimate but for high versus low exposure the risk estimate was 2.78 (95% Confidence Interval 0.17, 46.40). Colorectal cancer risk estimates for medium versus low exposure was 1.97 (95% Confidence Interval 0.40, 22.82) and for high versus low exposure the risk estimate was 2.73 (95% Confidence Interval 0.37, 19.94). **Prostate cancer risk estimates for medium versus low exposure was 6.15 (95% Confidence Interval 1.00, 38.00)** and for high versus low exposure the risk estimate was 0.92 (95% Confidence Interval 0.10, 9.65). **Total cancer risk estimates for medium versus low exposure was 3.24 (95% Confidence Interval 1.20, 8.73) and for high versus low exposure the risk estimate was 5.05 (95% Confidence Interval 2.15, 11.91).** No data were obtained from Hodgkin's Lymphoma cancer, Esophageal cancer, Leukemia cancer, Renal cancer, or Skin cancer from our database. For Breast cancer, Lung and Bronchus cancer, Stomach cancer, Bladder cancer, Hepatic cancer, and Lymphoma cancer the risk estimate for both medium versus low and high versus low the model was unable to generate an estimate.

Table 20. Adjusted Risk Estimates For Confirmed Specific Cancers Among Police Officers by High, Medium and Low Exposures

1) HODGKIN'S LYMPHOMA (Confirmed)

Variables	Risk Estimates	95% Confidence Interval	
Exposure			
Not applicable	NA	NA	NA
Age	NA	NA	NA

2) THYROID (Confirmed)

Variables	Risk Estimates	95% Confidence Interval	
Exposure			
Low	1.00 (Ref.)		
Medium	NA	NA	NA
High	2.90	0.18	47.75
Age	1.02	0.90	1.15

3) ESOPHAGEAL (Confirmed)

Variables	Risk Estimates	95% Confidence Interval	
Exposure			
Not applicable	NA	NA	NA
Age	NA	NA	NA

4) BREAST (Confirmed)

Variables	Risk Estimates	95% Confidence Interval	
Exposure			
Low	1.00 (Ref.)		
Medium	NA	NA	NA
High	NA	NA	NA
Age	1.07	0.92	1.25

5) OTHER (Confirmed)

Variables	Risk Estimates	95% Confidence Interval	
Exposure			
Low	1.00 (Ref.)		
Medium	NA	NA	NA
High	5.69	0.51	64.02
Age	1.03	0.93	1.14

6) LUNG AND BRONCHUS (Confirmed)

Variables	Risk Estimates	95% Confidence Interval	
Exposure			
Low	1.00 (Ref.)		
Medium	1.02	<0.001	>999.999
High	NA	NA	NA
Age	1.18	0.97	1.45

7) RECTUM (Confirmed)

Variables	Risk Estimates	95% Confidence Interval	
Exposure			
Low	1.00 (Ref.)		

Medium	3.64	0.22	59.83
High	1.97	0.17	43.70
Age	1.06	0.96	1.18

8) NHL (Confirmed)

Variables	Risk Estimates	95% Confidence Interval	
Exposure			
Low	1.00 (Ref.)		
Medium	8.83	0.73	106.46
High	5.62	0.49	64.23
Age	1.10	1.01	1.20

9) STOMACH (Confirmed)

Variables	Risk Estimates	95% Confidence Interval	
Exposure			
Low	1.00 (Ref.)		
Medium	7.69	<0.001	>999.999
High	NA	NA	NA
Age	0.62	0.31	1.27

10) TESTIS (Confirmed)

Variables	Risk Estimates	95% Confidence Interval	
Exposure			
Low	1.00 (Ref.)		
Medium	NA	NA	NA
High	2.76	0.17	44.80
Age	1.04	0.92	1.17

11) MELANOMA (Confirmed)

Variables	Risk Estimates	95% Confidence Interval	
Exposure			
Low	1.00 (Ref.)		
Medium	9.06	0.74	110.25
High	5.66	0.49	64.93
Age	1.11	1.02	1.21

12) BLADDER (Confirmed)

Variables	Risk Estimates	95% Confidence Interval	
Exposure			
Low	1.00 (Ref.)		
Medium	NA	NA	NA
High	NA	NA	NA
Age	3.02	0.32	28.86

13) COLON (Confirmed)

Variables	Risk Estimates	95% Confidence Interval	
Exposure			
Low	1.00 (Ref.)		
Medium	NA	NA	NA
High	2.78	0.17	46.40
Age	1.12	0.99	1.26

14) COLORECTAL (Confirmed)

Variables	Risk Estimates	95% Confidence Interval	
Exposure			
Low	1.00 (Ref.)		
Medium	1.97	0.17	22.82
High	2.73	0.37	19.94
Age	1.09	1.01	1.18

15) PROSTATE (Confirmed)

Variables	Risk Estimates	95% Confidence Interval	
Exposure			
Low	1.00 (Ref.)		
Medium	6.15	1.00	38.00
High	0.92	0.09	9.65
Age	1.15	1.07	1.25

16) HEPATIC (Confirmed)

Variables	Risk Estimates	95% Confidence Interval	
Exposure			
Low	1.00 (Ref.)		
Medium	0.70	<0.001	>999.999
High	NA	NA	NA
Age	0.99	0.85	1.14

17) LEUKEMIA (Confirmed)

Variables	Risk Estimates	95% Confidence Interval	
Exposure			
Not applicable	NA	NA	NA
Age	NA	NA	NA

18) RENAL (Confirmed)

Variables	Risk Estimates	95% Confidence Interval	
Exposure			
Not applicable	NA	NA	NA

Age	NA	NA	NA

19) LYMPHOMA (Confirmed)

Variables	Risk Estimates	95% Confidence Interval	
Exposure			
Low	1.00 (Ref.)		
Medium	NA	NA	NA
High	NA	NA	NA
Age	1.12	0.97	1.29

20) SKIN

Variables	Risk Estimates	95% Confidence Interval	
Exposure			
Not applicable	NA	NA	NA
Age	NA	NA	NA

20) TOTAL

Variables	Risk Estimates	95% Confidence Interval	
Exposure			
Low	1.00 (Ref.)		
Medium	3.24	1.20	8.73
High	5.05	2.15	11.91
Age	1.11	1.07	1.15

Unadjusted Risk Estimates For Any Reported Specific Cancers Among Police Officers by combined High and Medium versus Low Exposures

Thyroid cancer the risk estimate for medium high versus low exposure was 0.84 (95% Confidence Interval 0.08, 9.28). For Other cancer the risk estimate for medium high versus low exposure was 1.68 (95% Confidence Interval 0.24, 12.03). Rectal cancer the risk estimate for medium high versus low exposure was 3.37 (95% Confidence Interval 0.30, 37.42). NHL cancer risk estimate for medium high versus low was 6.81 (95% Confidence Interval 0.76, 61.37).For Testis cancer the risk estimates for medium high versus low exposure was 1.68 (95% Confidence Interval 0.24, 12.02). **Melanoma cancer the risk estimate for medium high versus low was 5.16 (95% Confidence Interval 1.03, 25.73).** For Colon cancer the risk estimate for medium high versus low exposure was 1.68 (95% Confidence Interval 0.10, 26.97). Colorectal cancer risk estimate for medium high versus low exposure was 2.54 (95% Confidence Interval 0.42, 15.30). Prostate cancer risk estimate for medium high versus low exposure was 1.20 (95% Confidence Interval 0.38, 8.34). Lymphoma cancer risk estimate for medium high versus low exposure was 6.81(95% Confidence Interval 0.76, 61.37). Skin cancer risk estimates for medium versus low exposure was 1.12 (95% Confidence Interval 0.53, 2.38). **Total cancer risk estimate for medium high versus low exposure was 2.80 (95% Confidence Interval 1.58, 4.95).** No cases of Esophageal cancer were reported. For Hodgkin's Lymphoma cancer, Breast cancer, Lung and Bronchus cancer, Stomach cancer, Bladder cancer, Hepatic cancer, Leukemia cancer, and Renal cancer the risk estimate for both medium high versus low the model was unable to generate an estimate due to a very small number of cases.

Table 21. Unadjusted Risk Estimates For Any Reported Specific Cancers Among Police Officers by combined High and Medium versus Low Exposures

1) HODGKIN'S LYMPHOMA

Variables	Risk Estimates	95% Confidence Interval	
Exposure			
Low	1.00 (Ref.)		
Med-High	NA	NA	NA

2) THYROID

Variables	Risk Estimates	95% Confidence Interval	
Exposure			
Low	1.00 (Ref.)		
Med-High	0.84	0.08	9.28

3) ESOPHAGEAL

Variables	Risk Estimates	95% Confidence Interval	
Exposure			
Not applicable	NA	NA	NA

4) BREAST

Variables	Risk Estimates	95% Confidence Interval	
Exposure			
Low	1.00 (Ref.)		
Med-High	NA	NA	NA

5) OTHER

Variables	Risk Estimates	95% Confidence Interval	
Exposure			
Low	1.00 (Ref.)		
Med-High	1.68	0.24	12.03

6) LUNG AND BRONCHUS

Variables	Risk Estimates	95% Confidence Interval	
Exposure			
Low	1.00 (Ref.)		
Med-High	NA	NA	NA

7) RECTUM

Variables	Risk Estimates	95% Confidence Interval	
Exposure			
Low	1.00 (Ref.)		
Med-High	3.37	0.30	37.43

8) NHL

Variables	Risk Estimates	95% Confidence Interval	
Exposure			
Low	1.00 (Ref.)		
Med-High	6.81	0.76	61.37

9) STOMACH

Variables	Risk Estimates	95% Confidence Interval	
Exposure			
Low	1.00 (Ref.)		
Med-High	NA	NA	NA

10) TESTIS

Variables	Risk Estimates	95% Confidence Interval	
Exposure			
Low	1.00 (Ref.)		
Med-High	1.68	0.24	12.03

11) MELANOMA

Variables	Risk Estimates	95% Confidence Interval	
Exposure			
Low	1.00 (Ref.)		
Med-High	5.15	1.03	25.73

12) BLADDER

Variables	Risk Estimates	95% Confidence Interval	
Exposure			
Low	1.00 (Ref.)		
Med-High	NA	NA	NA

13) COLON

Variables	Risk Estimates	95% Confidence Interval	
Exposure			
Low	1.00 (Ref.)		
Med-High	1.68	0.10	26.97

14) COLORECTAL

Variables	Risk Estimates	95% Confidence Interval	
Exposure			
Low	1.00 (Ref.)		
Med-High	2.54	0.42	15.30

15) PROSTATE

Variables	Risk Estimates	95% Confidence Interval	
Exposure			
Low	1.00 (Ref.)		
Med-High	1.20	0.38	3.84

16) HEPATIC

Variables	Risk Estimates	95% Confidence Interval	
Exposure			
Low	1.00 (Ref.)		
Med-High	NA	NA	NA

17) LEUKEMIA

Variables	Risk Estimates	95% Confidence Interval	
Exposure			
Low	1.00 (Ref.)		
Med-High	NA	NA	NA

18) RENAL

Variables	Risk Estimates	95% Confidence Interval	
Exposure			
Low	1.00 (Ref.)		
Med-High	NA	NA	NA

19) Lymphoma

Variables	Risk Estimates	95% Confidence Interval	
Exposure			
Low	1.00 (Ref.)		
Med-High	6.81	0.76	61.37

20) SKIN

Variables	Risk Estimates	95% Confidence Interval	
Exposure			
Low	1.00 (Ref.)		
Med-High	1.12	0.53	2.38

21) TOTAL

Variables	Risk Estimates	95% Confidence Interval	
Exposure			
Low	1.00 (Ref.)		
Med-High	2.80	1.58	4.95

Unadjusted Risk Estimates For Confirmed Specific Cancers Among Police Officers by combined High and Medium versus Low Exposures

Thyroid cancer the risk estimate for medium high versus low exposure was 1.67 (95% Confidence Interval 0.10, 26.84). For Other cancer the risk estimate for medium high versus low exposure was 3.36 (95% Confidence Interval 0.30, 37.24). Rectal cancer the risk estimate for medium high versus low exposure was 3.36 (95% Confidence Interval 0.30, 37.24). NHL cancer risk estimate for medium high versus low was 6.78 (95% Confidence Interval 0.75, 61.06).For Testis cancer the risk estimates for medium high versus low exposure was 1.67 (95% Confidence Interval 0.10, 26.84). Melanoma cancer the risk estimate for medium high versus low was 6.78 (95% Confidence Interval 0.75, 61.06). For Colon cancer the risk estimate for medium high versus low exposure was 1.67 (95% Confidence Interval 0.10, 26.84). Colorectal cancer risk estimate for medium high versus low exposure was 2.52 (95% Confidence Interval 0.42, 15.22). Prostate cancer risk estimate for medium high versus low exposure was 1.11 (95% Confidence Interval 0.31, 3.99). **Total cancer risk estimate for medium high versus low exposure was 2.89 (95% Confidence Interval 1.48, 5.64).** No data were obtained from Esophageal cancer, Renal cancer, or Skin cancer from our database. For Hodgkin's Lymphoma cancer, Breast cancer, Lung and Bronchus cancer, Stomach cancer, Bladder cancer, Hepatic cancer, Leukemia cancer, and Lymphoma cancer the risk estimate for medium high versus low the model was unable to generate an estimate.

Table 22. Unadjusted Risk Estimates For Confirmed Specific Cancers Among Police Officers by combined High and Medium versus Low Exposures

1) HODGKIN'S LYMPHOMA (Confirmed)

Variables	Risk Estimates	95% Confidence Interval	
Exposure			
Low	1.00 (Ref.)		
Med-High	NA	NA	NA

2) THYROID (Confirmed)

Variables	Risk Estimates	95% Confidence Interval	
Exposure			
Low	1.00 (Ref.)		
Med-High	1.67	0.10	26.84

3) ESOPHAGEAL (Confirmed)

Variables	Risk Estimates	95% Confidence Interval	
Exposure			
Not applicable	NA	NA	NA

4) BREAST (Confirmed)

Variables	Risk Estimates	95% Confidence Interval
Exposure		

Low	1.00 (Ref.)		
Med-High	NA	NA	NA

5) OTHER (Confirmed)

Variables	Risk Estimates	95% Confidence Interval	
Exposure			
Low	1.00 (Ref.)		
Med-High	3.36	0.30	37.24

6) LUNG AND BRONCHUS (Confirmed)

Variables	Risk Estimates	95% Confidence Interval	
Exposure			
Low	1.00 (Ref.)		
Med-High	NA	NA	NA

7) RECTUM (Confirmed)

Variables	Risk Estimates	95% Confidence Interval	
Exposure			
Low	1.00 (Ref.)		
Med-High	3.36	0.30	37.24

8) NHL (Confirmed)

Variables	Risk Estimates	95% Confidence Interval	
Exposure			
Low	1.00 (Ref.)		
Med-High	6.78	0.75	61.06

9) STOMACH (Confirmed)

Variables	Risk Estimates	95% Confidence Interval	
Exposure			
Low	1.00 (Ref.)		
Med-High	NA	NA	NA

10) TESTIS (Confirmed)

Variables	Risk Estimates	95% Confidence Interval	
Exposure			
Low	1.00 (Ref.)		
Med-High	1.67	0.10	26.84

11)MELANOMA (Confirmed)

Variables	Risk Estimates	95% Confidence Interval	
Exposure			
Low	1.00 (Ref.)		
Med-High	6.78	0.75	61.06

12) BLADDER (Confirmed)

Variables	Risk Estimates	95% Confidence Interval	
Exposure			
Low	1.00 (Ref.)		
Med-High	NA	NA	NA

13) COLON (Confirmed)

Variables	Risk Estimates	95% Confidence Interval	
Exposure			
Low	1.00 (Ref.)		
Med-High	1.67	0.10	26.84

14) COLORECTAL (Confirmed)

Variables	Risk Estimates	95% Confidence Interval	
Exposure			
Low	1.00 (Ref.)		
Med-High	2.52	0.42	15.22

15) PROSTATE (Confirmed)

Variables	Risk Estimates	95% Confidence Interval	
Exposure			
Low	1.00 (Ref.)		
Med-High	1.11	0.31	3.99

16)HEPATIC (Confirmed)

Variables	Risk Estimates	95% Confidence Interval	
Exposure			
Low	1.00 (Ref.)		
Med-High	NA	NA	NA

17) LEUKEMIA

Variables	Risk Estimates	95% Confidence Interval	
Exposure			
Not applicable	NA	NA	NA

18) RENAL (Confirmed)

Variables	Risk Estimates	95% Confidence Interval	
Exposure			
Not applicable	NA	NA	NA

19) LYMPHOMA (Confirmed)

Variables	Risk Estimates	95% Confidence Interval	
Exposure			
Low	1.00 (Ref.)		
Med-High	NA	NA	NA

20) SKIN

Variables	Risk Estimates	95% Confidence Interval	
Exposure			
Not applicable	NA	NA	NA

20) TOTAL (Confirmed)

Variables	Risk Estimates	95% Confidence Interval	
Exposure			
Low	1.00 (Ref.)		
Med-High	2.89	1.48	5.64

<u>Risk Estimates Adjusted for Age For Any Reported Specific Cancers Among Police Officers by combined High and Medium versus Low Exposures</u>

Thyroid cancer the risk estimate for medium high versus low exposure was 0.91 (95% Confidence Interval 0.08, 10.57). For Other cancer the risk estimate for medium high versus low exposure was 1.72 (95% Confidence Interval 0.23, 12.65). Rectal cancer the risk estimate for medium high versus low exposure was 3.10 (95% Confidence Interval 0.29, 12.65). NHL cancer risk estimate for medium high versus low was 6.81 (95% Confidence Interval 0.73, 63.83). For Testis cancer the risk estimates for medium high versus low exposure was 1.55 (95% Confidence Interval 0.22, 11.15). Melanoma cancer the risk estimate for medium high versus low was 4.77 (95% Confidence Interval 0.95, 24.00). For Colon cancer the risk estimate for medium high versus low exposure was 1.78 (95% Confidence Interval 0.10, 30.38). Colorectal cancer risk estimate for medium high versus low exposure was 2.43 (95% Confidence Interval 0.39, 14.98). Prostate cancer risk estimate for medium high versus low exposure was 2.36 (95% Confidence Interval 0.58, 9.63). Lymphoma cancer risk estimate for medium high versus low exposure was 6.45 (95% Confidence Interval 0.71, 58.92). Skin cancer risk estimate for medium high versus low exposure was 1.04 (95% Confidence Interval 0.48, 2.53). **Total cancer risk estimate for medium high versus low exposure was 3.36 (95% Confidence Interval 1.79, 6.30).** No data were obtained from Hodgkin's Lymphoma cancer or Esophageal cancer from our database. For Breast cancer, Lung and Bronchus cancer, Stomach cancer, Bladder cancer, Hepatic cancer, Leukemia cancer, and Renal cancer the risk estimate for medium high versus low the model was unable to generate an estimate.

Table 23. Adjusted Risk Estimates For Any Reported Specific Cancers Among Police Officers by combined High and Medium versus Low Exposures

1) HODGKIN'S LYMPHOMA

Variables	Risk Estimates	95% Confidence Interval	
Exposure			
Not Applicable	NA	NA	NA
Age	NA	NA	NA

2) THYROID

Variables	Risk Estimates	95% Confidence Interval	
Exposure			
Low	1.00 (Ref.)		
Med and High	0.91	0.08	10.57
Age	0.97	0.87	1.09

3) ESOPHAGEAL

Variables	Risk Estimates	95% Confidence Interval	
Exposure			
Not Applicable	NA	NA	NA
Age	NA	NA	NA

4) BREAST

Variables	Risk Estimates	95% Confidence Interval	
Exposure			
Low	1.00 (Ref.)		
Med and High	NA	NA	NA
Age	1.06	0.95	1.18

5) OTHER

Variables	Risk Estimates	95% Confidence Interval	
Exposure			
Low	1.00 (Ref.)		
Med and High	1.72	0.23	12.65
Age	0.99	0.90	1.09

6) LUNG AND BRONCHUS

Variables	Risk Estimates	95% Confidence Interval	
Exposure			
Low	1.00 (Ref.)		
Med and High	NA	NA	NA
Age	1.21	0.98	1.50

7) RECTUM

Variables	Risk Estimates	95% Confidence Interval	
Exposure			
Low	1.00 (Ref.)		
Med and High	3.10	0.28	34.60
Age	1.06	0.96	1.18

8) NHL

Variables	Risk Estimates	95% Confidence Interval	
Exposure			
Low	1.00 (Ref.)		
Med and High	6.81	0.73	63.83
Age	1.10	1.01	1.20

9) STOMACH

Variables	Risk Estimates	95% Confidence Interval	
Exposure			
Low	1.00 (Ref.)		
Med and High	NA	NA	NA
Age	0.56	0.24	1.31

10) TESTIS

Variables	Risk Estimates	95% Confidence Interval	
Exposure			
Low	1.00 (Ref.)		
Med and High	1.55	0.22	11.15
Age	1.03	0.95	1.13

11) Melanoma

Variables	Risk Estimates	95% Confidence Interval	
Exposure			
Low	1.00 (Ref.)		
Med and High	4.77	0.95	24.00
Age	1.06	1.00	1.13

12) BLADDER

Variables	Risk Estimates	95% Confidence Interval	
Exposure			
Low	1.00 (Ref.)		
Med and High	NA	NA	NA
Age	4.21	0.23	78.81

13) COLON

Variables	Risk Estimates	95% Confidence Interval	
Exposure			
Low	1.00 (Ref.)		
Med and High	1.78	0.10	30.38
Age	1.13	1.00	1.27

14) COLORECTAL

Variables	Risk Estimates	95% Confidence Interval	
Exposure			
Low	1.00 (Ref.)		
Med and High	2.43	0.39	14.98
Age	1.09	1.01	1.18

15) PROSTATE

Variables	Risk Estimates	95% Confidence Interval	
Exposure			
Low	1.00 (Ref.)		
Med and High	2.36	0.58	9.63
Age	1.14	1.07	1.21

16) HEPATIC

Variables	Risk Estimates	95% Confidence Interval	
Exposure			
Low	1.00 (Ref.)		
Med and High	NA	NA	NA
Age	0.99	0.85	1.16

17) LEUKEMIA

Variables	Risk Estimates	95% Confidence Interval	
Exposure			
Low	1.00 (Ref.)		
Med and High	NA	NA	NA
Age	1.18	0.97	1.43

18) RENAL

Variables	Risk Estimates	95% Confidence Interval	
Exposure			
Low	1.00 (Ref.)		
Med and High	NA	NA	NA
Age	0.97	0.85	1.10

19) LYMPHOMA

Variables	Risk Estimates	95% Confidence Interval	
Exposure			
Low	1.00 (Ref.)		
Med and High	6.45	0.71	58.92
Age	1.08	0.99	1.17

20) SKIN

Variables	Risk Estimates	95% Confidence Interval	
Exposure			
Low	1.00 (Ref.)		
Med and High	1.04	0.48	2.53
Age	1.09	1.06	1.13

21) TOTAL

Variables	Risk Estimates	95% Confidence Interval	
Exposure			
Low	1.00 (Ref.)		
Med and High	3.36	1.79	6.30
Age	1.08	1.05	1.11

Risk Estimates Adjusted for Age For Specific Confirmed Cancers Among Police Officers by combined High and Medium versus Low Exposures

Thyroid cancer the risk estimate for medium high versus low exposure was 1.57 (95% Confidence Interval 0.10, 25.49). For Other cancer the risk estimate for medium high versus low exposure was 3.10 (95% Confidence Interval 0.28, 34.50). Rectal cancer the risk estimate for medium high versus low exposure was 3.10 (95% Confidence Interval 0.28, 34.50). NHL cancer risk estimate for medium high versus low was 6.80 (95% Confidence Interval 0.73, 63.33). For Testis cancer the risk estimates for medium high versus low exposure was 1.53 (95% Confidence Interval 0.10, 24.66). Melanoma cancer the risk estimate for medium high versus low was 6.89 (95% Confidence Interval 0.74, 64.45). For Colon cancer the risk estimate for medium high versus low exposure was 1.77 (95% Confidence Interval 0.10, 30.72). Colorectal cancer risk estimate for medium high versus low exposure was 2.42 (95% Confidence Interval 0.39, 14.95). Prostate cancer risk estimate for medium high versus low exposure was 2.50 (95% Confidence Interval 0.51, 12.21). **Total cancer risk estimate for medium high versus low exposure was 4.25 (95% Confidence Interval 1.93, 9.31).**

No data were obtained from Hodgkin's Lymphoma cancer, Esophageal cancer, Leukemia cancer, Renal cancer, or Skin cancer from our database. For Breast cancer, Lung and Bronchus cancer, Stomach cancer, Hepatic cancer, and Lymphoma cancer the risk estimate for medium high versus low the model was unable to generate an estimate.

Table 24. Adjusted Risk Estimates For Confirmed Specific Cancers Among Police Officers by combined High and Medium versus Low Exposures

1) HODGKIN'S LYMPHOMA (Confirmed)

Variables	Risk Estimates	95% Confidence Interval	
Exposure			
Not Applicable	NA	NA	NA
Age	NA	NA	NA

2) THYROID (Confirmed)

Variables	Risk Estimates	95% Confidence Interval	
Exposure			
Low	1.00 (Ref.)		
Med and High	1.57	0.10	25.49
Age	1.02	0.90	1.16

3) ESOPHAGEAL (Confirmed)

Variables	Risk Estimates	95% Confidence Interval	
Exposure			
Not Applicable	NA	NA	NA
Age	NA	NA	NA

4) BREAST (Confirmed)

Variables	Risk Estimates	95% Confidence Interval	
Exposure			
Low	1.00 (Ref.)		
Med and High	NA	NA	NA
Age	1.07	0.92	1.25

5) OTHER (Confirmed)

Variables	Risk Estimates	95% Confidence Interval	
Exposure			
Low	1.00 (Ref.)		
Med and High	3.10	0.28	34.50
Age	1.04	0.93	1.15

6) LUNG AND BRONCHUS

Variables	Risk Estimates	95% Confidence Interval
Exposure		

Low	1.00 (Ref.)		
Med and High	NA	NA	NA
Age	1.21	0.98	1.50

7) RECTUM (Confirmed)

Variables	Risk Estimates	95% Confidence Interval	
Exposure			
Low	1.00 (Ref.)		
Med and High	3.10	0.28	34.51
Age	1.06	0.96	1.18

8) NHL (Confirmed)

Variables	Risk Estimates	95% Confidence Interval	
Exposure			
Low	1.00 (Ref.)		
Med and High	6.80	0.73	63.33
Age	1.10	1.01	1.20

9) STOMACH (Confirmed)

Variables	Risk Estimates	95% Confidence Interval	
Exposure			
Low	1.00 (Ref.)		
Med and High	NA	NA	NA
Age	0.56	0.24	1.31

10) TESTIS (Confirmed)

Variables	Risk Estimates	95% Confidence Interval	
Exposure			
Low	1.00 (Ref.)		
Med and High	1.53	0.10	24.66
Age	1.05	0.93	1.18

11) Melanoma (Confirmed)

Variables	Risk Estimates	95% Confidence Interval	
Exposure			
Low	1.00 (Ref.)		
Med and High	6.89	0.74	64.45
Age	1.10	1.02	1.20

12) BLADDER (Confirmed)

Variables	Risk Estimates	95% Confidence Interval	
Exposure			
Low	1.00 (Ref.)		

Med and High	NA	NA	NA
Age	4.21	0.22	78.95

13) COLON (Confirmed)

Variables	Risk Estimates	95% Confidence Interval	
Exposure			
Low	1.00 (Ref.)		
Med and High	1.77	0.10	30.37
Age	1.13	1.00	1.27

14) COLORECTAL (Confirmed)

Variables	Risk Estimates	95% Confidence Interval	
Exposure			
Low	1.00 (Ref.)		
Med and High	2.42	0.39	14.96
Age	1.09	1.01	1.18

15) PROSTATE (Confirmed)

Variables	Risk Estimates	95% Confidence Interval	
Exposure			
Low	1.00 (Ref.)		
Med and High	2.50	0.51	12.21
Age	1.14	1.06	1.22

16) HEPATIC (Confirmed)

Variables	Risk Estimates	95% Confidence Interval	
Exposure			
Low	1.00 (Ref.)		
Med and High	NA	NA	NA
Age	0.99	0.85	1.16

17) LEUKEMIA (Confirmed)

Variables	Risk Estimates	95% Confidence Interval	
Exposure			
Not Applicable	NA	NA	NA
Age	NA	NA	NA

18) RENAL (Confirmed)

Variables	Risk Estimates	95% Confidence Interval	
Exposure			
Not Applicable	NA	NA	NA
Age	NA	NA	NA

19) LYMPHOMA (Confirmed)

Variables	Risk Estimates	95% Confidence Interval	
Exposure			
Low	1.00 (Ref.)		
Med and High	NA	NA	NA
Age	1.11	0.97	1.27

20) SKIN (Confirmed)

Variables	Risk Estimates	95% Confidence Interval	
Exposure			
Not Applicable	NA	NA	NA
Age	NA	NA	NA

21) TOTAL (Confirmed)

Variables	Risk Estimates	95% Confidence Interval	
Exposure			
Low	1.00 (Ref.)		
Med and High	4.25	1.93	9.34
Age	1.11	1.07	1.15

FIREFIGHTERS

Unadjusted Risk Estimates for Any Reported Specific Cancers among Firefighters by High, Medium and Low Exposures

Hodgkin's Lymphoma cancer risk estimate for medium versus low exposure was 2.31 (95% confidence interval 0.14, 37.26) and for high versus low exposure the model was unable to generate an estimate. For Thyroid cancer risk estimate for medium versus low exposure the model was unable to generate an estimate but for high versus low exposure the risk estimate was 2.50 (95% confidence interval 0.16, 41.86). For Other cancer risk estimates for medium versus low exposure, the model was unable to generate an estimate but for high versus low exposure the risk estimate was 2.60 (95% confidence interval 0.16, 41.86). Prostate cancer risk estimate for medium versus low exposure was 3.51 (95% confidence interval 0.58, 21.26) and for high versus low exposure the risk estimate was 3.95 (95% confidence interval 0.65, 23.95). Lymphoma cancer risk estimate for medium versus low exposure was 2.31 (95% confidence interval 0.14, 37.26) and for high versus low exposure the model was unable to generate an estimate. Skin cancer risk estimate for medium versus low exposure was 3.35 (95% confidence interval 1.04, 10.76) and risk estimate for **high versus low exposure was 3.79 (95%confidence interval 1.18, 12.18).** For Rectum, NHL, Melanoma, Bladder, Colorectal, Leukemia and Renal cancer risk estimate both medium versus low and high versus low, the model was unable to generate an estimate. No data were obtained regarding Esophageal, Lung and Bronchus, Stomach, Testis and Hepatic cancer from out database. **The Total Cancer risk estimate for medium versus low exposure was 3.11 (95% confidence interval 1.13, 8.53) and risk estimate for high versus low exposure was 3.52 (95% confidence interval 1.28, 9.68).**

Table 25 . Risk Estimates for Any Reported Specific Cancers Among Firefighters by High, Medium and Low Exposures

1) HODGKIN'S LYMPHOMA			
Variables	Risk Estimate	95% Confidence Interval	
Exposure			
Low	1.00 (Ref.)		
Medium	2.31	0.14	37.26
High	NA	NA	NA
2) THYROID			
Variables	Risk Estimate	95% Confidence Interval	
Exposure			
Low	1.00 (Ref.)		
Medium	NA	NA	NA
High	2.60	0.16	41.86
3) ESOPHAGEAL			
Variables	Risk Estimate	95% Confidence Interval	
Exposure			
Not applicable	NA	NA	NA
4) BREAST			
Variables	Risk Estimate	95% Confidence Interval	
Exposure			
Not applicable	NA	NA	NA
5) OTHER			
Variables	Risk Estimate	95% Confidence Interval	
Exposure			
Low	1.00 (Ref.)		
Medium	NA	NA	NA
High	2.60	0.16	41.86
6) LUNG AND BRONCHUS			
Variables	Risk Estimate	95% Confidence Interval	
Exposure			
Not applicable	NA	NA	NA
7) RECTUM			
Variables	Risk Estimate	95% Confidence Interval	
Exposure			
Low	1.00 (Ref.)		

Medium	NA	NA	NA
High	NA	NA	NA

8) NHL

Variables	Risk Estimate	95% Confidence Interval	
Exposure			
Low	1.00 (Ref.)		
Medium	NA	NA	NA
High	NA	NA	NA

9) STOMACH

Variables	Risk Estimate	95% Confidence Interval	
Exposure			
Not applicable	NA	NA	NA

10)TESTIS

Variables	Risk Estimate	95% Confidence Interval	
Exposure			
Not applicable	NA	NA	NA

11) MELANOMA

Variables	Risk Estimate	95% Confidence Interval	
Exposure			
Low	1.00 (Ref.)		
Medium	NA	NA	NA
High	NA	NA	NA

12) BLADDER

Variables	Risk Estimate	95% Confidence Interval	
Exposure			
Low	1.00 (Ref.)		
Medium	NA	NA	NA
High	NA	NA	NA

13) COLON

Variables	Risk Estimate	95% Confidence Interval	
Exposure			
Not applicable	NA	NA	NA

14) COLORECTAL

Variables	Risk Estimate	95% Confidence Interval	
Exposure			
Low	1.00 (Ref.)		

Medium	NA	NA	NA
High	NA	NA	NA

15) PROSTATE

Variables	Risk Estimate	95% Confidence Interval	
Exposure			
Low	1.00 (Ref.)		
Medium	3.51	0.58	21.26
High	3.95	0.65	23.95

16) HEPATIC

Variables	Risk Estimate	95% Confidence Interval	
Exposure			
Not applicable	NA	NA	NA

17) LEUKEMIA

Variables	Risk Estimate	95% Confidence Interval	
Exposure			
Low	1.00 (Ref.)		
Medium	NA	NA	NA
High	0.63	<0.001	>999.999

18) RENAL

Variables	Risk Estimate	95% Confidence Interval	
Exposure			
Low	1.00 (Ref.)		
Medium	0.63	<0.001	>999.999
High	NA	NA	NA

19) LYMPHOMA

Variables	Risk Estimate	95% Confidence Interval	
Exposure			
Low	1.00 (Ref.)		
Medium	2.31	0.14	37.26
High	NA	NA	NA

20) SKIN

Variables	Risk Estimate	95% Confidence Interval	
Exposure			
Low	1.00 (Ref.)		
Medium	3.35	1.04	10.76
High	3.79	1.18	12.18

21) TOTAL			
Variables	Risk Estimate	95% Confidence Interval	
Exposure			
Low	1.00 (Ref.)		
Medium	3.11	1.13	8.53
High	3.52	1.28	9.68

Unadjusted Risk Estimates for Specific Confirmed Cancers among Firefighters by High, Medium and Low Exposures

For Hodgkin's Lymphoma, Other, Rectum, NHL, Melanoma, Bladder, Colorectal, Prostate, Leukemia and Lymphoma cancer risk estimate for both medium versus low and high versus low, the model was unable to generate an estimate. No data were obtained regarding Thyroid, Esophageal, Breast, Lung and Bronchus, Stomach, Testis, Colon, Hepatic and Renal cancer from our database. **The Total Cancer risk estimate for medium versus low exposure was 8.52 (95% 1.75, 41.59) and from high versus low exposure the risk estimate was 6.69 (95% confidence interval 1.28, 34.98).**

Table 26 Risk Estimates for Specific Confirmed Cancers Among Firefighters by High, Medium and Low Exposures

1) HODGKIN'S LYMPHOMA (Confirmed)			
Variables	Risk Estimate	95% Confidence Interval	
Exposure			
Low	1.00 (Ref.)		
Medium	NA	NA	NA
High	NA	NA	NA

2) THYROID (Confirmed)			
Variables	Risk Estimate	95% Confidence Interval	
Exposure			
Not applicable	NA	NA	NA

3)ESOPHAGEAL (Confirmed)			
Variables	Risk Estimate	95% Confidence Interval	
Exposure			
Not applicable	NA	NA	NA

4) BREAST (Confirmed)

Variables	Risk Estimate	95% Confidence Interval	
Exposure			
Not applicable	NA	NA	NA

5) OTHER (Confirmed)

Variables	Risk Estimate	95% Confidence Interval	
Exposure			
Low	1.00 (Ref.)		
Medium	0.63	<0.001	>999.999
High	NA	NA	NA

6) LUNG AND BRONCHUS (Confirmed)

Variables	Risk Estimate	95% Confidence Interval	
Exposure			
Not applicable	NA	NA	NA

7) RECTUM (Confirmed)

Variables	Risk Estimate	95% Confidence Interval	
Exposure			
Low	1.00 (Ref.)		
Medium	NA	NA	NA
High	NA	NA	NA

8) NHL (Confirmed)

Variables	Risk Estimate	95% Confidence Interval	
Exposure			
Low	1.00 (Ref.)		
Medium	NA	NA	NA
High	NA	NA	NA

9) STOMACH (Confirmed)

Variables	Risk Estimate	95% Confidence Interval	
Exposure			
Not applicable	NA	NA	NA

10) TESTIS (Confirmed)

Variables	Risk Estimate	95% Confidence Interval	
Exposure			
Not applicable	NA	NA	NA

11) MELANOMA (Confirmed)

Variables	Risk Estimate	95% Confidence Interval	
Exposure			
Low	1.00 (Ref.)		
Medium	NA	NA	NA
High	0.63	<0.001	>999.999

12) BLADDER (Confirmed)

Variables	Risk Estimate	95% Confidence Interval	
Exposure			
Low	1.00 (Ref.)		
Medium	NA	NA	NA
High	NA	NA	NA

13) COLON (Confirmed)

Variables	Risk Estimate	95% Confidence Interval	
Exposure			
Not applicable	NA	NA	NA

14) COLORECTAL (Confirmed)

Variables	Risk Estimate	95% Confidence Interval	
Exposure			
Low	1.00 (Ref.)		
Medium	NA	NA	NA
High	NA	NA	NA

15) PROSTATE (Confirmed)

Variables	Risk Estimate	95% Confidence Interval	
Exposure			
Low	1.00 (Ref.)		
Medium	NA	NA	NA
High	NA	NA	NA

16) HEPATIC (Confirmed)			
Variables	Risk Estimate	95% Confidence Interval	
Exposure			
Not applicable	NA	NA	NA
17) LEUKEMIA (Confirmed)			
Variables	Risk Estimate	95% Confidence Interval	
Exposure			
Low	1.00 (Ref.)		
Medium	NA	NA	NA
High	0.63	<0.001	>999.999
18) RENAL (Confirmed)			
Variables	Risk Estimate	95% Confidence Interval	
Exposure			
Not applicable	NA	NA	NA
19) LYMPHOMA (Confirmed)			
Variables	Risk Estimate	95% Confidence Interval	
Exposure			
Low	1.00 (Ref.)		
Medium	NA	NA	NA
High	0.63	<0.001	>999.999
20) TOTAL (Confirmed)			
Variables	Risk Estimate	95% Confidence Interval	
Exposure			
Low	1.00 (Ref.)		
Medium	8.52	1.75	41.59
High	6.69	1.28	34.98

Risk Estimates Adjusted for Age for Any Reported Specific Cancers among Firefighters by High, Medium and Low Exposures

Hodgkin's Lymphoma cancer risk estimate for medium versus low exposure was 1.81 (95% confidence interval 0.09, 36.09), for high versus low exposure the model was unable to generate an estimate. For Thyroid cancer, risk estimate for medium versus low exposure the model was unable to generate an estimate, high versus low exposure risk estimate was 1.71 (95% confidence interval 0.05, 64.15). For Other cancer, risk estimate for medium versus low exposure the model was unable to generate an estimate, high versus low exposure risk estimate was 0.68 (95% confidence interval 0.02, 21.10. Prostate risk cancer estimate for medium versus low exposure was 1.25 (95% confidence interval 0.18, 8.62), high versus low exposure was 0.60 (95% confidence interval 0.08, 4.87). Lymphoma cancer risk estimate for medium versus low exposure was 0.67 (95% confidence interval 0.03, 15.06), for high versus low exposure the model was unable to generate an estimate. Skin cancer risk estimate for medium versus low exposure was 2.05 (95% confidence interval 0.60, 7.03), high versus low exposure was 1.44 (95% confidence interval 0.37, 5.58). For Rectum, NHL, Melanoma, Bladder, Colorectal, Leukemia and Renal cancer risk estimate both medium versus low and high versus low, the model was unable to generate an estimate. No data were obtained regarding Esophageal, Breast, Lung and Bronchus, Stomach, Testis and Hepatic cancer from our database. The Cancer total risk estimate for medium versus low exposure was 1.56 (95% confidence interval 0.53, 4.62), high versus low exposure was 0.94 (95% confidence interval 0.29, 3.04).

Table 27. Adjusted Risk Estimates For Any Reported Specific Cancers Among Firefighters by High, Medium and Low Exposures

1) HODGKIN'S LYMPHOMA

Variables	Risk Estimate	95% Confidence Interval	
Exposure			
Low	1.00 (Ref.)		
Medium	1.81	0.09	36.09
High	NA	NA	NA
Age	1.03	0.91	1.17

2) THYROID

Variables	Risk Estimate	95% Confidence Interval	
Exposure			
Low	1.00 (Ref.)		
Medium	NA	NA	NA
High	1.71	0.05	64.15
Age	1.03	0.89	1.18

3) ESOPHAGEAL

Variables	Risk Estimate	95% Confidence Interval	
Exposure			
Not applicable	NA	NA	NA
Age	NA	NA	NA

4) BREAST

Variables	Risk Estimate	95% Confidence Interval	
Exposure			
Not applicable	NA	NA	NA
Age	NA	NA	NA

5) OTHER

Variables	Risk Estimate	95% Confidence Interval	
Exposure			
Low	1.00 (Ref.)		
Medium	NA	NA	NA
High	0.68	0.02	21.10
Age	1.08	0.96	1.22

6) LUNG AND BRONCHUS

Variables	Risk Estimate	95% Confidence Interval	
Exposure			
Not applicable	NA	NA	NA
Age	NA	NA	NA

7) RECTUM

Variables	Risk Estimate	95% Confidence Interval	
Exposure			
Low	1.00 (Ref.)		
Medium	NA	NA	NA
High	NA	NA	NA
Age	1.05	0.92	1.19

8) NHL

Variables	Risk Estimate	95% Confidence Interval	
Exposure			
Low	1.00 (Ref.)		
Medium	NA	NA	NA
High	NA	NA	NA
Age	0.97	0.77	1.23

9) STOMACH

Variables	Risk Estimate	95% Confidence Interval	
Exposure			
Not applicable	NA	NA	NA
Age	NA	NA	NA

10) TESTIS

Variables	Risk Estimate	95% Confidence Interval	
Exposure			
Not applicable	NA	NA	NA
Age	NA	NA	NA

11) MELANOMA

Variables	Risk Estimate	95% Confidence Interval	
Exposure			
Low	1.00 (Ref.)		
Medium	NA	NA	NA
High	NA	NA	NA
Age	1.01	0.91	1.13

12) BLADDER

Variables	Risk Estimate	95% Confidence Interval	
Exposure			
Low	1.00 (Ref.)		
Medium	NA	NA	NA
High	NA	NA	NA
Age	1.14	1.02	1.28

13) COLON

Variables	Risk Estimate	95% Confidence Interval	
Exposure			
Not applicable	NA	NA	NA
Age	NA	NA	NA

14) COLORECTAL

Variables	Risk Estimate	95% Confidence Interval	
Exposure			
Low	1.00 (Ref.)		
Medium	NA	NA	NA
High	NA	NA	NA
Age	1.05	0.92	1.19

15) PROSTATE

Variables	Risk Estimate	95% Confidence Interval	
Exposure			
Low	1.00 (Ref.)		
Medium	1.25	0.18	8.62
High	0.60	0.08	4.87
Age	1.13	1.05	1.20

16) HEPATIC

Variables	Risk Estimate	95% Confidence Interval	
Exposure			

Not applicable	NA	NA	NA
Age	NA	NA	NA

17) LEUKEMIA

Variables	Risk Estimate	95% Confidence Interval	
Exposure			
Low	1.00 (Ref.)		
Medium	NA	NA	NA
High	0.15	<0.001	>999.999
Age	1.09	0.92	1.29

18) RENAL

Variables	Risk Estimate	95% Confidence Interval	
Exposure			
Low	1.00 (Ref.)		
Medium	0.26	<0.001	>999.999
High	NA	NA	NA
Age	1.10	0.95	1.28

19) LYMPHOMA

Variables	Risk Estimate	95% Confidence Interval	
Exposure			
Low	1.00 (Ref.)		
Medium	0.67	0.03	15.06
High	NA	NA	NA
Age	1.14	1.00	1.31

20) SKIN

Variables	Risk Estimate	95% Confidence Interval	
Exposure			
Low	1.00 (Ref.)		
Medium	2.05	0.60	7.03
High	1.44	0.37	5.58
Age	1.06	1.02	1.11

21) TOTAL

Variables	Risk Estimate	95% Confidence Interval	
Exposure			
Low	1.00 (Ref.)		
Medium	1.56	0.53	4.62
High	0.94	0.29	3.04
Age	1.09	1.05	1.13

Adjusted Risk Estimates For Specific Confirmed Cancers among Firefighters by High, Medium and Low Exposures

For Hodgkin's Lymphoma, Other, Rectum, NHL, Melanoma, Bladder, Prostate, Leukemia, and Lymphoma cancer risk estimate both medium versus low and high versus low, the model was unable to generate an estimate. No data were obtained for Thyroid, Esophageal, Breast, Lung and Bronchus, Stomach, Testis, Colorectal, Hepatic and Renal cancer from our database. The total cancer risk estimate for medium versus low exposure was 3.87 (95% confidence interval 0.74, 20.24) and high versus low exposure was 1.43 (95% confidence interval 0.23, 8.82).

Table 28. Adjusted Risk Estimates For Specific Confirmed Cancers Among Firefighters by High, Medium and Low Exposures

1) HODGKIN'S LYMPHOMA (Confirmed)

Variables	Risk Estimate	95% Confidence Interval	
Exposure			
Low	1.00 (Ref.)		
Medium	<0.001	<0.001	>999.999
High	<0.001	<0.001	>999.999
Age	1.06	0.88	1.27

2) THYROID (Confirmed)

Variables	Risk Estimate	95% Confidence Interval	
Exposure			
Not applicable	NA	NA	NA
Age	NA	NA	NA

3) ESOPHAGEAL (Confirmed)

Variables	Risk Estimate	95% Confidence Interval	
Exposure			
Not applicable	NA	NA	NA
Age	NA	NA	NA

4) BREAST (Confirmed)

Variables	Risk Estimate	95% Confidence Interval	
Exposure			
Not applicable	NA	NA	NA
Age	NA	NA	NA

5) OTHER (Confirmed)

Variables	Risk Estimate	95% Confidence Interval	
Exposure			
Low	1.00 (Ref.)		
Medium	0.45	<0.001	>999.999
High	NA	NA	NA

Age	1.04	0.86	1.26

6) LUNG AND BRONCHUS (Confirmed)

Variables	Risk Estimate	95% Confidence Interval	
Exposure			
Not applicable	NA	NA	NA
Age	NA	NA	NA

7) RECTUM (Confirmed)

Variables	Risk Estimate	95% Confidence Interval	
Exposure			
Low	1.00 (Ref.)		
Medium	NA	NA	NA
High	NA	NA	NA
Age	1.05	0.92	1.19

8) NHL (Confirmed)

Variables	Risk Estimate	95% Confidence Interval	
Exposure			
Low	1.00 (Ref.)		
Medium	NA	NA	NA
High	NA	NA	NA
Age	0.97	0.77	1.22

9) STOMACH (Confirmed)

Variables	Risk Estimate	95% Confidence Interval	
Exposure			
Not applicable	NA	NA	NA
Age	NA	NA	NA

10) TESTIS (Confirmed)

Variables	Risk Estimate	95% Confidence Interval	
Exposure			
Not applicable	NA	NA	NA
Age	NA	NA	NA

11) MELANOMA (Confirmed)

Variables	Risk Estimate	95% Confidence Interval	
Exposure			
Low	1.00 (Ref.)		
Medium	>999.999	<0.001	>999.999
High	<0.001	<0.001	>999.999
Age	1.65	0.52	5.23

12) BLADDER (Confirmed)

Variables	Risk Estimate	95% Confidence Interval	
Exposure			
Low	1.00 (Ref.)		
Medium	NA	NA	NA
High	NA	NA	NA
Age	1.14	1.02	1.28

13) COLON (Confirmed)

Variables	Risk Estimate	95% Confidence Interval	
Exposure			
Not applicable	NA	NA	NA
Age	NA	NA	NA

14) COLORECTAL (Confirmed)

Variables	Risk Estimate	95% Confidence Interval	
Exposure			
Low	1.00 (Ref.)		
Medium	NA	NA	NA
High	NA	NA	NA
Age	1.05	0.92	1.19

15) PROSTATE (Confirmed)

Variables	Risk Estimate	95% Confidence Interval	
Exposure			
Low	1.00 (Ref.)		
Medium	NA	NA	NA
High	NA	NA	NA
Age	1.11	1.03	1.20

16) HEPATIC (Confirmed)

Variables	Risk Estimate	95% Confidence Interval	
Exposure			
Not applicable	NA	NA	NA
Age	NA	NA	NA

17) LEUKEMIA (Confirmed)

Variables	Risk Estimate	95% Confidence Interval	
Exposure			
Low	1.00 (Ref.)		
Medium	NA	NA	NA
High	0.15	<0.001	>999.999
Age	1.09	0.92	1.29

18) RENAL (Confirmed)

Variables	Risk Estimate	95% Confidence Interval	
Exposure			
Not applicable	NA	NA	NA
Age	NA	NA	NA

19) LYMPHOMA (Confirmed)

Variables	Risk Estimate	95% Confidence Interval	
Exposure			
Low	1.00 (Ref.)		
Medium	NA	NA	NA
High	NA	NA	NA
Age	1.65	0.52	5.23

20) TOTAL (Confirmed)

Variables	Risk Estimate	95% Confidence Interval	
Exposure			
Low	1.00 (Ref.)		
Medium	3.87	0.74	20.24
High	1.43	0.23	8.82
Age	1.10	1.05	1.16

Unadjusted Risk Estimates For Any Reported Specific Cancers Among Firefighters by combined High and Medium versus Low Exposures

For Hodgkin's Lymphoma cancer the risk estimate for med/high versus low was 1.22 (95% confidence interval 0.08, 19.58). For Thyroid cancer the risk estimate for med/high versus low was 1.22 (95% confidence interval 0.08, 19.58). For Other cancer the risk estimate for med/high versus low was 1.22 (95% confidence interval 0.08, 19.58). For Prostate cancer the risk estimate for med/high versus low was 3.72 (95% confidence interval 0.74, 18.58). For Lymphoma cancer the risk estimate for med/high versus low was 1.22 (95% confidence interval 0.08, 19.58). For **Skin cancer the risk estimate for med/high versus low was 3.55 (95% confidence interval 1.26, 10.01).** For Rectum, NHL, Melanoma, Bladder, Colorectal, Leukemia, and Renal cancer risk estimate for med/high versus low, the model was unable to generate and estimate. No data obtained for Esophageal, Breast, Lung and Bronchus, Stomach, Testis, Colon, and Hepatic cancer from our database. **For total cancer the risk estimate for med/high versus low was 3.30 (95% confidence interval 1.36, 8.04).**

Table 29. Unadjusted Risk Estimates For Any Reported Specific Cancers Among Firefighters by combined High and Medium versus Low Exposures

1) HODGKIN'S LYMPHOMA

Variables	Risk Estimate	95% Confidence Interval

Exposure			
Low	1.00 (Ref.)		
Med-High	1.22	0.08	19.58

2) THYROID

Variables	Risk Estimate	95% Confidence Interval	
Exposure			
Low	1.00 (Ref.)		
Med-High	1.22	0.08	19.58

3) ESOPHAGEAL

Variables	Risk Estimate	95% Confidence Interval	
Exposure			
Not applicable	NA	NA	NA

4) BREAST

Variables	Risk Estimate	95% Confidence Interval	
Exposure			
Not applicable	NA	NA	NA

5) OTHER

Variables	Risk Estimate	95% Confidence Interval	
Exposure			
Low	1.00 (Ref.)		
Med-High	1.22	0.08	19.58

6) LUNG AND BRONCHUS

Variables	Risk Estimate	95% Confidence Interval	
Exposure			
Not applicable	NA	NA	NA

7) RECTUM

Variables	Risk Estimate	95% Confidence Interval	
Exposure			
Low	1.00 (Ref.)		
Med-High	NA	NA	NA

8) NHL

Variables	Risk Estimate	95% Confidence Interval	
Exposure			
Low	1.00 (Ref.)		
Med-High	NA	NA	NA

9) STOMACH

Variables	Risk Estimate	95% Confidence Interval	
Exposure			
Not applicable	NA	NA	NA

10) TESTIS

Variables	Risk Estimate	95% Confidence Interval	
Exposure			
Not applicable	NA	NA	NA

11) MELANOMA

Variables	Risk Estimate	95% Confidence Interval	
Exposure			
Low	1.00 (Ref.)		
Med-High	NA	NA	NA

12) BLADDER

Variables	Risk Estimate	95% Confidence Interval	
Exposure			
Low	1.00 (Ref.)		
Med-High	NA	NA	NA

13) COLON

Variables	Risk Estimate	95% Confidence Interval	
Exposure			
Not applicable	NA	NA	NA

14) COLORECTAL

Variables	Risk Estimate	95% Confidence Interval	
Exposure			
Low	1.00 (Ref.)		
Med-High	NA	NA	NA

15) PROSTATE

Variables	Risk Estimate	95% Confidence Interval	
Exposure			
Low	1.00 (Ref.)		
Med-High	3.72	0.74	18.58

16) HEPATIC

Variables	Risk Estimate	95% Confidence Interval	
Exposure			
Not applicable	NA	NA	NA

17) LEUKEMIA

Variables	Risk Estimate	95% Confidence Interval	
Exposure			
Low	1.00 (Ref.)		
Med-High	NA	NA	NA

18) RENAL

Variables	Risk Estimate	95% Confidence Interval	
Exposure			
Low	1.00 (Ref.)		
Med-High	NA	NA	NA

19) Lymphoma

Variables	Risk Estimate	95% Confidence Interval	
Exposure			
Low	1.00 (Ref.)		
Med-High	1.22	0.08	19.58

20) SKIN

Variables	Risk Estimate	95% Confidence Interval	
Exposure			
Low	1.00 (Ref.)		
Med-High	3.55	1.26	10.01

21) TOTAL

Variables	Risk Estimate	95% Confidence Interval	
Exposure			
Low	1.00 (Ref.)		
Med-High	3.30	1.36	8.04

Unadjusted Risk Estimates For Specific Confirmed Cancers Among Firefighters by Combined High and Medium versus Low Exposures

For Hodgkin's Lymphoma, Other, NHL, Melanoma, Bladder, Colorectal, Prostate, Leukemia, and Lymphoma cancer risk estimate med/high versus low, the model was unable to generate an estimate. No data were obtained for Thyroid, Esophageal, Breast, Lung and Bronchus, Stomach, Testis, Colon, Hepatic, and Renal cancer from our database. **The total cancer risk estimate for med/high versus low exposure was 7.65 (95% confidence interval 1.70, 34.51).**

Table 30. Unadjusted Risk Estimates For Confirmed Specific Cancers Among Firefighters by combined High and Medium versus Low Exposures

1) HODGKIN'S LYMPHOMA (Confirmed)

Variables	Risk Estimate	95% Confidence Interval	
Exposure			
Low	1.00 (Ref.)		
Med-High	NA	NA	NA

2) THYROID (Confirmed)

Variables	Risk Estimate	95% Confidence Interval	
Exposure			
Not applicable	NA	NA	NA

3) ESOPHAGEAL (Confirmed)

Variables	Risk Estimate	95% Confidence Interval	
Exposure			
Not applicable	NA	NA	NA

4) BREAST (Confirmed)

Variables	Risk Estimate	95% Confidence Interval	
Exposure			
Not applicable	NA	NA	NA

5) OTHER (Confirmed)

Variables	Risk Estimate	95% Confidence Interval	
Exposure			
Low	1.00 (Ref.)		
Med-High	NA	NA	NA

6) LUNG AND BRONCHUS (Confirmed)

Variables	Risk Estimate	95% Confidence Interval	
Exposure			
Not applicable	NA	NA	NA

7) RECTUM (Confirmed)

Variables	Risk Estimate	95% Confidence Interval	
Exposure			
Low	1.00 (Ref.)		
Med-High	NA	NA	NA

8) NHL (Confirmed)

Variables	Risk Estimate	95% Confidence Interval	
Exposure			
Low	1.00 (Ref.)		
Med-High	NA	NA	NA

9) STOMACH (Confirmed)

Variables	Risk Estimate	95% Confidence Interval	
Exposure			
Not applicable	NA	NA	NA

10) TESTIS (Confirmed)

Variables	Risk Estimate	95% Confidence Interval	
Exposure			
Not applicable	NA	NA	NA

11)MELANOMA (Confirmed)

Variables	Risk Estimate	95% Confidence Interval	
Exposure			
Low	1.00 (Ref.)		
Med-High	NA	NA	NA

12) BLADDER (Confirmed)

Variables	Risk Estimate	95% Confidence Interval	
Exposure			
Low	1.00 (Ref.)		
Med-High	NA	NA	NA

13) COLON (Confirmed)

Variables	Risk Estimate	95% Confidence Interval	
Exposure			
Not applicable	NA	NA	NA

14) COLORECTAL (Confirmed)

Variables	Risk Estimate	95% Confidence Interval	
Exposure			
Low	1.00 (Ref.)		
Med-High	NA	NA	NA

15) PROSTATE (Confirmed)

Variables	Risk Estimate	95% Confidence Interval	
Exposure			
Low	1.00 (Ref.)		
Med-High	NA	NA	NA

16)HEPATIC (Confirmed)

Variables	Risk Estimate	95% Confidence Interval	
Exposure			
Not applicable	NA	NA	NA

17) Leukemia (Confirmed)

Variables	Risk Estimate	95% Confidence Interval	
Exposure			
Low	1.00 (Ref.)		
Med-High	NA	NA	NA

18) RENAL (Confirmed)

Variables	Risk Estimate	95% Confidence Interval	
Exposure			
Not applicable	NA	NA	NA

19) LYMPHOMA (Confirmed)

Variables	Risk Estimate	95% Confidence Interval	
Exposure			
Low	1.00 (Ref.)		
Med-High	NA	NA	NA

20) TOTAL (Confirmed)

Variables	Risk Estimate	95% Confidence Interval	
Exposure			
Low	1.00 (Ref.)		
Med-High	7.65	1.70	34.51

Risk Estimates Adjusted for Age for Any Reported Specific Cancers among Firefighters by Combined High and Medium versus Low Exposures

For Hodgkin's Lymphoma cancer the risk estimate for med/high versus low was 1.07 (95% confidence interval 0.040, 27.20). For Thyroid cancer the risk estimate for med/high versus low was 0.72 (95% confidence interval 0.03, 18.35). For Other cancer the risk estimate for med/high versus low was 0.37 (95% confidence interval 0.01, 9.62). For Prostate cancer the risk estimate for med/high versus low was 0.88 (95% confidence interval 0.14, 5.47). For Lymphoma cancer the risk estimate for med/high versus low was 1.77 (95% confidence interval 0.55, 5.70). For Rectum, NHL, Melanoma, Bladder, Colorectal, Leukemia, and Renal cancer risk estimate for med/high versus low, the model was unable to generate an estimate. No data were obtained regarding Esophageal, Breast, Lung and Bronchus, Stomach, Testis, Colon, and Hepatic from our data. For total cancer the risk estimate for med/high versus low was 1.24 (95% confidence interval 0.45, 3.44).

Table 31. Adjusted Risk Estimates For Any Reported Specific Cancers Among Firefighters by combined High and Medium versus Low Exposures

1) HODGKIN'S LYMPHOMA

Variables	Risk Estimate	95% Confidence Interval	
Exposure			
Low	1.00 (Ref.)		
Med and High	1.07	0.04	27.20
Age	1.01	0.88	1.16

2) THYROID

Variables	Risk Estimate	95% Confidence Interval	
Exposure			
Low	1.00 (Ref.)		
Med and High	0.72	0.03	18.35
Age	1.04	0.92	1.18

3) ESOPHAGEAL

Variables	Risk Estimate	95% Confidence Interval	
Exposure			
Not Applicable	NA	NA	NA
Age	NA	NA	NA

4) BREAST

Variables	Risk Estimate	95% Confidence Interval	
Exposure			
Not Applicable	NA	NA	NA
Age	NA	NA	NA

5) OTHER

Variables	Risk Estimate	95% Confidence Interval	
Exposure			
Low	1.00 (Ref.)		
Med and High	0.37	0.01	9.62
Age	1.09	0.98	1.23

6) LUNG AND BRONCHUS

Variables	Risk Estimate	95% Confidence Interval	
Exposure			
Not Applicable	NA	NA	NA
Age	NA	NA	NA

7) RECTUM

Variables	Risk Estimate	95% Confidence Interval	
Exposure			
Low	1.00 (Ref.)		
Med and High	NA	NA	NA
Age	1.04	0.92	1.18

8) NHL

Variables	Risk Estimate	95% Confidence Interval	
Exposure			
Low	1.00 (Ref.)		
Med and High	NA	NA	NA
Age	0.97	0.77	1.23

9) STOMACH

Variables	Risk Estimate	95% Confidence Interval	
Exposure			
Not Applicable	NA	NA	NA
Age	NA	NA	NA

10) TESTIS

Variables	Risk Estimate	95% Confidence Interval	
Exposure			
Not Applicable	NA	NA	NA
Age	NA	NA	NA

11) Melanoma

Variables	Risk Estimate	95% Confidence Interval	
Exposure			
Low	1.00 (Ref.)		
Med and High	NA	NA	NA
Age	1.00	0.90	1.11

12) BLADDER

Variables	Risk Estimate	95% Confidence Interval	
Exposure			
Low	1.00 (Ref.)		
Med and High	NA	NA	NA
Age	1.13	1.01	1.26

13) COLON

Variables	Risk Estimate	95% Confidence Interval	
Exposure			
Not Applicable	NA	NA	NA
Age	NA	NA	NA

14) COLORECTAL

Variables	Risk Estimate	95% Confidence Interval	
Exposure			
Low	1.00 (Ref.)		
Med and High	NA	NA	NA
Age	1.04	0.92	1.18

15) PROSTATE

Variables	Risk Estimate	95% Confidence Interval	
Exposure			
Low	1.00 (Ref.)		
Med and High	0.88	0.14	5.47
Age	1.12	1.05	1.20

16) HEPATIC

Variables	Risk Estimate	95% Confidence Interval	
Exposure			
Not Applicable	NA	NA	NA
Age	NA	NA	NA

17) LEUKEMIA

Variables	Risk Estimate	95% Confidence Interval	
Exposure			
Low	1.00 (Ref.)		
Med and High	NA	NA	NA
Age	1.05	0.89	1.24

18) RENAL

Variables	Risk Estimate	95% Confidence Interval	
Exposure			
Low	1.00 (Ref.)		
Med and High	NA	NA	NA
Age	1.12	0.97	1.29

19) LYMPHOMA

Variables	Risk Estimate	95% Confidence Interval	
Exposure			
Low	1.00 (Ref.)		
Med and High	0.29	0.01	7.75
Age	1.11	0.99	1.25

20) SKIN

Variables	Risk Estimate	95% Confidence Interval	
Exposure			
Low	1.00 (Ref.)		
Med and High	1.77	0.55	5.70
Age	1.06	1.01	1.10

21) TOTAL

Variables	Risk Estimate	95% Confidence Interval	
Exposure			
Low	1.00 (Ref.)		
Med and High	1.24	0.45	3.44
Age	1.08	1.04	1.13

Adjusted Risk Estimates for Specific Confirmed Cancers among Firefighters by Combined High and Medium versus Low Exposures

For Hodgkin's Lymphoma, Other, Rectum, NHL, Melanoma, Bladder, Colorectal, Prostate, Leukemia, and Lymphoma cancer the risk estimate for med/high versus low, the model was unable to generate an estimate. No data were obtained for Thyroid, Esophageal, Breast, Lung and Bronchus, Stomach, Testis, Colon, Hepatic and renal from our database. The total cancer risk estimate for med/high versus low was 2.56 (95% confidence interval 0.50, 13.03).

Table 32. Risk Estimates Adjusted for Age For Confirmed Specific Cancers Among Firefighters by Combined High and Medium versus Low Exposures

1) HODGKIN'S LYMPHOMA (Confirmed)

Variables	Risk Estimate	95% Confidence Interval	
Exposure			
Low	1.00 (Ref.)		
Med and High	NA	NA	NA
Age	1.06	0.88	1.27

2) THYROID (Confirmed)

Variables	Risk Estimate	95% Confidence Interval	
Exposure			
Not applicable	NA	NA	NA
Age	NA	NA	NA

3) ESOPHAGEAL (Confirmed)

Variables	Risk Estimate	95% Confidence Interval	
Exposure			
Not Applicable	NA	NA	NA
Age	NA	NA	NA

4) BREAST (Confirmed)

Variables	Risk Estimate	95% Confidence Interval	
Exposure			
Not Applicable	NA	NA	NA
Age	NA	NA	NA

5) OTHER (Confirmed)

Variables	Risk Estimate	95% Confidence Interval	
Exposure			
Low	1.00 (Ref.)		
Med and High	NA	NA	NA
Age	1.07	0.91	1.25

6) LUNG AND BRONCHUS

Variables	Risk Estimate	95% Confidence Interval	
Exposure			
Not Applicable	NA	NA	NA
Age	NA	NA	NA

7) RECTUM (Confirmed)

Variables	Risk Estimate	95% Confidence Interval	
Exposure			
Low	1.00 (Ref.)		
Med and High	NA	NA	NA
Age	1.04	0.92	1.18

8) NHL (Confirmed)

Variables	Risk Estimate	95% Confidence Interval	
Exposure			
Low	1.00 (Ref.)		
Med and High	NA	NA	NA
Age	0.97	0.77	1.22

9) STOMACH (Confirmed)

Variables	Risk Estimate	95% Confidence Interval	
Exposure			
Not Applicable	NA	NA	NA
Age	NA	NA	NA

10) TESTIS (Confirmed)

Variables	Risk Estimate	95% Confidence Interval	
Exposure			
Not Applicable	NA	NA	NA
Age	NA	NA	NA

11) Melanoma (Confirmed)

Variables	Risk Estimate	95% Confidence Interval	
Exposure			
Low	1.00 (Ref.)		
Med and High	NA	NA	NA
Age	1.15	1.00	1.32

12) BLADDER (Confirmed)

Variables	Risk Estimate	95% Confidence Interval	
Exposure			
Low	1.00 (Ref.)		
Med and High	NA	NA	NA
Age	1.13	1.01	1.26

13) COLON (Confirmed)

Variables	Risk Estimate	95% Confidence Interval	
Exposure			
Not Applicable	NA	NA	NA
Age	NA	NA	NA

14) COLORECTAL (Confirmed)

Variables	Risk Estimate	95% Confidence Interval	
Exposure			
Low	1.00 (Ref.)		
Med and High	NA	NA	NA
Age	1.04	0.92	1.18

15) PROSTATE (Confirmed)

Variables	Risk Estimate	95% Confidence Interval	
Exposure			
Low	1.00 (Ref.)		
Med and High	NA	NA	NA
Age	1.10	1.02	1.18

16) HEPATIC (Confirmed)

Variables	Risk Estimate	95% Confidence Interval	
Exposure			
Not Applicable	NA	NA	NA
Age	NA	NA	NA

17) LEUKEMIA (Confirmed)

Variables	Risk Estimate	95% Confidence Interval	
Exposure			
Low	1.00 (Ref.)		
Med and High	NA	NA	NA
Age	1.05	0.89	1.24

18) RENAL (Confirmed)

Variables	Risk Estimate	95% Confidence Interval	
Exposure			
Not Applicable	NA	NA	NA
Age	NA	NA	NA

19) LYMPHOMA (Confirmed)

Variables	Risk Estimate	95% Confidence Interval	
Exposure			
Low	1.00 (Ref.)		
Med and High	NA	NA	NA
Age	1.15	1.00	1.32

20) TOTAL (Confirmed)

Variables	Risk Estimate	95% Confidence Interval	
Exposure			
Low	1.00 (Ref.)		
Med and High	2.56	0.50	13.03
Age	1.09	1.04	1.15

POISSON REGRESSION

POLICE OFFICERS

Unadjusted Risk Estimates for Any Reported Specific Cancers among Police Officers by High, Medium and Low Exposures

For Thyroid cancer risk estimate for medium versus low exposure, the model was unable to generate an estimate but for high versus low exposure the risk estimate was 1.55 (95% Confidence Interval 0.14, 17.14). For Other cancer risk estimate for medium versus low exposure, the model was unable to generate an estimate but for high versus low exposure the risk estimate was 3.11 (95% Confidence Interval 0.44, 22.07). Rectal cancer risk estimate for medium versus low exposure was 3.63 (95% Confidence Interval 0.23,58.06) and high versus low exposure was 3.11 (95% Confidence Interval 0.19, 49.69). NHL cancer risk estimate for medium versus low exposure was 7.26 (95% Confidence Interval 0.66,80.10) and high versus low exposure was 6.22 (95% Confidence Interval 0.56, 68.55). For Testis cancer risk estimate for medium versus low exposure, the model was unable to generate an estimate but for high versus low exposure the risk estimate was 3.11 (95% Confidence Interval 0.44, 22.07). Melanoma cancer risk estimate for medium versus low exposure was 5.45 (95% Confidence Interval 0.91, 32.60) and high versus low exposure was 4.66 (95% Confidence Interval 0.78, 27.90). For Colon cancer risk estimate for medium versus low exposure, the model was unable to generate an estimate but for high versus low exposure the risk estimate was 3.11 (95% Confidence Interval 0.19, 49.69). Colorectal cancer risk estimate for medium versus low exposure was 1.82 (95% Confidence Interval 0.16, 20.03) and high versus low exposure was 3.11 (95% Confidence Interval 0.44, 22.07). Prostate cancer risk estimate for medium versus low exposure was 1.56 (95% Confidence Interval 0.40 6.02) and high versus low exposure was 0.89 (95% Confidence Interval 0.18, 4.27). **Lymphoma cancer risk estimate for medium versus low exposure was 10.89 (95% Confidence Interval 1.13, 104.74)** and high versus low exposure was 3.11 (95% Confidence Interval 0.19, 49.69). Skin cancer risk estimate for medium versus low exposure was 1.21 (95% Confidence Interval 0.48, 3.05) and high versus low exposure was 1.04 (95% Confidence Interval 0.41, 2.61). For Hodgkin's Lymphoma, Esophageal, Breast, Lung and Bronchus, Stomach, Bladder, Hepatic, Leukemia, and Renal cancer risk estimate for both medium versus low and high versus low, the model was unable to generate an estimate. The total cancer risk estimate for medium versus low exposure was 1.98 (95% Confidence Interval 0.98, 4.00) and **high versus low exposure was 2.97 (95% Confidence Interval 1.63, 5.39).**

Table 33. Unadjusted Risk Estimates For Any Reported Specific Cancers Among Police Officers by High, Medium and Low Exposures

1) HODGKIN'S LYMPHOMA

Variables	Risk Estimate	95% Confidence Interval	
Exposure			
Low	1.00 (Ref.)		
Medium	N/A	N/A	N/A
High	N/A	N/A	N/A

2) THYROID

Variables	Risk Estimate	95% Confidence Interval	
Exposure			
Low	1.00 (Ref.)		
Medium	N/A	N/A	N/A
High	1.55	0.14	17.14

3) ESOPHAGEAL

Variables	Risk Estimate	95% Confidence Interval	
Exposure			
Low	1.00 (Ref.)		
Medium	1.00	N/A	N/A
High	N/A	N/A	N/A

4) BREAST

Variables	Risk Estimate	95% Confidence Interval	
Exposure			
Low	1.00 (Ref.)		
Medium	N/A	N/A	N/A
High	N/A	N/A	N/A

5) OTHER

Variables	Risk Estimate	95% Confidence Interval	
Exposure			
Low	1.00 (Ref.)		
Medium	N/A	N/A	N/A
High	3.11	0.44	22.07

6) LUNG AND BRONCHUS

Variables	Risk Estimate	95% Confidence Interval	
Exposure			
Low	1.00 (Ref.)		
Medium	1.00	N/A	N/A
High	N/A	N/A	N/A

7) RECTUM

Variables	Risk Estimate	95% Confidence Interval	
Exposure			
low	1.00 (Ref.)		
Medium	3.63	0.23	58.06
High	3.11	0.19	49.69

8) NHL

Variables	Risk Estimate	95% Confidence Interval	
Exposure			
low	1.00 (Ref.)		
Medium	7.26	0.66	80.10
High	6.22	0.56	68.55

9) STOMACH

Variables	Risk Estimate	95% Confidence Interval	
Exposure			
Low	1.00 (Ref.)		
Medium	1.00	N/A	N/A
High	N/A	N/A	N/A

10)TESTIS

Variables	Risk Estimate	95% Confidence Interval	
Exposure			
Low	1.00 (Ref.)		
Medium	N/A	N/A	N/A
High	3.11	0.44	22.07

11) MELANOMA

Variables	Risk Estimate	95% Confidence Interval	
Exposure			
low	1.00 (Ref.)		
Medium	5.45	0.91	32.60
High	4.66	0.78	27.90

12) BLADDER

Variables	Risk Estimate	95% Confidence Interval	
Exposure			
low	1.00 (Ref.)		
Medium	1.00	N/A	N/A
High	N/A	N/A	N/A

13) COLON

Variables	Risk Estimate	95% Confidence Interval	
Exposure			
low	1.00 (Ref.)		
Medium	N/A	N/A	N/A
High	3.11	0.19	49.69

14) COLORECTAL

Variables	Risk Estimate	95% Confidence Interval	
Exposure			
low	1.00 (Ref.)		
Medium	1.82	0.16	20.03
High	3.11	0.44	22.07

15) PROSTATE

Variables	Risk Estimate	95% Confidence Interval	
Exposure			
low	1.00 (Ref.)		
Medium	1.56	0.40	6.02
High	0.89	0.18	4.27

16) HEPATIC

Variables	Risk Estimate	95% Confidence Interval	
Exposure			
low	1.00 (Ref.)		
Medium	1.00	N/A	N/A
High	N.A	N/A	N/A

17) LEUKEMIA

Variables	Risk Estimate	95% Confidence Interval	
Exposure			
low	1.00 (Ref.)		
Medium	1.00	N/A	N/A
High	N/A	N/A	N/A

18) RENAL

Variables	Risk Estimate	95% Confidence Interval	
Exposure			
low	1.00 (Ref.)		
Medium	N/A	N/A	N/A
High	N/A	N/A	N/A

19) LYMPHOMA

Variables	Risk Estimate	95% Confidence Interval	
Exposure			
low	1.00 (Ref.)		
Medium	10.89	1.13	104.74
High	3.11	0.19	49.69

20) SKIN

Variables	Risk Estimate	95% Confidence Interval	
Exposure			
low	1.00 (Ref.)		
Medium	1.21	0.48	3.05
High	1.04	0.41	2.61

21) TOTAL

Variables	Risk Estimate	95% Confidence Interval	
Exposure			
low	1.00 (Ref.)		
Medium	1.98	0.98	4.00
High	2.97	1.63	5.39

Unadjusted Risk Estimates for Confirmed Specific Cancers among Police Officers by High, Medium and Low Exposures

For Thyroid cancer risk estimate for medium versus low exposure, the model was unable to generate an estimate but for high versus low exposure the risk estimate was 3.08 (95% Confidence Interval 0.19, 49.25). For Other cancer risk estimate for medium versus low exposure, the model was unable to generate an estimate but for high versus low exposure the risk estimate was 6.16 (95% Confidence Interval 0.56, 67.94). Rectal cancer risk estimate for medium versus low exposure was 3.63 (95% Confidence Interval 0.23, 58.06) and high versus low exposure was 3.08 (95% Confidence Interval 0.19, 49.25). NHL cancer risk estimate for medium versus low exposure was 7.26 (95% Confidence Interval 0.66, 80.10) and high versus low exposure was 6.22 (95% Confidence Interval 0.56, 68.55). For Testis cancer risk estimate for medium versus low exposure, the model was unable to generate an estimate but for high versus low exposure the risk estimate was 3.08 (95% Confidence Interval 0.19, 49.25). Melanoma cancer risk estimate for medium versus low exposure was 7.26 (95% Confidence Interval 0.66, 80.10) and high versus low exposure was 6.16 (95% Confidence Interval 0.56, 67.94). For Colon cancer risk estimate for medium versus low exposure, the model was unable to generate an estimate but for high versus low exposure the risk estimate was 3.08 (95% Confidence Interval 0.19, 49.25). Colorectal cancer risk estimate for medium versus low exposure was 1.82 (95% Confidence Interval 0.16, 20.03) and high versus low exposure was 3.08 (95% Confidence Interval 0.43, 21.87). Prostate cancer risk estimate for medium versus low exposure was 1.82 (95% Confidence Interval 0.49, 7.26) and high versus low exposure was 0.51 (95% Confidence Interval 0.06, 4.26). For Hodgkin's Lymphoma, Esophageal, Breast, Lung and Bronchus, Stomach, Bladder, Leukemia, Renal, and Lymphoma cancer risk estimate for both medium versus low and high versus low, the model was unable to generate an estimate. The total cancer risk estimate for medium versus low exposure was 1.94 (95% Confidence Interval 0.82, 4.57) and **high versus low exposure was 3.29 (95% Confidence Interval 1.62, 6.65).**

Table 34 Unadjusted for age, Confirmed Risk Estimates For Specific Cancers Among Police Officers by High, Medium and Low Exposures

1) HODGKIN'S LYMPHOMA (Confirmed)

Variables	Risk Estimate	95% Confidence Interval	
Exposure			
Low	1.00 (Ref.)		
Medium	N/A	N/A	N/A
High	N/A	N/A	N/A

2) THYROID (Confirmed)

Variables	Risk Estimate	95% Confidence Interval	
Exposure			
Low	1.00 (Ref.)		
Medium	N/A	N/A	N/A
High	3.08	0.19	49.25

3)ESOPHAGEAL (Confirmed)

Variables	Risk Estimate	95% Confidence Interval	
Exposure			
Low	1.00 (Ref.)		
Medium	1.00	N/A	N/A
High	N/A	N/A	N/A

4) BREAST (Confirmed)

Variables	Risk Estimate	95% Confidence Interval	
Exposure			
Low	1.00 (Ref.)		
Medium	N/A	N/A	N/A
High	N/A	N/A	N/A

5) OTHER (Confirmed)

Variables	Risk Estimate	95% Confidence Interval	
Exposure			
Low	1.00 (Ref.)		
Medium	N/A	N/A	N/A
High	6.16	0.56	67.94

6) LUNG AND BRONCHUS (Confirmed)

Variables	Risk Estimate	95% Confidence Interval	
Exposure			
Low	1.00 (Ref.)		
Medium	1.00	N/A	N/A
High	N/A	N/A	N/A

7) RECTUM (Confirmed)

Variables	Risk Estimate	95% Confidence Interval	
Exposure			
Low	1.00 (Ref.)		
Medium	3.63	0.23	58.06
High	3.08	0.19	49.25

8) NHL (Confirmed)

Variables	Risk Estimate	95% Confidence Interval	
Exposure			
Low	1.00 (Ref.)		
Medium	7.26	0.66	80.10
High	6.22	0.56	68.55

9) STOMACH (Confirmed)

Variables	Risk Estimate	95% Confidence Interval	
Exposure			
Low	1.00 (Ref.)		
Medium	1.00	N/A	N/A
High	N/A	N/A	N/A

10) TESTIS (Confirmed)

Variables	Risk Estimate	95% Confidence Interval	
Exposure			
Low	1.00 (Ref.)		
Medium	N/A	N/A	N/A
High	3.08	0.19	49.25

11) MELANOMA (Confirmed)

Variables	Risk Estimate	95% Confidence Interval	
Exposure			
Low	1.00 (Ref.)		
Medium	7.26	0.66	80.10
High	6.16	0.56	67.94

12) BLADDER (Confirmed)

Variables	Risk Estimate	95% Confidence Interval	
Exposure			
Low	1.00 (Ref.)		
Medium	1.00	N/A	N/A
High	N/A	N/A	N/A

13) COLON (Confirmed)

Variables	Risk Estimate	95% Confidence Interval	
Exposure			
Low	1.00 (Ref.)		
Medium	N/A	N/A	N/A
High	3.08	0.19	49.25

14) COLORECTAL (Confirmed)

Variables	Risk Estimate	95% Confidence Interval	
Exposure			
Low	1.00 (Ref.)		
Medium	1.82	0.16	20.03
High	3.08	0.43	21.87

15) PROSTATE (Confirmed)

Variables	Risk Estimate	95% Confidence Interval	
Exposure			
Low	1.00 (Ref.)		
Medium	1.82	0.49	7.26
High	0.51	0.06	4.26

16) HEPATIC (Confirmed)

Variables	Risk Estimate	95% Confidence Interval	
Exposure			
Low	1.00 (Ref.)		
Medium	1.00	N/A	N/A
High	N/A	N/A	N/A

17) LEUKEMIA (Confirmed)

Variables	Risk Estimate	95% Confidence Interval	
Exposure			
Low	1.00 (Ref.)		
Medium	1.00	N/A	N/A
High	1.00	N/A	N/A

18) RENAL (Confirmed)

Variables	Risk Estimate	95% Confidence Interval	
Exposure			
Low	1.00 (Ref.)		
Medium	1.00	N/A	N/A
High	1.00	N/A	N/A

19) LYMPHOMA (Confirmed)

Variables	Risk Estimate	95% Confidence Interval	
Exposure			
Low	1.00 (Ref.)		
Medium	N/A	N/A	N/A
High	N/A	N/A	N/A

20) TOTAL (Confirmed)			
Variables	Risk Estimate	95% Confidence Interval	
Exposure			
Low	1.00 (Ref.)		
Medium	1.94	0.82	4.57
High	3.29	1.62	6.65

Adjusted Risk Estimates for Any Reported Specific Cancers among Police Officers by High, Medium and Low Exposures

For Thyroid cancer risk estimate for medium versus low exposure, the model was unable to generate an estimate but for high versus low exposure the risk estimate was 1.73 (95% Confidence Interval 0.15, 20.09). For Other cancer risk estimate for medium versus low exposure, the model was unable to generate an estimate but for high versus low exposure the risk estimate was 3.23 (95% Confidence Interval 0.44, 23.82). Rectal cancer risk estimate for medium versus low exposure was 3.60 (95% Confidence Interval 0.22, 58.36) and high versus low exposure was 2.69 (95% Confidence Interval 0.17, 1.18). NHL cancer risk estimate for medium versus low exposure was 8.41 (95% Confidence Interval 0.72, 97.64) and high versus low exposure was 5.38 (95% Confidence Interval 0.49, 59.35). For Testis cancer risk estimate for medium versus low exposure, the model was unable to generate an estimate but for high versus low exposure the risk estimate was 2.82 (95% Confidence Interval 0.39, 20.22). Melanoma cancer risk estimate for medium versus low exposure was 5.40 (95% Confidence Interval 0.90, 32.59) and high versus low exposure was 4.03 (95% Confidence Interval 0.67, 24.14). For Colon cancer risk estimate for medium versus low exposure, the model was unable to generate an estimate but for high versus low exposure the risk estimate was 2.72 (95% Confidence Interval 5.89, 43.68). Colorectal cancer risk estimate for medium versus low exposure was 1.95 (95% Confidence Interval 0.17, 22.11) and high versus low exposure was 2.67 (95% Confidence Interval 0.38, 18.97). Prostate cancer risk estimate for medium versus low exposure was 4.00 (95% Confidence Interval 0.81, 19.70) and high versus low exposure was 1.40 (95% Confidence Interval 0.26, 7.65). **Lymphoma cancer risk estimate for medium versus low exposure was 11.85 (95% Confidence Interval 1.18, 118.72)** and high versus low exposure was 2.67 (95% Confidence Interval 0.17, 42.74). Skin cancer risk estimate for medium versus low exposure was 1.29 (95% Confidence Interval 0.51, 1.20) and high versus low exposure was 0.89 (95% Confidence Interval 0.35, 2.24). Hodgkin's Lymphoma, Esophageal, Breast, Lung and Bronchus, Stomach, Bladder, Hepatic, Leukemia, and Renal cancer risk estimate for both medium versus low and high versus low, the model was unable to generate an estimate. **The total cancer risk estimate for medium versus low exposure was 2.41 (95% Confidence Interval 1.16, 5.02) and high versus low exposure was 3.13 (95% Confidence Interval 1.67, 5.88).**

Table 35. Adjusted Risk Estimates For Any Reported Specific Cancers Among Police Officers by High, Medium and Low Exposures

1) HODGKIN'S LYMPHOMA

Variables	Risk Estimate	95% Confidence Interval	
Exposure			
Low	1.00 (Ref.)		
Medium	1.00	N/A	N/A
High	1.00	N/A	N/A
Age	1.00	N/A	N/A

2) THYROID

Variables	Risk Estimate	95% Confidence Interval	
Exposure			
Low	1.00 (Ref.)		
Medium	N/A	N/A	N/A
High	1.73	0.15	20.09
Age	0.97	0.87	1.09

3) ESOPHAGEAL

Variables	Risk Estimate	95% Confidence Interval	
Exposure			
Low	1.00 (Ref.)		
Medium	0.96	N/A	N/A
High	N/A	N/A	N/A
Age	1.04	0.91	1.19

4) BREAST

Variables	Risk Estimate	95% Confidence Interval	
Exposure			
Low	1.00 (Ref.)		
Medium	N/A	N/A	N/A
High	N/A	N/A	N/A
Age	1.06	0.95	1.18

5) OTHER

Variables	Risk Estimate	95% Confidence Interval	
Exposure			
Low	1.00 (Ref.)		
Medium	N/A	N/A	N/A
High	3.23	0.44	23.82
Age	0.99	0.90	1.08

6) LUNG AND BRONCHUS

Variables	Risk Estimate	95% Confidence Interval	
Exposure			
Low	1.00 (Ref.)		
Medium	1.68	N/A	N/A
High	N/A	N/A	N/A
Age	1.17	0.97	1.42

7) RECTUM

Variables	Risk Estimate	95% Confidence Interval	
Exposure			
Low	1.00 (Ref.)		
Medium	3.60	0.22	58.36
High	2.69	0.17	43.01
Age	1.06	0.96	1.18

8) NHL

Variables	Risk Estimate	95% Confidence Interval	
Exposure			
Low	1.00 (Ref.)		
Medium	8.41	0.72	97.64
High	5.38	0.49	59.35
Age	1.10	1.01	1.20

9) STOMACH

Variables	Risk Estimate	95% Confidence Interval	
Exposure			
Low	1.00 (Ref.)		
Medium	8.30	N/A	N/A
High	N/A	N/A	N/A
Age	0.65	0.34	1.24

10) TESTIS

Variables	Risk Estimate	95% Confidence Interval	
Exposure			
Low	1.00 (Ref.)		
Medium	N/A	N/A	N/A
High	2.82	0.39	20.22
Age	1.03	0.94	1.12

11) MELANOMA

Variables	Risk Estimate	95% Confidence Interval	
Exposure			
Low	1.00 (Ref.)		
Medium	5.40	0.90	32.59
High	4.03	0.67	24.14
Age	1.06	1.00	1.13

12) BLADDER

Variables	Risk Estimate	95% Confidence Interval	
Exposure			
Low	1.00 (Ref.)		
Medium	N/A	N/A	N/A
High	N/A	N/A	N/A
Age	2345.37	2345.37	2345.37

13) COLON

Variables	Risk Estimate	95% Confidence Interval	
Exposure			
Low	1.00 (Ref.)		
Medium	N/A	N/A	N/A
High	2.72	5.89	43.68
Age	1.12	0.99	1.25

14) COLORECTAL

Variables	Risk Estimate	95% Confidence Interval	
Exposure			
Low	1.00 (Ref.)		
Medium	1.95	0.17	22.11
High	2.67	0.38	18.97
Age	1.09	1.01	1.17

15) PROSTATE

Variables	Risk Estimate	95% Confidence Interval	
Exposure			
Low	1.00 (Ref.)		
Medium	4.00	0.81	19.70
High	1.40	0.26	7.65
Age	1.14	1.07	1.21

16) HEPATIC

Variables	Risk Estimate	95% Confidence Interval	
Exposure			
Low	1.00 (Ref.)		
Medium	1.04	N/A	N/A
High	N/A	N/A	N/A
Age	0.99	0.85	1.14

17) LEUKEMIA

Variables	Risk Estimate	95% Confidence Interval	
Exposure			
Low	1.00 (Ref.)		
Medium	1.35	N/A	N/A
High	N/A	N/A	N/A
Age	1.14	0.96	1.36

18) RENAL

Variables	Risk Estimate	95% Confidence Interval	
Exposure			
Low	1.00 (Ref.)		
Medium	N/A	N/A	N/A
High	N/A	N/A	N/A
Age	0.97	0.85	1.11

19) LYMPHOMA

Variables	Risk Estimate	95% Confidence Interval	
Exposure			
Low	1.00 (Ref.)		
Medium	11.85	1.18	118.72
High	2.67	0.17	42.74
Age	1.09	1.00	1.19

20) SKIN

Variables	Risk Estimate	95% Confidence Interval	
Exposure			
Low	1.00 (Ref.)		
Medium	1.29	0.51	1.20
High	0.89	0.35	2.24
Age	1.08	1.05	1.12

21) TOTAL

Variables	Risk Estimate	95% Confidence Interval	
Exposure			
Low	1.00 (Ref.)		
Medium	2.41	1.16	5.02
High	3.13	1.67	5.88
Age	1.06	1.04	1.09

Adjusted Risk Estimates for Confirmed Specific Cancers among Police Officers by High, Medium and Low Exposures

For Thyroid cancer risk estimate for medium versus low exposure, the model was unable to generate an estimate but for high versus low exposure the risk estimate was 2.88 (95% Confidence Interval 0.18, 47.07). For Other cancer risk estimate for medium versus low exposure, the model was unable to generate an estimate but for high versus low exposure the risk estimate was 5.60 (95% Confidence Interval 0.50, 62.43). Rectal cancer risk estimate for medium versus low exposure was 3.60 (95% Confidence Interval 0.22, 58.40) and high versus low exposure was 2.67 (95% Confidence Interval 0.17, 42.79). NHL cancer risk estimate for medium versus low exposure was 8.41 (95% Confidence Interval 0.72, 97.64) and high versus low exposure was 5.38 (95% Confidence Interval 0.49, 59.35). For Testis cancer risk estimate for medium versus low exposure, the model was unable to generate an estimate but for high versus low exposure the risk estimate was 2.74 (95% Confidence Interval 0.17, 44.08). Melanoma cancer risk estimate for medium versus low exposure was 8.61 (95% Confidence Interval 0.74, 100.57) and high versus low exposure was 5.38 (95% Confidence Interval 0.49, 59.40). For Colon cancer risk estimate for medium versus low exposure, the model was unable to generate an estimate but for high versus low exposure the risk estimate was 2.72 (95% Confidence Interval 0.17, 43.61). Colorectal cancer risk estimate for medium versus low exposure was 1.95 (95% Confidence Interval 0.17, 22.13) and high versus low exposure was 2.66 (95% Confidence Interval 0.38, 18.90). **Prostate cancer risk estimate for medium versus low exposure was 5.69 (95% Confidence Interval 1.00, 32.51)** and high versus low exposure was 0.94 (95% Confidence Interval 0.10, 9.09). Hodgkin's Lymphoma, Esophageal, Breast, Lung and Bronchus, Stomach, Bladder, Hepatic, Leukemia, Renal, and Lymphoma cancer risk estimate for both medium versus low and high versus low, the model was unable to generate an estimate. **The total cancer risk estimate for medium versus low exposure was 2.84 (95% Confidence Interval 1.13, 7.12) and high versus low exposure was 3.87 (95% Confidence Interval 1.80, 8.34).**

Table 36. Adjusted Risk Estimates For Confirmed Specific Cancers Among Police Officers by High, Medium and Low Exposures

1) HODGKIN'S LYMPHOMA (Confirmed)

Variables	Risk Estimate	95% Confidence Interval	
Exposure			
Low	1.00 (Ref.)		
Medium	1.00	N/A	N/A
High	1.00	N/A	N/A
Age	1.00	N/A	N/A

2) THYROID (Confirmed)

Variables	Risk Estimate	95% Confidence Interval	
Exposure			
Low	1.00 (Ref.)		
Medium	N/A	N/A	N/A
High	2.88	0.18	47.07
Age	1.02	0.90	1.15

3) ESOPHAGEAL (Confirmed)

Variables	Risk Estimate	95% Confidence Interval	
Exposure			
Low	1.00 (Ref.)		
Medium	0.96	N/A	N/A
High	N/A	N/A	N/A
Age	1.04	0.91	1.19

4) BREAST (Confirmed)

Variables	Risk Estimate	95% Confidence Interval	
Exposure			
Low	1.00 (Ref.)		
Medium	N/A	N/A	N/A
High	N/A	N/A	N/A
Age	1.07	0.92	1.24

5) OTHER (Confirmed)

Variables	Risk Estimate	95% Confidence Interval	
Exposure			
Low	1.00 (Ref.)		
Medium	N/A	N/A	N/A
High	5.60	0.50	62.43
Age	1.03	0.93	1.14

6) LUNG AND BRONCHUS (Confirmed)

Variables	Risk Estimate	95% Confidence Interval	
Exposure			
Low	1.00 (Ref.)		
Medium	1.69	N/A	N/A
High	N/A	N/A	N/A
Age	1.17	0.97	1.42

7) RECTUM (Confirmed)

Variables	Risk Estimate	95% Confidence Interval	
Exposure			
Low	1.00 (Ref.)		
Medium	3.60	0.22	58.40
High	2.67	0.17	42.79
Age	1.06	0.96	1.18

8) NHL (Confirmed)

Variables	Risk Estimate	95% Confidence Interval	
Exposure			
Low	1.00 (Ref.)		
Medium	8.41	0.72	97.64
High	5.38	0.49	59.35
Age	1.10	1.01	1.20

9) STOMACH (Confirmed)

Variables	Risk Estimate	95% Confidence Interval	
Exposure			
Low	1.00 (Ref.)		
Medium	8.36	N/A	N/A
High	N/A	N/A	N/A
Age	0.65	0.34	1.24

10) TESTIS (Confirmed)

Variables	Risk Estimate	95% Confidence Interval	
Exposure			
Low	1.00 (Ref.)		
Medium	N/A	N/A	N/A
High	2.74	0.17	44.08
Age	1.04	0.92	1.17

11) MELANOMA (Confirmed)

Variables	Risk Estimate	95% Confidence Interval	
Exposure			
Low	1.00 (Ref.)		
Medium	8.61	0.74	100.57
High	5.38	0.49	59.40
Age	1.10	1.02	1.20

12) BLADDER (Confirmed)

Variables	Risk Estimate	95% Confidence Interval	
Exposure			
Low	1.00 (Ref.)		
Medium	N/A	N/A	N/A
High	N/A	N/A	N/A
Age	2343.97	2343.97	2343.97

13) COLON (Confirmed)

Variables	Risk Estimate	95% Confidence Interval	
Exposure			
Low	1.00 (Ref.)		
Medium	N/A	N/A	N/A
High	2.72	0.17	43.61
Age	1.12	0.99	1.25

14) COLORECTAL (Confirmed)

Variables	Risk Estimate	95% Confidence Interval	
Exposure			
Low	1.00 (Ref.)		
Medium	1.95	0.17	22.13
High	2.66	0.38	18.90
Age	1.09	1.01	1.17

15) PROSTATE (Confirmed)

Variables	Risk Estimate	95% Confidence Interval	
Exposure			
Low	1.00 (Ref.)		
Medium	5.69	1.00	32.51
High	0.94	0.10	9.09
Age	1.14	1.06	1.23

16) HEPATIC (Confirmed)

Variables	Risk Estimate	95% Confidence Interval	
Exposure			
Low	1.00 (Ref.)		
Medium	1.03	N/A	N/A
High	N/A	N/A	N/A
Age	0.99	0.85	1.14

17) LEUKEMIA (Confirmed)

Variables	Risk Estimate	95% Confidence Interval	
Exposure			
Low	1.00 (Ref.)		
Medium	1.00	N/A	N/A
High	1.00	N/A	N/A
Age	1.00	N/A	N/A

18) RENAL (Confirmed)

Variables	Risk Estimate	95% Confidence Interval	
Exposure			
Low	1.00 (Ref.)		
Medium	1.00	N/A	N/A
High	1.00	N/A	N/A
Age	1.00	N/A	N/A

19) LYMPHOMA (Confirmed)

Variables	Risk Estimate	95% Confidence Interval	
Exposure			
Low	1.00 (Ref.)		
Medium	N/A	N/A	N/A
High	N/A	N/A	N/A
Age	1.11	0.97	1.28

20) TOTAL (Confirmed)

Variables	Risk Estimate	95% Confidence Interval	
Exposure			
Low	1.00 (Ref.)		
Medium	2.84	1.13	7.12
High	3.87	1.80	8.34
Age	1.09	1.05	1.12

Unadjusted Risk Estimates for Any Reported Specific Cancers among Police Officers by combined High and Medium versus Low Exposures

For Thyroid cancer the risk estimate for med/high versus low exposure was 0.84 (95% Confidence Interval 0.08, 9.23). For Other cancer the risk estimate for med/high versus low exposure was 1.67 (95% Confidence Interval 0.24, 11.89). For Rectal cancer the risk estimate for med/high versus low exposure was 3.35 (95% Confidence Interval 0.30, 36.94). For NHL cancer the risk estimate for med/high versus low exposure was 6.70 (95% Confidence Interval 0.75, 59.94). For Testis cancer the risk estimate for med/high versus low exposure was 1.67 (95% Confidence Interval 0.24, 11.89). For **Melanoma cancer the risk estimate for med/high versus low exposure was 5.02**

(95% Confidence Interval 1.01, 24.89). For Colon cancer the risk estimate for med/high versus low exposure was 1.67 (95% Confidence Interval 0.10, 26.78). For Colorectal cancer the risk estimate for med/high versus low exposure was 2.51 (95% Confidence Interval 0.42, 15.03). For Prostate cancer the risk estimate for med/high versus low exposure was 1.20 (95% Confidence Interval 0.38, 3.77). For Lymphoma cancer the risk estimate for med/high versus low exposure was 6.70 (95% Confidence Interval 0.75, 59.94). For Skin cancer the risk estimate for med/high versus low exposure was 1.12 (95% Confidence Interval 0.54, 2.32). Hodgkin's lymphoma, Esophageal, Breast, Lung and Bronchus, Stomach, Bladder, Hepatic, Leukemia and Renal cancer risk estimate for both medium versus low and high versus low, the model was unable to generate an estimate. **The total cancer the risk estimate for med/high versus low exposure was 2.51 (95% Confidence Interval 1.46, 4.31).**

Table 37. Unadjusted Risk Estimates For Any Reported Specific Cancers Among Police Officers by combined High and Medium versus Low Exposures

1) HODGKIN'S LYMPHOMA

Variables	Risk Estimate	95% Confidence Interval	
Exposure			
Low	1.00 (Ref.)		
Med-High	N/A	N/A	N/A

2) THYROID

Variables	Risk Estimate	95% Confidence Interval	
Exposure			
Low	1.00 (Ref.)		
Med-High	0.84	0.08	9.23

3) ESOPHAGEAL

Variables	Risk Estimate	95% Confidence Interval	
Exposure			
Low	1.00 (Ref.)		
Med-High	N/A	N/A	N/A

4) BREAST

Variables	Risk Estimate	95% Confidence Interval	
Exposure			
Low	1.00 (Ref.)		
Med-High	N/A	N/A	N/A

5) OTHER

Variables	Risk Estimate	95% Confidence Interval	
Exposure			
Low	1.00 (Ref.)		
Med-High	1.67	0.24	11.89

6) LUNG AND BRONCHUS

Variables	Risk Estimate	95% Confidence Interval	
Exposure			
Low	1.00 (Ref.)		
Med-High	N/A	N/A	N/A

7) RECTUM

Variables	Risk Estimate	95% Confidence Interval	
Exposure			
Low	1.00 (Ref.)		
Med-High	3.35	0.30	36.94

8) NHL

Variables	Risk Estimate	95% Confidence Interval	
Exposure			
Low	1.00 (Ref.)		
Med-High	6.70	0.75	59.94

9) STOMACH

Variables	Risk Estimate	95% Confidence Interval	
Exposure			
Low	1.00 (Ref.)		
Med-High	N/A	N/A	N/A

10) TESTIS

Variables	Risk Estimate	95% Confidence Interval	
Exposure			
Low	1.00 (Ref.)		
Med-High	1.67	0.24	11.89

11) MELANOMA

Variables	Risk Estimate	95% Confidence Interval	
Exposure			
Low	1.00 (Ref.)		
Med-High	5.02	1.01	24.89

12) BLADDER

Variables	Risk Estimate	95% Confidence Interval	
Exposure			
Low	1.00 (Ref.)		
Med-High	N/A	N/A	N/A

13) COLON

Variables	Risk Estimate	95% Confidence Interval	
Exposure			
Low	1.00 (Ref.)		
Med-High	1.67	0.10	26.78

14) COLORECTAL

Variables	Risk Estimate	95% Confidence Interval	
Exposure			
Low	1.00 (Ref.)		
Med-High	2.51	0.42	15.03

15) PROSTATE

Variables	Risk Estimate	95% Confidence Interval	
Exposure			
Low	1.00 (Ref.)		
Med-High	1.20	0.38	3.77

16) HEPATIC

Variables	Risk Estimate	95% Confidence Interval	
Exposure			
Low	1.00 (Ref.)		
Med-High	N/A	N/A	N/A

17) LEUKEMIA

Variables	Risk Estimate	95% Confidence Interval	
Exposure			
Low	1.00 (Ref.)		
Med-High	N/A	N/A	N/A

18) RENAL

Variables	Risk Estimate	95% Confidence Interval	
Exposure			
Low	1.00 (Ref.)		
Med-High	N/A	N/A	N/A

19) Lymphoma

Variables	Risk Estimate	95% Confidence Interval	
Exposure			
Low	1.00 (Ref.)		
Med-High	6.70	0.75	59.94

20) SKIN

Variables	Risk Estimate	95% Confidence Interval	
Exposure			
Low	1.00 (Ref.)		
Med-High	1.12	0.54	2.32

21) TOTAL

Variables	Risk Estimate	95% Confidence Interval	
Exposure			
Low	1.00 (Ref.)		
Med-High	2.51	1.46	4.31

Unadjusted Risk Estimates for Confirmed Specific Cancers among Police Officers by Combined High and Medium versus Low Exposures

For Thyroid cancer the risk estimate for med/high versus low exposure was 1.67 (95% Confidence Interval 0.10, 26.64). For Other cancer the risk estimate for med/high versus low exposure was 3.33 (95% Confidence Interval 0.30, 36.76). For Rectal cancer the risk estimate for med/high versus low exposure was 3.33 (95% Confidence Interval 0.30, 36.76). For NHL cancer the risk estimate for med/high versus low exposure was 6.70 (95% Confidence Interval 0.75, 59.94). For Testis cancer the risk estimate for med/high versus low exposure was 1.67 (95% Confidence Interval 0.10, 26.64). For Melanoma cancer the risk estimate for med/high versus low exposure was 6.67 (95% Confidence Interval 0.75, 59.64). For Colon cancer the risk estimate for med/high versus low exposure was 1.67 (95% Confidence Interval 0.10, 26.64). For Colorectal cancer the risk estimate for med/high versus low exposure was 2.50 (95% Confidence Interval 0.42, 14.96). For Prostate cancer the risk estimate for med/high versus low exposure was 1.11 (95% Confidence Interval 0.31, 3.94). Hodgkin's Lymphoma, Esophageal, Breast, Lung and Bronchus, Stomach, Bladder, Hepatic, Leukemia, Renal, and Lymphoma cancer risk estimate for both medium versus low and high versus low, the model was unable to generate an estimate. **The total cancer the risk estimate for med/high versus low exposure was 2.67 (95% Confidence Interval 1.40, 5.08).**

Table 38. Unadjusted Risk Estimates For Confirmed Specific Cancers Among Police Officers by combined High and Medium versus Low Exposures

1) HODGKIN'S LYMPHOMA (Confirmed)

Variables	Risk Estimate	95% Confidence Interval	
Exposure			
Low	1.00 (Ref.)		
Med-High	N/A	N/A	N/A

2) THYROID (Confirmed)

Variables	Risk Estimate	95% Confidence Interval	
Exposure			
Low	1.00 (Ref.)		
Med-High	1.67	0.10	26.64

3) ESOPHAGEAL (Confirmed)

Variables	Risk Estimate	95% Confidence Interval	
Exposure			
Low	1.00 (Ref.)		
Med-High	N/A	N/A	N/A

4) BREAST (Confirmed)

Variables	Risk Estimate	95% Confidence Interval	
Exposure			
Low	1.00 (Ref.)		
Med-High	N/A	N/A	N/A

5) OTHER (Confirmed)

Variables	Risk Estimate	95% Confidence Interval	
Exposure			
Low	1.00 (Ref.)		
Med-High	3.33	0.30	36.76

6) LUNG AND BRONCHUS (Confirmed)

Variables	Risk Estimate	95% Confidence Interval	
Exposure			
Low	1.00 (Ref.)		
Med-High	N/A	N/A	N/A

7) RECTUM (Confirmed)

Variables	Risk Estimate	95% Confidence Interval	
Exposure			
Low	1.00 (Ref.)		
Med-High	3.33	0.30	36.76

8) NHL (Confirmed)

Variables	Risk Estimate	95% Confidence Interval	
Exposure			
Low	1.00 (Ref.)		
Med-High	6.70	0.75	59.94

9) STOMACH (Confirmed)

Variables	Risk Estimate	95% Confidence Interval	
Exposure			
Low	1.00 (Ref.)		
Med-High	N/A	N/A	N/A

10) TESTIS (Confirmed)

Variables	Risk Estimate	95% Confidence Interval	
Exposure			
Low	1.00 (Ref.)		
Med-High	1.67	0.10	26.64

11)MELANOMA (Confirmed)

Variables	Risk Estimate	95% Confidence Interval	
Exposure			
Low	1.00 (Ref.)		
Med-High	6.67	0.75	59.64

12) BLADDER (Confirmed)

Variables	Risk Estimate	95% Confidence Interval	
Exposure			
Low	1.00 (Ref.)		
Med-High	N/A	N/A	N/A

13) COLON (Confirmed)

Variables	Risk Estimate	95% Confidence Interval	
Exposure			
Low	1.00 (Ref.)		
Med-High	1.67	0.10	26.64

14) COLORECTAL (Confirmed)

Variables	Risk Estimate	95% Confidence Interval	
Exposure			
Low	1.00 (Ref.)		
Med-High	2.50	0.42	14.96

15) PROSTATE (Confirmed)

Variables	Risk Estimate	95% Confidence Interval	
Exposure			
Low	1.00 (Ref.)		
Med-High	1.11	0.31	3.94

16)HEPATIC (Confirmed)

Variables	Risk Estimate	95% Confidence Interval	
Exposure			
Low	1.00 (Ref.)		
Med-High	N/A	N/A	N/A

17) Leukemia (Confirmed)

Variables	Risk Estimate	95% Confidence Interval	
Exposure			
Low	1.00 (Ref.)		
Med-High	1.00	N/A	N/A

18) RENAL (Confirmed)

Variables	Risk Estimate	95% Confidence Interval	
Exposure			
Low	1.00 (Ref.)		
Med-High	1.00	N/A	N/A

19) LYMPHOMA (Confirmed)

Variables	Risk Estimate	95% Confidence Interval	
Exposure			
Low	1.00 (Ref.)		
Med-High	N/A	N/A	N/A

20) TOTAL (Confirmed)

Variables	Risk Estimate	95% Confidence Interval	
Exposure			
Low	1.00 (Ref.)		
Med-High	2.67	1.40	5.08

Adjusted Risk Estimates for Any Reported Specific Cancers among Police Officers by Combined High and Medium versus Low Exposures

For Thyroid cancer the risk estimate for med/high versus low exposure was 0.91 (95% Confidence Interval 0.08, 10.51). For Other cancer the risk estimate for med/high versus low exposure was 1.71 (95% Confidence Interval 0.23, 12.49). For Rectal cancer the risk estimate for med/high versus low exposure was 3.08 (95% Confidence Interval 0.28, 33.94). For NHL cancer the risk estimate for med/high versus low exposure was 6.49 (95% Confidence Interval 0.72, 58.65). For Testis cancer the risk estimate for med/high versus low exposure was 1.55 (95% Confidence Interval 0.22, 11.01). For Melanoma cancer the risk estimate for med/high versus low exposure was 4.61 (95% Confidence Interval 0.93, 22.86). For Colon cancer the risk estimate for med/high versus low exposure was 1.76 (95% Confidence Interval 0.11, 29.25). For Colorectal cancer the risk estimate for med/high versus low exposure was 2.39 (95% Confidence Interval 0.40, 14.39). For Prostate cancer the risk estimate for med/high versus low exposure was 2.22 (95% Confidence Interval 0.59, 8.42). For Lymphoma cancer the risk estimate for med/high versus low exposure was 6.25 (95% Confidence Interval 0.70, 56.12). For Skin cancer the risk estimate for med/high versus low exposure was 1.05 (95% Confidence Interval 0.50, 2.18). Hodgkin's Lymphoma, Esophageal, Breast, Lung and Bronchus, Stomach, Bladder, Hepatic and Renal cancer risk estimate for both medium versus low and high versus low, the model was unable to generate an estimate. **The total cancer the risk estimate for med/high versus low exposure was 2.83 (95% Confidence Interval 1.59, 5.02).**

Table 39. Adjusted Risk Estimates For Any Reported Specific Cancers Among Police Officers by combined High and Medium versus Low Exposures

1) HODGKIN'S LYMPHOMA

Variables	Risk Estimate	95% Confidence Interval	
Exposure			
Low	1.00 (Ref.)		
Med and High	1.00	N/A	N/A
Age	1.00	N/A	N/A

2) THYROID

Variables	Risk Estimate	95% Confidence Interval	
Exposure			
Low	1.00 (Ref.)		
Med and High	0.91	0.08	10.51
Age	0.97	1.06	0.87

3) ESOPHAGEAL

Variables	Risk Estimate	95% Confidence Interval	
Exposure			
Low	1.00 (Ref.)		
Med and High	N/A	N/A	N/A
Age	1.05	0.92	1.21

4) BREAST

Variables	Risk Estimate	95% Confidence Interval	
Exposure			
Low	1.00 (Ref.)		
Med and High	N/A	N/A	N/A
Age	1.06	0.95	1.18

5) OTHER

Variables	Risk Estimate	95% Confidence Interval	
Exposure			
Low	1.00 (Ref.)		
Med and High	1.71	0.23	12.49
Age	0.99	0.90	1.09

6) LUNG AND BRONCHUS

Variables	Risk Estimate	95% Confidence Interval	
Exposure			
Low	1.00 (Ref.)		
Med and High	N/A	N/A	N/A
Age	1.20	0.99	1.47

7) RECTUM

Variables	Risk Estimate	95% Confidence Interval	
Exposure			
Low	1.00 (Ref.)		
Med and High	3.08	0.28	33.94
Age	1.06	0.96	1.17

8) NHL

Variables	Risk Estimate	95% Confidence Interval	
Exposure			
Low	1.00 (Ref.)		
Med and High	6.49	0.72	58.65
Age	1.10	1.01	1.19

9) STOMACH

Variables	Risk Estimate	95% Confidence Interval	
Exposure			
Low	1.00 (Ref.)		
Med and High	N/A	N/A	N/A
Age	0.59	3.70	1.27

10) TESTIS

Variables	Risk Estimate	95% Confidence Interval	
Exposure			
Low	1.00 (Ref.)		
Med and High	1.55	0.22	11.01
Age	1.03	0.95	1.13

11) Melanoma

Variables	Risk Estimate	95% Confidence Interval	
Exposure			
Low	1.00 (Ref.)		
Med and High	4.61	0.93	22.86
Age	1.06	0.99	1.13

12) BLADDER

Variables	Risk Estimate	95% Confidence Interval	
Exposure			
Low	1.00 (Ref.)		
Med and High	N/A	N/A	N/A
Age	NA	NA	NA

13) COLON

Variables	Risk Estimate	95% Confidence Interval	
Exposure			
Low	1.00 (Ref.)		
Med and High	1.76	0.11	29.25
Age	1.12	1.00	1.27

14) COLORECTAL

Variables	Risk Estimate	95% Confidence Interval	
Exposure			
Low	1.00 (Ref.)		
Med and High	2.39	0.40	14.39
Age	1.09	1.01	1.17

15) PROSTATE

Variables	Risk Estimate	95% Confidence Interval	
Exposure			
Low	1.00 (Ref.)		
Med and High	2.22	0.59	8.42
Age	1.13	1.06	1.19

16) HEPATIC

Variables	Risk Estimate	95% Confidence Interval	
Exposure			
Low	1.00 (Ref.)		
Med and High	NA	NA	NA
Age	0.99	0.85	1.16

17) LEUKEMIA

Variables	Risk Estimate	95% Confidence Interval	
Exposure			
Low	1.00 (Ref.)		
Med and High	NA	NA	NA
Age	1.17	0.97	1.41

18) RENAL

Variables	Risk Estimate	95% Confidence Interval	
Exposure			
Low	1.00 (Ref.)		
Med and High	NA	NA	NA
Age	0.97	0.85	1.10

19) LYMPHOMA

Variables	Risk Estimate	95% Confidence Interval	
Exposure			
Low	1.00 (Ref.)		
Med and High	6.25	0.70	56.12
Age	1.08	0.99	1.17

20) SKIN

Variables	Risk Estimate	95% Confidence Interval	
Exposure			
Low	1.00 (Ref.)		
Med and High	1.05	0.50	2.18
Age	1.08	1.05	1.11

21) TOTAL

Variables	Risk Estimate	95% Confidence Interval	
Exposure			
Low	1.00 (Ref.)		
Med and High	2.83	1.59	5.02
Age	1.06	1.04	1.09

Adjusted Risk Estimates for Confirmed Specific Cancers among Police Officers by combined High and Medium versus Low Exposures

For Thyroid cancer the risk estimate for med/high versus low exposure was 1.57 (95% Confidence Interval 0.10, 25.30). For Other cancer the risk estimate for med/high versus low exposure was 3.08 (95% Confidence Interval 0.28, 34.02). For Rectal cancer the risk estimate for med/high versus low exposure was 3.07 (95% Confidence Interval 0.28, 33.86). For NHL cancer the risk estimate for med/high versus low exposure was 6.49 (95% Confidence Interval 0.72, 58.65). For Testis cancer the risk estimate for med/high versus low exposure was 1.53 (95% Confidence Interval 0.10, 24.46). For Melanoma cancer the risk estimate for med/high versus low exposure was 6.54 (95% Confidence Interval 0.72, 59.19). For Colon cancer the risk estimate for med/high versus low exposure was 1.76 (95% Confidence Interval 0.11, 29.24). For Colorectal cancer the risk estimate for med/high versus low exposure was 2.38 (95% Confidence Interval 0.40, 14.37). For Prostate cancer the risk estimate for med/high versus low exposure was 2.37 (95% Confidence Interval 0.52, 10.83). Hodgkin's Lymphoma, Esophageal, Breast, Lung and Bronchus, Stomach, Bladder, Hepatic, Leukemia, Renal, and Lymphoma cancer risk estimate for both medium versus low and high versus low, the model was unable to generate an estimate. **The total cancer the risk estimate for med/high versus low exposure was 3.46 (95% Confidence Interval 1.69, 7.09).**

Table 40. Adjusted Risk Estimates For Confirmed Specific Cancers Among Police Officers by combined High and Medium versus Low Exposures

1) HODGKIN'S LYMPHOMA (Confirmed)

Variables	Risk Estimate	95% Confidence Interval	
Exposure			
Low	1.00 (Ref.)		
Med and High	1.00	NA	NA
Age	1.00	NA	NA

2) THYROID (Confirmed)

Variables	Risk Estimate	95% Confidence Interval	
Exposure			
Low	1.00 (Ref.)		
Med and High	1.57	0.10	25.30
Age	1.02	0.90	1.16

3) ESOPHAGEAL (Confirmed)

Variables	Risk Estimate	95% Confidence Interval	
Exposure			
Low	1.00 (Ref.)		
Med and High	NA	NA	NA
Age	1.05	0.92	1.21

4) BREAST (Confirmed)

Variables	Risk Estimate	95% Confidence Interval	
Exposure			
Low	1.00 (Ref.)		
Med and High	NA	NA	NA
Age	1.07	0.92	1.24

5) OTHER (Confirmed)

Variables	Risk Estimate	95% Confidence Interval	
Exposure			
Low	1.00 (Ref.)		
Med and High	3.08	0.28	34.02
Age	1.03	0.93	1.15

6) LUNG AND BRONCHUS

Variables	Risk Estimate	95% Confidence Interval	
Exposure			
Low	1.00 (Ref.)		
Med and High	NA	NA	NA
Age	1.20	0.99	1.47

7) RECTUM (Confirmed)

Variables	Risk Estimate	95% Confidence Interval	
Exposure			
Low	1.00 (Ref.)		
Med and High	3.07	0.28	33.86
Age	1.06	0.96	1.17

8) NHL (Confirmed)

Variables	Risk Estimate	95% Confidence Interval	
Exposure			
Low	1.00 (Ref.)		
Med and High	6.49	0.72	58.65
Age	1.10	1.01	1.19

9) STOMACH (Confirmed)

Variables	Risk Estimate	95% Confidence Interval	
Exposure			
Low	1.00 (Ref.)		
Med and High	NA	NA	NA
Age	0.59	0.27	1.27

10) TESTIS (Confirmed)

Variables	Risk Estimate	95% Confidence Interval	
Exposure			
Low	1.00 (Ref.)		
Med and High	1.53	0.10	24.46
Age	1.05	0.93	1.18

11) Melanoma (Confirmed)

Variables	Risk Estimate	95% Confidence Interval	
Exposure			
Low	1.00 (Ref.)		
Med and High	6.54	0.72	59.19
Age	1.10	1.02	1.19

12) BLADDER (Confirmed)

Variables	Risk Estimate	95% Confidence Interval	
Exposure			
Low	1.00 (Ref.)		
Med and High	NA	NA	NA
Age	NA	NA	NA

13) COLON (Confirmed)

Variables	Risk Estimate	95% Confidence Interval	
Exposure			
Low	1.00 (Ref.)		
Med and High	1.76	0.11	29.24
Age	1.12	1.00	1.27

14) COLORECTAL (Confirmed)

Variables	Risk Estimate	95% Confidence Interval	
Exposure			
Low	1.00 (Ref.)		
Med and High	2.38	0.40	14.37
Age	1.09	1.01	1.17

15) PROSTATE (Confirmed)

Variables	Risk Estimate	95% Confidence Interval	
Exposure			
Low	1.00 (Ref.)		
Med and High	2.37	0.52	10.83
Age	1.13	-1.06	1.20

16) HEPATIC (Confirmed)

Variables	Risk Estimate	95% Confidence Interval	
Exposure			
Low	1.00 (Ref.)		
Med and High	NA	NA	NA
Age	0.99	0.85	1.16

17) LEUKEMIA (Confirmed)

Variables	Risk Estimate	95% Confidence Interval	
Exposure			
Low	1.00 (Ref.)		
Med and High	1.00	NA	NA
Age	1.00	NA	NA

18) RENAL (Confirmed)

Variables	Risk Estimate	95% Confidence Interval	
Exposure			
Low	1.00 (Ref.)		
Med and High	1.00	NA	NA
Age	1.00	NA	NA

19) LYMPHOMA (Confirmed)

Variables	Risk Estimate	95% Confidence Interval	
Exposure			
Low	1.00 (Ref.)		
Med and High	NA	NA	NA
Age	2.70	0.97	1.26

20) TOTAL (Confirmed)

Variables	Risk Estimate	95% Confidence Interval	
Exposure			
Low	1.00 (Ref.)		
Med and High	3.46	1.69	7.09
Age	1.09	1.06	1.12

FIREFIGHTERS
Unadjusted Risk Estimates for Any Reported Specific Cancers among Firefighters by High, Medium and Low Exposures

Esophageal, Breast, Lung and Bronchus, Rectum, NHL, Stomach, Testis, Melanoma, Bladder, Colon, Colorectal, Hepatic, Leukemia, and Renal cancer risk estimate for both medium versus low and high versus low, the model was unable to generate an estimate. For Hodgkin's Lymphoma cancer risk estimate for medium versus low exposure was 2.30 (95% Confidence Interval 0.14, 36.81) and for high versus low exposure the risk estimate model was unable to generate an estimate. For Thyroid cancer risk estimate for medium versus low exposure, the model was unable to generate an estimate but for high versus low exposure the risk estimate was 2.68 (95% Confidence Interval 0.16, 41.29).

For Other cancer risk estimate for medium versus low exposure, the model was unable to generate an estimate but for high versus low exposure the risk estimate was 2.58 (95% Confidence Interval 0.16, 41.29). For Prostate cancer risk estimate for medium versus low exposure was 3.45 (95% Confidence Interval 0.58, 20.67) and high versus low exposure was 3.87 (95% Confidence Interval 0.65, 23.18). For Lymphoma cancer risk estimate for medium versus low exposure was 2.30 (95% Confidence Interval 0.14, 36.81) and for high versus low exposure the risk estimate model was unable to generate an estimate. **For skin cancer risk estimate for medium versus low exposure was 3.22 (95% Confidence Interval 1.02, 10.16) and high versus low exposure was 3.62 (95% Confidence Interval 1.15, 11.39). The total cancer risk estimate for medium versus low exposure was 2.96 (95% Confidence Interval 1.10, 7.95) and high versus low exposure was 3.32 (95% Confidence Interval 1.24, 8.92).**

Table 41. Unadjusted Risk Estimates for Any Reported Specific Cancers Among Firefighters by High, Medium and Low Exposures

1) HODGKIN'S LYMPHOMA			
Variables	Risk Estimate	95% Confidence Interval	
Exposure			
Low	1.00 (Ref.)		
Medium	2.30	0.14	36.81
High	NA	NA	NA
2) THYROID			
Variables	Risk Estimate	95% Confidence Interval	
Exposure			
Low	1.00 (Ref.)		
Medium	NA	NA	NA
High	2.68	0.16	41.29
3) ESOPHAGEAL			
Variables	Risk Estimate	95% Confidence Interval	
Exposure			
Low	1.00 (Ref.)		
Medium	1.00	NA	NA
High	1.00	NA	NA
4) BREAST			
Variables	Risk Estimate	95% Confidence Interval	
Exposure			
Low	1.00 (Ref.)		
Medium	1.00	NA	NA
High	1.00	NA	NA

5) OTHER

Variables	Risk Estimate	95% Confidence Interval	
Exposure			
Low	1.00 (Ref.)		
Medium	NA	NA	NA
High	2.58	0.16	41.29

6) LUNG AND BRONCHUS

Variables	Risk Estimate	95% Confidence Interval	
Exposure			
Low	1.00 (Ref.)		
Medium	1.00	NA	NA
High	1.00	NA	NA

7) RECTUM

Variables	Risk Estimate	95% Confidence Interval	
Exposure			
low	1.00 (Ref.)		
Medium	NA	NA	NA
High	NA	NA	NA

8) NHL

Variables	Risk Estimate	95% Confidence Interval	
Exposure			
low	1.00 (Ref.)		
Medium	NA	NA	NA
High	NA	NA	NA

9) STOMACH

Variables	Risk Estimate	95% Confidence Interval	
Exposure			
Low	1.00 (Ref.)		
Medium	1.00	NA	NA
High	1.00	NA	NA

10)TESTIS

Variables	Risk Estimate	95% Confidence Interval	
Exposure			
Low	1.00 (Ref.)		
Medium	1.00	NA	NA
High	1.00	NA	NA

11) MELANOMA

Variables	Risk Estimate	95% Confidence Interval	
Exposure			
low	1.00 (Ref.)		
Medium	NA	NA	NA
High	NA	NA	NA

12) BLADDER

Variables	Risk Estimate	95% Confidence Interval	
Exposure			
low	1.00 (Ref.)		
Medium	NA	NA	NA
High	NA	NA	NA

13) COLON

Variables	Risk Estimate	95% Confidence Interval	
Exposure			
Low	1.00 (Ref.)		
Medium	1.00	NA	NA
High	1.00	NA	NA

14) COLORECTAL

Variables	Risk Estimate	95% Confidence Interval	
Exposure			
low	1.00 (Ref.)		
Medium	NA	NA	NA
High	NA	NA	NA

15) PROSTATE

Variables	Risk Estimate	95% Confidence Interval	
Exposure			
low	1.00 (Ref.)		
Medium	3.45	0.58	20.67
High	3.87	0.65	23.18

16) HEPATIC

Variables	Risk Estimate	95% Confidence Interval	
Exposure			
Low	1.00 (Ref.)		
Medium	1.00	NA	NA
High	1.00	NA	NA

17) LEUKEMIA

Variables	Risk Estimate	95% Confidence Interval	
Exposure			
low	1.00 (Ref.)		
Medium	NA	NA	NA
High	1.00	NA	NA

18) RENAL

Variables	Risk Estimate	95% Confidence Interval	
Exposure			
low	1.00 (Ref.)		
Medium	1.00	NA	NA
High	NA	NA	NA

19) LYMPHOMA

Variables	Risk Estimate	95% Confidence Interval	
Exposure			
low	1.00 (Ref.)		
Medium	2.30	0.14	36.81
High	NA	NA	NA

20) SKIN

Variables	Risk Estimate	95% Confidence Interval	
Exposure			
low	1.00 (Ref.)		
Medium	3.22	1.02	10.16
High	3.62	1.15	11.39

21) TOTAL

Variables	Risk Estimate	95% Confidence Interval	
Exposure			
low	1.00 (Ref.)		
Medium	2.96	1.10	7.95
High	3.32	1.24	8.92

Unadjusted Risk Estimate for Confirmed Specific Cancers among Firefighters by High, Medium and Low Exposures

Hodgkin's Lymphoma, Thyroid, Esophageal, Breast, Other, Lung and Bronchus, Rectum, NHL, Stomach, Testis, Melanoma, Bladder, Colon, Colorectal, Prostate, Hepatic, Leukemia, Renal, and Lymphoma cancer risk estimate for both medium versus low and high versus low, the model was unable to generate an estimate. **The total cancer risk estimate for medium versus low exposure**

was 8.11 (95% Confidence Interval 1.69, 39.05) and high versus low exposure was 6.44 (95% Confidence Interval 1.25, 33.21).

Table 42 Unadjusted Risk Estimate for Confirmed Specific Cancers Among Firefighters by High, Medium and Low Exposures

1) HODGKIN'S LYMPHOMA (Confirmed)

Variables	Risk Estimate	95% Confidence Interval	
Exposure			
Low	1.00 (Ref.)		
Medium	NA	NA	NA
High	NA	NA	NA

2) THYROID (Confirmed)

Variables	Risk Estimate	95% Confidence Interval	
Exposure			
Low	1.00 (Ref.)		
medium	1.00	NA	NA
High	1.00	NA	NA

3)ESOPHAGEAL (Confirmed)

Variables	Risk Estimate	95% Confidence Interval	
Exposure			
Low	1.00 (Ref.)		
Medium	1.00	NA	NA
High	1.00	NA	NA

4) BREAST (Confirmed)

Variables	Risk Estimate	95% Confidence Interval	
Exposure			
Low	1.00 (Ref.)		
Medium	1.00	NA	NA
High	1.00	NA	NA

5) OTHER (Confirmed)

Variables	Risk Estimate	95% Confidence Interval	
Exposure			
Low	1.00 (Ref.)		
Medium	1.00	NA	NA
High	NA	NA	NA

6) LUNG AND BRONCHUS (Confirmed)

Variables	Risk Estimate	95% Confidence Interval	
Exposure			
Low	1.00 (Ref.)		
Medium	1.00	NA	NA
High	1.00	NA	NA

7) RECTUM (Confirmed)

Variables	Risk Estimate	95% Confidence Interval	
Exposure			
Low	1.00 (Ref.)		
Medium	NA	NA	NA
High	NA	NA	NA

8) NHL (Confirmed)

Variables	Risk Estimate	95% Confidence Interval	
Exposure			
Low	1.00 (Ref.)		
Medium	0.00	NA	NA
High	0.00	NA	NA

9) STOMACH (Confirmed)

Variables	Risk Estimate	95% Confidence Interval	
Exposure			
Low	1.00 (Ref.)		
Medium	1.00	NA	NA
High	1.00	NA	NA

10) TESTIS (Confirmed)

Variables	Risk Estimate	95% Confidence Interval	
Exposure			
Low	1.00 (Ref.)		
Medium	1.00	NA	NA
High	1.00	NA	NA

11) MELANOMA (Confirmed)

Variables	Risk Estimate	95% Confidence Interval	
Exposure			
Low	1.00 (Ref.)		
Medium	NA	NA	NA
High	1.00	NA	NA

12) BLADDER (Confirmed)

Variables	Risk Estimate	95% Confidence Interval	
Exposure			
Low	1.00 (Ref.)		
Medium	NA	NA	NA
High	NA	NA	NA

13) COLON (Confirmed)

Variables	Risk Estimate	95% Confidence Interval	
Exposure			
Low	1.00 (Ref.)		
Medium	1.00	NA	NA
High	1.00	NA	NA

14) COLORECTAL (Confirmed)

Variables	Risk Estimate	95% Confidence Interval	
Exposure			
Low	1.00 (Ref.)		
Medium	NA	NA	NA
High	NA	NA	NA

15) PROSTATE (Confirmed)

Variables	Risk Estimate	95% Confidence Interval	
Exposure			
Low	1.00 (Ref.)		
Medium	NA	NA	NA
High	NA	NA	NA

16) HEPATIC (Confirmed)

Variables	Risk Estimate	95% Confidence Interval	
Exposure			
Low	1.00 (Ref.)		
Medium	1.00	NA	NA
High	1.00	NA	NA

17) LEUKEMIA (Confirmed)

Variables	Risk Estimate	95% Confidence Interval	
Exposure			
Low	1.00 (Ref.)		
Medium	NA	NA	NA
High	1.00	NA	NA

18) RENAL (Confirmed)

Variables	Risk Estimate	95% Confidence Interval	
Exposure			
Low	1.00 (Ref.)		
Medium	1.00	NA	NA
High	1.00	NA	NA

19) LYMPHOMA (Confirmed)

Variables	Risk Estimate	95% Confidence Interval	
Exposure			
Low	1.00 (Ref.)		
Medium	NA	NA	NA
High	1.00	NA	NA

20) TOTAL (Confirmed)

Variables	Risk Estimate	95% Confidence Interval	
Exposure			
Low	1.00 (Ref.)		
Medium	8.11	1.69	39.05
High	6.44	1.25	33.21

Adjusted Risk Estimates for Any Reported Specific Cancers among Firefighters by High, Medium and Low Exposures

Esophageal, Breast, Lung and Bronchus, Rectum, NHL, Stomach, Testis, Melanoma, Bladder, Colon, Colorectal, Hepatic, Leukemia, Renal, cancer risk estimate for both medium versus low and high versus low, the model was unable to generate an estimate. For Hodgkin's Lymphoma cancer risk estimate for medium versus low exposure was 1.80 (95% Confidence Interval 0.09, 35.69) and for high versus low exposure the risk estimate model was unable to generate an estimate. For Thyroid cancer risk estimate for medium versus low exposure was 1.71 (95% Confidence Interval 0.05, 63.29) and high versus low exposure was 1.03 (95% Confidence Interval 0.89, 1.18). For Other cancer risk estimate for medium versus low exposure was 0.69 (95% Confidence Interval 0.02, 21.08) and high versus low exposure was 1.08 (95% Confidence Interval 0.97, 1.21). For Prostate cancer risk estimate for medium versus low exposure was 1.32 (95% Confidence Interval 0.20, 8.60) and high versus low exposure was 0.64 (95% Confidence Interval 0.08, 5.13). For Lymphoma cancer risk estimate for medium versus low exposure was 0.68 (95% Confidence Interval 0.03, 14.41) and for high versus low exposure the risk estimate model was unable to generate an estimate. For Skin cancer risk estimate for medium versus low exposure was 2.02 (95% Confidence Interval 0.60, 6.73) and high versus low exposure was 1.45 (95% Confidence Interval 0.39, 5.48). The total cancer risk estimate for medium versus low exposure was 1.57 (95% Confidence Interval 0.56, 4.43) and high versus low exposure was 0.99 (95% Confidence Interval 0.32, 3.11).

Table 43. Adjusted Risk Estimates for Any Reported Specific Cancers Among Firefighters by High, Medium and Low Exposures

1) HODGKIN'S LYMPHOMA

Variables	Risk Estimate	95% Confidence Interval	
Exposure			
Low	1.00 (Ref.)		
Medium	1.80	0.09	35.69
High	NA	NA	NA
Age	1.03	0.91	1.17

2) THYROID

Variables	Risk Estimate	95% Confidence Interval	
Exposure			
Low	1.00 (Ref.)		
Medium	NA	NA	NA
High	1.71	0.05	63.29
Age	1.03	0.89	1.18

3) ESOPHAGEAL

Variables	Risk Estimate	95% Confidence Interval	
Exposure			
Low	1.00 (Ref.)		
Medium	NA	NA	NA
High	NA	NA	NA
Age	NA	NA	NA

4) BREAST

Variables	Risk Estimate	95% Confidence Interval	
Exposure			
Low	1.00 (Ref.)		
Medium	1.00	NA	NA
High	1.00	NA	NA
Age	1.00	NA	NA

5) OTHER

Variables	Risk Estimate	95% Confidence Interval	
Exposure			
Low	1.00 (Ref.)		
Medium	NA	NA	NA
High	0.69	0.02	21.08
Age	1.08	0.97	1.21

6) LUNG AND BRONCHUS

Variables	Risk Estimate	95% Confidence Interval	
Exposure			
Low	1.00 (Ref.)		
Medium	1.00	NA	NA
High	1.00	NA	NA
Age	1.00	NA	NA

7) RECTUM

Variables	Risk Estimate	95% Confidence Interval	
Exposure			
Low	1.00 (Ref.)		
Medium	NA	NA	NA
High	NA	NA	NA
Age	1.04	0.92	1.18

8) NHL

Variables	Risk Estimate	95% Confidence Interval	
Exposure			
Low	1.00 (Ref.)		
Medium	NA	NA	NA
High	NA	NA	NA
Age	0.97	0.77	1.22

9) STOMACH

Variables	Risk Estimate	95% Confidence Interval	
Exposure			
Low	1.00 (Ref.)		
Medium	1.00	NA	NA
High	1.00	NA	NA
Age	1.00	NA	NA

10) TESTIS

Variables	Risk Estimate	95% Confidence Interval	
Exposure			
Low	1.00 (Ref.)		
Medium	1.00	NA	NA
High	1.00	NA	NA
Age	1.00	NA	NA

11) MELANOMA

Variables	Risk Estimate	95% Confidence Interval	
Exposure			
Low	1.00 (Ref.)		
Medium	NA	NA	NA
High	NA	NA	NA
Age	1.01	0.91	1.13

12) BLADDER

Variables	Risk Estimate	95% Confidence Interval	
Exposure			
Low	1.00 (Ref.)		
Medium	NA	NA	NA
High	NA	NA	NA
Age	1.13	1.02	1.25

13) COLON

Variables	Risk Estimate	95% Confidence Interval	
Exposure			
Low	1.00 (Ref.)		
Medium	1.00	NA	NA
High	1.00	NA	NA
Age	1.00	NA	NA

14) COLORECTAL

Variables	Risk Estimate	95% Confidence Interval	
Exposure			
Low	1.00 (Ref.)		
Medium	NA	NA	NA
High	NA	NA	NA
Age	1.04	0.92	1.18

15) PROSTATE

Variables	Risk Estimate	95% Confidence Interval	
Exposure			
Low	1.00 (Ref.)		
Medium	1.32	0.20	8.60
High	0.64	0.08	5.13
Age	1.11	1.05	1.17

16) HEPATIC

Variables	Risk Estimate	95% Confidence Interval	
Exposure			
Low	1.00 (Ref.)		
Medium	1.00	NA	NA
High	1.00	NA	NA
Age	1.00	NA	NA

17) LEUKEMIA

Variables	Risk Estimate	95% Confidence Interval	
Exposure			
Low	1.00 (Ref.)		
Medium	NA	NA	NA
High	0.25	NA	NA
Age	1.09	0.92	1.29

18) RENAL

Variables	Risk Estimate	95% Confidence Interval	
Exposure			
Low	1.00 (Ref.)		
Medium	0.44	NA	NA
High	NA	NA	NA
Age	1.10	0.96	1.26

19) LYMPHOMA

Variables	Risk Estimate	95% Confidence Interval	
Exposure			
Low	1.00 (Ref.)		
Medium	0.68	0.03	14.41
High	NA	NA	NA
Age	1.14	1.00	1.30

20) SKIN

Variables	Risk Estimate	95% Confidence Interval	
Exposure			
Low	1.00 (Ref.)		
Medium	2.02	0.60	6.73
High	1.45	0.39	5.48
Age	1.06	1.02	1.10

21) TOTAL

Variables	Risk Estimate	95% Confidence Interval	
Exposure			
Low	1.00 (Ref.)		
Medium	1.57	0.56	4.43
High	0.99	0.32	3.11
Age	1.07	1.04	1.11

Adjusted Risk Estimates for Confirmed Specific Cancers among Firefighters by High, Medium and Low Exposures

Hodgkin's Lymphoma, Thyroid, Esophageal, Breast, Other, Lung and Bronchus, Rectum, NHL, Stomach, Testis, Melanoma, Bladder, Colon, Colorectal, Prostate, Hepatic, Leukemia, Renal, and Lymphoma cancer risk estimate for both medium versus low and high versus low, the model was unable to generate an estimate. The total cancer risk estimate for medium versus low exposure was 3.79 (95% Confidence Interval 0.75, 19.23) and high versus low exposure was 1.52 (95% Confidence Interval 0.25, 9.25).

Table 44. Adjusted Risk Estimates for Confirmed Specific Cancers Among Firefighters by High, Medium and Low Exposures

1) HODGKIN'S LYMPHOMA (Confirmed)

Variables	Risk Estimate	95% Confidence Interval	
Exposure			
Low	1.00 (Ref.)		
Medium	NA	NA	NA
High	NA	NA	NA
Age	1.06	0.88	1.27

2) THYROID (Confirmed)

Variables	Risk Estimate	95% Confidence Interval	
Exposure			
Low	1.00 (Ref.)		
Medium	1.00	NA	NA
High	1.00	NA	NA
Age	1.00	NA	NA

3) ESOPHAGEAL (Confirmed)

Variables	Risk Estimate	95% Confidence Interval	
Exposure			
Low	1.00 (Ref.)		
Medium	NA	NA	NA
High	NA	NA	NA
Age	NA	NA	NA

4) BREAST (Confirmed)

Variables	Risk Estimate	95% Confidence Interval	
Exposure			
Low	1.00 (Ref.)		
Medium	1.00	NA	NA
High	1.00	NA	NA
Age	1.00	NA	NA

5) OTHER (Confirmed)

Variables	Risk Estimate	95% Confidence Interval	
Exposure			
Low	1.00 (Ref.)		
Medium	0.71	NA	NA
High	NA	NA	NA
Age	1.04	0.86	1.25

6) LUNG AND BRONCHUS (Confirmed)

Variables	Risk Estimate	95% Confidence Interval	
Exposure			
Low	1.00 (Ref.)		
Medium	1.00	NA	NA
High	1.00	NA	NA
Age	1.00	NA	NA

7) RECTUM (Confirmed)

Variables	Risk Estimate	95% Confidence Interval	
Exposure			
Low	1.00 (Ref.)		
Medium	NA	NA	NA
High	NA	NA	NA
Age	1.04	0.92	1.18

8) NHL (Confirmed)

Variables	Risk Estimate	95% Confidence Interval	
Exposure			
Low	1.00 (Ref.)		
Medium	NA	NA	NA
High	NA	NA	NA
Age	0.97	0.77	1.22

9) STOMACH (Confirmed)

Variables	Risk Estimate	95% Confidence Interval	
Exposure			
Low	1.00 (Ref.)		
Medium	1.00	NA	NA
High	1.00	NA	NA
Age	1.00	NA	NA

10) TESTIS (Confirmed)

Variables	Risk Estimate	95% Confidence Interval	
Exposure			
Low	1.00 (Ref.)		
Medium	1.00	NA	NA
High	1.00	NA	NA
Age	1.00	NA	NA

11) MELANOMA (Confirmed)

Variables	Risk Estimate	95% Confidence Interval	
Exposure			
Low	1.00 (Ref.)		
Medium	NA	NA	NA
High	0.00	NA	NA
Age	1.59	0.55	4.60

12) BLADDER (Confirmed)

Variables	Risk Estimate	95% Confidence Interval	
Exposure			
Low	1.00 (Ref.)		
Medium	NA	NA	NA
High	NA	NA	NA
Age	1.13	1.02	1.26

13) COLON (Confirmed)

Variables	Risk Estimate	95% Confidence Interval	
Exposure			
Low	1.00 (Ref.)		
Medium	1.00	NA	NA
High	1.00	NA	NA
Age	1.00	NA	NA

14) COLORECTAL (Confirmed)

Variables	Risk Estimate	95% Confidence Interval	
Exposure			
Low	1.00 (Ref.)		
Medium	NA	NA	NA
High	NA	NA	NA
Age	1.04	0.92	1.18

15) PROSTATE (Confirmed)

Variables	Risk Estimate	95% Confidence Interval	
Exposure			
Low	1.00 (Ref.)		
Medium	NA	NA	NA
High	NA	NA	NA
Age	1.10	1.03	1.18

16) HEPATIC (Confirmed)

Variables	Risk Estimate	95% Confidence Interval	
Exposure			
Low	1.00 (Ref.)		
Medium	1.00	NA	NA
High	1.00	NA	NA
Age	1.00	NA	NA

17) LEUKEMIA (Confirmed)

Variables	Risk Estimate	95% Confidence Interval	
Exposure			
Low	1.00 (Ref.)		
Medium	NA	NA	NA
High	0.25	NA	NA
Age	1.09	0.92	1.29

18) RENAL (Confirmed)

Variables	Risk Estimate	95% Confidence Interval	
Exposure			
Low	1.00 (Ref.)		
Medium	1.00	NA	NA
High	1.00	NA	NA
Age	1.00	NA	NA

19) LYMPHOMA (Confirmed)

Variables	Risk Estimate	95% Confidence Interval	
Exposure			
Low	1.00 (Ref.)		
Medium	NA	NA	NA
High	0.00	NA	NA
Age	1.59	0.55	4.60

20) TOTAL (Confirmed)

Variables	Risk Estimate	95% Confidence Interval	
Exposure			
Low	1.00 (Ref.)		
Medium	3.79	0.75	19.23
High	1.52	0.25	9.25
Age	1.09	1.04	1.14

Unadjusted Risk Estimates For Any Reported Specific Cancers Among Firefighters by combined High and Medium versus Low Exposures

For Hodgkin's Lymphoma cancer the risk estimate for med/high versus low exposure was 1.22 (95% Confidence Interval 0.08, 19.46). For Thyroid cancer the risk estimate for med/high versus low exposure was 1.22 (95% Confidence Interval 0.08, 19.46). For Other cancer the risk estimate for med/high versus low exposure was 1.22 (95% Confidence Interval 0.08, 19.46). For Prostate cancer the risk estimate for med/high versus low exposure was 3.65 (95% Confidence Interval 0.74, 18.09). For Lymphoma cancer the risk estimate for med/high versus low exposure was 61.22 (95% Confidence Interval 0.08, 19.46). **For Skin cancer the risk estimate for med/high versus low exposure was 3.41 (95% Confidence Interval 1.23, 9.46). The Total cancer the risk estimate for med/high versus low exposure was 3.13 (95% Confidence Interval 1.31, 7.49).** Esophageal, Breast, Lung and Bronchus, Stomach, Testis, Colon, and Hepatic cancer risk estimate for med/high versus low, the model was unable to generate an estimate. No data were obtained for Rectum, NHL, Melanoma, Bladder, Colorectal, Leukemia, and Renal cancer from our database.

Table 45. Unadjusted Risk Estimates For Any Reported Specific Cancers Among Firefighters by combined High and Medium versus Low Exposures

1) HODGKIN'S LYMPHOMA

Variables	Risk Estimate	95% Confidence Interval	
Exposure			
Low	1.00 (Ref.)		
Med-High	1.22	0.08	19.46

2) THYROID

Variables	Risk Estimate	95% Confidence Interval	
Exposure			
Low	1.00 (Ref.)		
Med-High	1.22	0.08	19.46

3) ESOPHAGEAL

Variables	Risk Estimate	95% Confidence Interval	
Exposure			
Low	1.00 (Ref.)		
Med-High	1.00	NA	NA

4) BREAST

Variables	Risk Estimate	95% Confidence Interval	
Exposure			
Low	1.00 (Ref.)		
Med-High	1.00	NA	NA

5) OTHER

Variables	Risk Estimate	95% Confidence Interval	
Exposure			
Low	1.00 (Ref.)		
Med-High	1.22	0.08	19.46

6) LUNG AND BRONCHUS

Variables	Risk Estimate	95% Confidence Interval	
Exposure			
Low	1.00 (Ref.)		
Med-High	1.00	NA	NA

7) RECTUM

Variables	Risk Estimate	95% Confidence Interval	
Exposure			
Low	1.00 (Ref.)		
Med-High	NA	NA	NA

8) NHL

Variables	Risk Estimate	95% Confidence Interval	
Exposure			
Low	1.00 (Ref.)		
Med-High	NA	NA	NA

9) STOMACH

Variables	Risk Estimate	95% Confidence Interval	
Exposure			
Low	1.00 (Ref.)		
Med-High	1.00	NA	NA

10) TESTIS

Variables	Risk Estimate	95% Confidence Interval	
Exposure			
Low	1.00 (Ref.)		
Med-High	1.00	NA	NA

11) MELANOMA

Variables	Risk Estimate	95% Confidence Interval	
Exposure			
Low	1.00 (Ref.)		
Med-High	NA	NA	NA

12) BLADDER

Variables	Risk Estimate	95% Confidence Interval	
Exposure			
Low	1.00 (Ref.)		
Med-High	NA	NA	NA

13) COLON

Variables	Risk Estimate	95% Confidence Interval	
Exposure			
Low	1.00 (Ref.)		
Med-High	1.00	NA	NA

14) COLORECTAL

Variables	Risk Estimate	95% Confidence Interval	
Exposure			
Low	1.00 (Ref.)		
Med-High	NA	NA	NA

15) PROSTATE

Variables	Risk Estimate	95% Confidence Interval	
Exposure			
Low	1.00 (Ref.)		
Med-High	3.65	0.74	18.09

16) HEPATIC

Variables	Risk Estimate	95% Confidence Interval	
Exposure			
Low	1.00 (Ref.)		
Med-High	1.00	NA	NA

17) LEUKEMIA

Variables	Risk Estimate	95% Confidence Interval	
Exposure			
Low	1.00 (Ref.)		
Med-High	NA	NA	NA

18) RENAL

Variables	Risk Estimate	95% Confidence Interval	
Exposure			
Low	1.00 (Ref.)		
Med-High	NA	NA	NA

19) Lymphoma

Variables	Risk Estimate	95% Confidence Interval	
Exposure			
Low	1.00 (Ref.)		
Med-High	1.22	0.08	19.46

20) SKIN

Variables	Risk Estimate	95% Confidence Interval	
Exposure			
Low	1.00 (Ref.)		
Med-High	3.41	1.23	9.46

21) TOTAL

Variables	Risk Estimate	95% Confidence Interval	
Exposure			
Low	1.00 (Ref.)		
Med-High	3.13	1.31	7.49

Unadjusted Risk Estimates For Confirmed Specific Cancers Among Firefighters by Combined High and Medium versus Low Exposures

The Total cancer the risk estimate for med/high versus low exposure was 7.32 (95% Confidence Interval 1.64, 32.72). Thyroid, Esophageal, Breast, Lung and Bronchus, Stomach, Testis, Colon, Hepatic, and Renal cancer risk estimate for med/high versus low, the model was unable to generate an estimate. No data were obtained for Hodgkin's Lymphoma, Other, Rectum, NHL, Melanoma, Bladder, Colorectal, Prostate, Leukemia, Lymphoma, and Skin cancer from our database.

Table 46. Unadjusted Risk Estimates For Confirmed Specific Cancers Among Firefighters by combined High and Medium versus Low Exposures

1) HODGKIN'S LYMPHOMA (Confirmed)

Variables	Risk Estimate	95% Confidence Interval	
Exposure			
Low	1.00 (Ref.)		
Med-High	NA	NA	NA

2) THYROID (Confirmed)

Variables	Risk Estimate	95% Confidence Interval	
Exposure			
Low	1.00 (Ref.)		
Med-High	1.00	NA	NA

3) ESOPHAGEAL (Confirmed)

Variables	Risk Estimate	95% Confidence Interval	
Exposure			
Low	1.00 (Ref.)		
Med-High	1.00	NA	NA

4) BREAST (Confirmed)

Variables	Risk Estimate	95% Confidence Interval	
Exposure			
Low	1.00 (Ref.)		
Med-High	1.00	NA	NA

5) OTHER (Confirmed)

Variables	Risk Estimate	95% Confidence Interval	
Exposure			
Low	1.00 (Ref.)		
Med-High	NA	NA	NA

6) LUNG AND BRONCHUS (Confirmed)

Variables	Risk Estimate	95% Confidence Interval	
Exposure			
Low	1.00 (Ref.)		
Med-High	1.00	NA	NA

7) RECTUM (Confirmed)

Variables	Risk Estimate	95% Confidence Interval	
Exposure			
Low	1.00 (Ref.)		
Med-High	NA	NA	NA

8) NHL (Confirmed)

Variables	Risk Estimate	95% Confidence Interval	
Exposure			
Low	1.00 (Ref.)		
Med-High	NA	NA	NA

9) STOMACH (Confirmed)

Variables	Risk Estimate	95% Confidence Interval	
Exposure			
Low	1.00 (Ref.)		
Med-High	1.00	NA	NA

10) TESTIS (Confirmed)

Variables	Risk Estimate	95% Confidence Interval	
Exposure			
Low	1.00 (Ref.)		
Med-High	1.00	NA	NA

11)MELANOMA (Confirmed)

Variables	Risk Estimate	95% Confidence Interval	
Exposure			
Low	1.00 (Ref.)		
Med-High	NA	NA	NA

12) BLADDER (Confirmed)

Variables	Risk Estimate	95% Confidence Interval	
Exposure			
Low	1.00 (Ref.)		
Med-High	NA	NA	NA

13) COLON (Confirmed)

Variables	Risk Estimate	95% Confidence Interval	
Exposure			
Low	1.00 (Ref.)		
Med-High	1.00	NA	NA

14) COLORECTAL (Confirmed)

Variables	Risk Estimate	95% Confidence Interval	
Exposure			
Low	1.00 (Ref.)		
Med-High	NA	NA	NA

15) PROSTATE (Confirmed)

Variables	Risk Estimate	95% Confidence Interval	
Exposure			
Low	1.00 (Ref.)		
Med-High	NA	NA	NA

16)HEPATIC (Confirmed)

Variables	Risk Estimate	95% Confidence Interval	
Exposure			
Low	1.00 (Ref.)		
Med-High	1.00	NA	NA

17) Leukemia (Confirmed)

Variables	Risk Estimate	95% Confidence Interval	
Exposure			
Low	1.00 (Ref.)		
Med-High	NA	NA	NA

18) RENAL (Confirmed)

Variables	Risk Estimate	95% Confidence Interval	
Exposure			
Low	1.00 (Ref.)		
Med-High	1.00	NA	NA

19) LYMPHOMA (Confirmed)

Variables	Risk Estimate	95% Confidence Interval	
Exposure			
Low	1.00 (Ref.)		
Med-High	NA	NA	NA

20) TOTAL (Confirmed)

Variables	Risk Estimate	95% Confidence Interval	
Exposure			
Low	1.00 (Ref.)		
Med-High	7.32	1.64	32.72

Adjusted Risk Estimates For Any Reported Specific Cancers Among Firefighters by combined High and Medium versus Low Exposures

For Hodgkin's Lymphoma cancer the risk estimate for med/high versus low exposure was 1.07 (95% Confidence Interval 0.04, 27.03). For Thyroid cancer the risk estimate for med/high versus low exposure was 0.72 (95% Confidence Interval 0.03, 18.24). For Other cancer the risk estimate for med/high versus low exposure was 0.37 (95% Confidence Interval 0.01, 9.58). For Prostate cancer the risk estimate for med/high versus low exposure was 0.96 (95% Confidence Interval 0.16, 5.79). For Lymphoma cancer the risk estimate for med/high versus low exposure was 2.91 (95% Confidence Interval 0.01, 7.77). For Skin cancer the risk estimate for med/high versus low exposure was 1.77 (95% Confidence Interval 0.56, 5.56). The Total cancer the risk estimate for med/high versus low exposure was 1.29 (95% Confidence Interval 0.48, 3.45). Breast, Lung and Bronchus, Stomach, Testis, Colon, and Hepatic cancer risk estimate for med/high versus low, the model was unable to generate an estimate. No data were obtained for Esophageal, Rectum, NHL, Melanoma, Bladder, Colorectal, Leukemia, and Renal cancer from our database.

Table 47. Adjusted Risk Estimates For Any Reported Specific Cancers Among Firefighters by combined High and Medium versus Low Exposures

1) HODGKIN'S LYMPHOMA

Variables	Risk Estimate	95% Confidence Interval	
Exposure			
Low	1.00 (Ref.)		
Med and High	1.07	0.04	27.03
Age	1.01	0.88	1.16

2) THYROID

Variables	Risk Estimate	95% Confidence Interval	
Exposure			
Low	1.00 (Ref.)		
Med and High	0.72	0.03	18.24
Age	1.04	0.92	1.18

3) ESOPHAGEAL

Variables	Risk Estimate	95% Confidence Interval	
Exposure			
Low	1.00 (Ref.)		
Med and High	NA	NA	NA
Age	NA	NA	NA

4) BREAST

Variables	Risk Estimate	95% Confidence Interval	
Exposure			
Low	1.00 (Ref.)		
Med and High	1.00	NA	NA
Age	1.00	NA	NA

5) OTHER

Variables	Risk Estimate	95% Confidence Interval	
Exposure			
Low	1.00 (Ref.)		
Med and High	0.37	0.01	9.58
Age	1.09	0.98	1.22

6) LUNG AND BRONCHUS

Variables	Risk Estimate	95% Confidence Interval	
Exposure			
Low	1.00 (Ref.)		
Med and High	1.00	NA	NA
Age	1.00	NA	NA

7) RECTUM

Variables	Risk Estimate	95% Confidence Interval	
Exposure			
Low	1.00 (Ref.)		
Med and High	NA	NA	NA
Age	1.04	0.92	1.17

8) NHL

Variables	Risk Estimate	95% Confidence Interval	
Exposure			
Low	1.00 (Ref.)		
Med and High	NA	NA	NA
Age	0.97	0.77	1.22

9) STOMACH

Variables	Risk Estimate	95% Confidence Interval	
Exposure			
Low	1.00 (Ref.)		
Med and High	1.00	NA	NA
Age	1.00	NA	NA

10) TESTIS

Variables	Risk Estimate	95% Confidence Interval	
Exposure			
Low	1.00 (Ref.)		
Med and High	1.00	NA	NA
Age	1.00	NA	NA

11) Melanoma

Variables	Risk Estimate	95% Confidence Interval	
Exposure			
Low	1.00 (Ref.)		
Med and High	NA	NA	NA
Age	1.00	0.90	1.11

12) BLADDER

Variables	Risk Estimate	95% Confidence Interval	
Exposure			
Low	1.00 (Ref.)		
Med and High	NA	NA	NA
Age	1.12	1.02	1.23

13) COLON

Variables	Risk Estimate	95% Confidence Interval	
Exposure			
Low	1.00 (Ref.)		
Med and High	1.00	NA	NA
Age	1.00	NA	NA

14) COLORECTAL

Variables	Risk Estimate	95% Confidence Interval	
Exposure			
Low	1.00 (Ref.)		
Med and High	NA	NA	NA
Age	1.50	0.92	1.17

15) PROSTATE

Variables	Risk Estimate	95% Confidence Interval	
Exposure			
Low	1.00 (Ref.)		
Med and High	0.96	0.16	5.79
Age	1.10	1.05	1.16

16) HEPATIC

Variables	Risk Estimate	95% Confidence Interval	
Exposure			
Low	1.00 (Ref.)		
Med and High	1.00	NA	NA
Age	1.00	NA	NA

17) LEUKEMIA

Variables	Risk Estimate	95% Confidence Interval	
Exposure			
Low	1.00 (Ref.)		
Med and High	NA	NA	NA
Age	1.05	0.89	1.24

18) RENAL

Variables	Risk Estimate	95% Confidence Interval	
Exposure			
Low	1.00 (Ref.)		
Med and High	NA	NA	NA
Age	1.11	0.98	1.27

19) LYMPHOMA

Variables	Risk Estimate	95% Confidence Interval	
Exposure			
Low	1.00 (Ref.)		
Med and High	0.29	0.01	7.77
Age	1.11	1.00	1.24

20) SKIN

Variables	Risk Estimate	95% Confidence Interval	
Exposure			
Low	1.00 (Ref.)		
Med and High	1.77	0.56	5.56
Age	1.05	1.01	1.09

21) TOTAL

Variables	Risk Estimate	95% Confidence Interval	
Exposure			
Low	1.00 (Ref.)		
Med and High	1.29	0.48	3.45
Age	1.07	1.04	1.11

Adjusted Risk Estimates For Confirmed Specific Cancers Among Firefighters by combined High and Medium versus Low Exposures

The Total cancer the risk estimate for med/high versus low exposure was 2.67 (95% Confidence Interval 0.54, 13.33). Thyroid, Breast, Lung and Bronchus, Stomach, Testis, Colon, Hepatic, and Renal cancer risk estimate for med/high versus low, the model was unable to generate an estimate. No data were obtained for Hodgkin's Lymphoma, Esophageal, Other, Rectum, NHL, Melanoma, Bladder, Colorectal, Prostate, Leukemia, Lymphoma, and Skin cancer from our database.

Table 48. Adjusted Risk Estimates For Confirmed Specific Cancers Among Firefighters by combined High and Medium versus Low Exposures

1) HODGKIN'S LYMPHOMA (Confirmed)

Variables	Risk Estimate	95% Confidence Interval	
Exposure			
Low	1.00 (Ref.)		
Med and High	NA	NA	NA
Age	1.06	0.88	1.27

2) THYROID (Confirmed)

Variables	Risk Estimate	95% Confidence Interval	
Exposure			
Low	1.00 (Ref.)		
Med and High	1.00	NA	NA
Age	1.00	NA	NA

3) ESOPHAGEAL (Confirmed)

Variables	Risk Estimate	95% Confidence Interval	
Exposure			
Low	1.00 (Ref.)		
Med and High	NA	NA	NA
Age	NA	NA	NA

4) BREAST (Confirmed)

Variables	Risk Estimate	95% Confidence Interval	
Exposure			
Low	1.00 (Ref.)		
Med and High	1.00	NA	NA
Age	1.00	NA	NA

5) OTHER (Confirmed)

Variables	Risk Estimate	95% Confidence Interval	
Exposure			
Low	1.00 (Ref.)		
Med and High	NA	NA	NA
Age	1.07	0.91	1.25

6) LUNG AND BRONCHUS

Variables	Risk Estimate	95% Confidence Interval	
Exposure			
Low	1.00 (Ref.)		
Med and High	1.00	NA	NA
Age	1.00	NA	NA

7) RECTUM (Confirmed)

Variables	Risk Estimate	95% Confidence Interval	
Exposure			
Low	1.00 (Ref.)		
Med and High	NA	NA	NA
Age	1.04	0.92	1.17

8) NHL (Confirmed)

Variables	Risk Estimate	95% Confidence Interval	
Exposure			
Low	1.00 (Ref.)		
Med and High	NA	NA	NA
Age	0.97	0.77	1.22

9) STOMACH (Confirmed)

Variables	Risk Estimate	95% Confidence Interval	
Exposure			
Low	1.00 (Ref.)		
Med and High	1.00	NA	NA
Age	1.00	NA	NA

10) TESTIS (Confirmed)

Variables	Risk Estimate	95% Confidence Interval	
Exposure			
Low	1.00 (Ref.)		
Med and High	1.00	NA	NA
Age	1.00	NA	NA

11) Melanoma (Confirmed)

Variables	Risk Estimate	95% Confidence Interval	
Exposure			
Low	1.00 (Ref.)		
Med and High	NA	NA	NA
Age	1.14	1.00	1.29

12) BLADDER (Confirmed)

Variables	Risk Estimate	95% Confidence Interval	
Exposure			
Low	1.00 (Ref.)		
Med and High	NA	NA	NA
Age	1.12	1.02	1.23

13) COLON (Confirmed)

Variables	Risk Estimate	95% Confidence Interval	
Exposure			
Low	1.00 (Ref.)		
Med and High	1.00	NA	NA
Age	1.00	NA	NA

14) COLORECTAL (Confirmed)

Variables	Risk Estimate	95% Confidence Interval	
Exposure			
Low	1.00 (Ref.)		
Med and High	NA	NA	NA
Age	1.04	0.92	1.17

15) PROSTATE (Confirmed)

Variables	Risk Estimate	95% Confidence Interval	
Exposure			
Low	1.00 (Ref.)		
Med and High	NA	NA	NA
Age	1.09	1.02	1.16

16) HEPATIC (Confirmed)

Variables	Risk Estimate	95% Confidence Interval	
Exposure			
Low	1.00 (Ref.)		
Med and High	1.00	NA	NA
Age	1.00	NA	NA

17) LEUKEMIA (Confirmed)

Variables	Risk Estimate	95% Confidence Interval	
Exposure			
Low	1.00 (Ref.)		
Med and High	NA	NA	NA
Age	1.05	0.89	1.24

18) RENAL (Confirmed)

Variables	Risk Estimate	95% Confidence Interval	
Exposure			
Low	1.00 (Ref.)		
Med and High	1.00	NA	NA
Age	1.00	NA	NA

19) LYMPHOMA (Confirmed)

Variables	Risk Estimate	95% Confidence Interval	
Exposure			
Low	1.00 (Ref.)		
Med and High	NA	NA	NA
Age	1.14	1.00	1.29

20) TOTAL (Confirmed)

Variables	Risk Estimate	95% Confidence Interval	
Exposure			
Low	1.00 (Ref.)		
Med and High	2.67	0.54	13.33
Age	1.08	1.03	1.13

Tobacco use and cancer

The relationship between cancer and tobacco use was assessed in both police officers and firefighters. Out of the 25 firefighters with cancer, none of them reported currently smoking and only four reported smoking in the past. When analyzing lung and bronchus cancer specifically, there were no cases among firefighters. Police officers have 48 participants with cancer, one was in a current smoker and 11 were former smokers. There was only one case of lung and bronchus cancer among police officers, and that was in a former smoker.

<u>Police Officers</u>

Cancers reported:

The most common cancers reported and confirmed among police officers were prostate (n=9), non-Hodgkin's lymphoma (n=4), and rectal cancer (n=3). There also were 28 skin cancer cases reported.

Univariate analyses:

There was a significantly increased risk (2.4-fold) for lymphoma among the medium exposure group. There were non-statistically elevated risk estimates for medium or high methamphetamine exposures and non-Hodgkins Lymphoma and melanoma. Colon and/or rectal cancer did not follow a dose-response pattern as there was a non-significantly increased risk in the high group and a reduced risk in the medium group compared with the low exposure group. The risks for all cancers combined were borderline reduced.

Unstable estimates with low numbers of reported or confirmed cases of cancers were found for all of the following: Hodgkin's Lymphoma, leukemias and cancers of the thyroid, esophagus, breast, lung, stomach, testis, bladder, liver and kidneys.

Age adjusted analyses

Total cancer cases in aggregate were analyzed and showed statistically increased risks among the medium exposure group (2.1-fold) and borderline risk in the high group (1.8-fold, or 80% increased risk). Those risks were comparable including the unconfirmed cases.

Risks for lymphoma were elevated in the medium exposure group (11-fold risk) and were not significantly elevated in the high exposure group (3.5-fold). However, when narrowed to the confirmed cases, the results were negative due few cases that were confirmed.

Risks for melanoma were elevated, but not statistically significantly (e.g., 3.5 to 7-fold risk). Colon and rectal cancers combined also were not statistically significantly elevated, but trended towards increased risks. Non-Hodgkin's lymphoma was not statistically significantly elevated, but was nevertheless increased with 3.5-fold risk in the high exposure group and 7.4-fold risk in the medium exposure group. All other cancer estimates were hampered by small numbers of cases.

Firefighters

Cancers reported:

The most common cancer reported and confirmed among firefighters was prostate (n=4). Other cancers were either 1 or 2 cases. There also were 19 skin cancer cases reported.

Univariate analyses:

Total cancers were statistically significantly related to high and combined medium-high exposures when not adjusted for age. After adjustment for age, the estimates became non-significant, while age was highly significant, suggesting that this relationship was confounded by age.

Skin cancer was associated with high and medium levels of exposure (approximately 3.5 fold risk), although those results should be interpreted cautiously due to the lack of systematic capture of data by the Utah Cancer Registry. Additionally, after adjustment for age there is no association with skin cancer, suggesting that age confounds the relationship between occupational exposures and skin cancer.

Unstable estimates with low numbers of reported or confirmed cases of cancers were found for all of the same cancers as for the police officers: Hodgkin's Lymphoma, leukemias and cancers of the thyroid, esophagus, breast, lung, stomach, testis, bladder, liver and kidneys. Additionally, there were few cases of rectal cancer, colon cancer, lymphomas and non-Hodgkin's lymphoma.

Age adjusted analyses

There were no statistically significant results for any cancer after age adjustment. These results may be hampered by small numbers of reported or confirmed cancers.

<u>Standardized Incidence Rates</u>

Age specific rates were calculated from these data for and standardized to the 2000 census data. These were then compared with the age standardized rates reported by the State Health Department in conjunction with the Utah Cancer Registry as accessed through the IBIS system.

Police Officer Age adjusted Rates

For total confirmed cancer, the low exposure age adjusted rate is 4420.61 per 100,000, the high exposure age adjusted rate is 12215.69 per 100,000, and the total exposure age adjusted rate is 7069.59 per 100,000. Total confirmed cancer state age adjusted rate is 400.34 per 100,000. For Hodgkin's Lymphoma cancer, the low exposure age adjusted rate is 212.08 per 100,000, for high exposure no data were obtained, and the total exposure age adjusted rate is 161.04 per 100,000. Hodgkin's Lymphoma cancer state age adjusted rate is 2.67 per 100,000.

For Thyroid cancer, the low exposure age adjusted rate is 356.85 per 100,000, the high exposure age adjusted rate is 257.38 per 100,000, and the total exposure age adjusted rate is 355.82 per 100,000. Thyroid cancer state age adjusted rate is 14.08 per 100,000.

For Esophageal cancer, the low exposure age adjusted rate is 204.86 per 100,000, the high exposure age adjusted rate is 1648.52 per 100.000 people, and the total exposure age adjusted rate is 616.40 per 100,000. Esophageal cancer state age adjusted rate is 3.81 per 100,000.

For Breast cancer, the low exposure age adjusted rate is 349.64 per 100,000, for high exposure no data were obtained, and the total exposure age adjusted rate is 194.78 per 100,000. Breast cancer state age adjusted rate is 56.44 per 100,000.

For Other cancer, the low exposure age adjusted rate is 605.23 per 100,000, the high exposure age adjusted rate is 1338.79 per 100,000, and the total exposure age adjusted rate is 734.33 per 100,000. Other cancer state age adjusted rate is 76.56 per 100,000.

For Lung and Bronchus cancer, no data were obtained for low exposure, the high exposure age adjusted rate is 695.56 per 100,000, and the total exposure age adjusted rate is 331.89 per 100,000. Lung and Bronchus cancer state age adjusted rate is 29.55 per 100,000.

For Rectal cancer, the low exposure age adjusted rate is 212.08 per 100,000, the high exposure age adjusted rate is 952.94 per 100,000, and the total exposure age adjusted rate is 526.26 per 100,000. Rectal cancer state age adjusted rate is 8.79 per 100,000.

For Non-Hodgkin's Lymphoma cancer, the low exposure age adjusted rate is 144.77 per 100,000, the high exposure age adjusted rate is 2219.33 per 100,000, and the total exposure age adjusted rate is 895.77 per 100,000. Non-Hodgkin's Lymphoma cancer state age adjusted rate is 18.08 per 100,000.

For Stomach cancer, no data were obtained for low exposure, the high exposure age adjusted rate is 669.40 per 100.000 people, and the total exposure age adjusted rate is 161.04 per 100,000. Stomach cancer state age adjusted rate is 3.7 per 100,000.

For Testis cancer, the low exposure age adjusted rate is 356.85 per 100,000, the high exposure age adjusted rate is 926.78 per 100,000, and the total exposure age adjusted rate is 516.88 per 100,000. Testis cancer state age adjusted rate is 2.84 per 100,000.

For Melanoma cancer, the low exposure age adjusted rate is 537.92 per 100,000, the high exposure age adjusted rate is 1735.60 per 100,000, and the total exposure age adjusted rate is 963.23 per 100,000. Melanoma cancer state age adjusted rate is 27.48 per 100,000.

For Bladder cancer, no data were obtained for low exposure, the high exposure age adjusted rate is 695.56 per 100,000, and the total exposure age adjusted rate is 251.16 per 100,000. Bladder cancer state age adjusted rate is 17.01 per 100,000.

For Colon cancer, the low exposure age adjusted rate is 393.15 per 100,000, the high exposure age adjusted rate is 695.56 per 100,000, and the total exposure age adjusted rate is 695.56 per 100,000. Colon cancer state age adjusted rate is 29.53 per 100,000.

For Colorectal cancer, the low exposure age adjusted rate is 605.23 per 100,000, the high exposure age adjusted rate is 1648.52 per 100,000, and the total exposure age adjusted rate is 1028.62 per 100,000. Colorectal cancer state age adjusted rate is 38.32 per 100,000.

For Prostate cancer, the low exposure age adjusted rate is 2503.64 per 100,000, the high exposure age adjusted rate is 2203.49 per 100,000, and the total exposure age adjusted rate is 2446.37 per 100,000. Prostate cancer state age adjusted rate is 78.01 per 100,000.

For Hepatic cancer, no data were obtained for low exposure, the high exposure age adjusted rate is 1364.96 per 100,000, and the total exposure age adjusted rate is 251.16 per 100,000. Hepatic cancer state age adjusted rate is 3.35 per 100,000.

For Leukemia cancer, no data were obtained for low exposure, the high exposure age adjusted rate is 695.56 per 100,000, and the total exposure age adjusted rate is 251.16 per 100,000. Leukemia cancer state age adjusted rate is 15.13 per 100,000.

For Renal cancer, no data were obtained for low exposure, the high exposure age adjusted rate is 1549.94 per 100,000, and the total exposure age adjusted rate is 492.93 per 100,000. Renal cancer state age adjusted rate is 11.47 per 100,000.

For Lymphoma cancer, the low exposure age adjusted rate is 144.77 per 100,000, the high exposure age adjusted rate is 1761.12 per 100,000, and the total exposure age adjusted rate is 744.50 per 100,000. Lymphoma cancer state age adjusted rate is 20.75 per 100,000.

For Skin cancer, the low exposure age adjusted rate is 5141.75 per 100,000, the high exposure age adjusted rate is 4664.40 per 100,000, and the total exposure age adjusted rate is 4985.11 per 100,000. Skin cancer state age adjusted rate is 27.48 per 100,000.

For Total cancer, the low exposure age adjusted rate is 5817.03 per 100,000, the high exposure age adjusted rate is 16450.29 per 100,000, and the total exposure age adjusted rate is 9397.01 per 100,000. Total cancer state age adjusted rate is 400.34 per 100,000.

For Confirmed Hodgkin's Lymphoma cancer, the low exposure age adjusted rate is 212.08 per 100,000, for high exposure no data were obtained, and the total exposure age adjusted rate is 161.04 per 100,000. Confirmed Hodgkin's Lymphoma cancer state age adjusted rate is 2.67 per 100,000.

For Confirmed Thyroid cancer, the low exposure age adjusted rate is 249.01 per 100,000, the high exposure age adjusted rate is 254.13 per 100,000, and the total exposure age adjusted rate is 194.14 per 100,000. Confirmed Thyroid cancer state age adjusted rate is 14.08 per 100,000.

For Confirmed Esophageal cancer, no data were obtained for low exposure, the high exposure age adjusted rate is 1645.27 per 100.000 people, and the total exposure age adjusted rate is 615.75 per 100,000. Confirmed Esophageal cancer state age adjusted rate is 3.81 per 100,000.

For Confirmed Breast cancer, the low exposure age adjusted rate is 204.86 per 100,000, for high exposure no data were obtained, and the total exposure age adjusted rate is 113.41 per 100,000. Confirmed Breast cancer state age adjusted rate is 56.44 per 100,000.

For Confirmed Other cancer, the low exposure age adjusted rate is 393.15 per 100,000, the high exposure age adjusted rate is 1338.79 per 100,000, and the total exposure age adjusted rate is 251.16 per 100,000. Confirmed Other cancer state age adjusted rate is 76.56 per 100,000.

For Confirmed Lung and Bronchus cancer, no data were obtained for low exposure, the high exposure age adjusted rate is 695.56 per 100,000, and the total exposure age adjusted rate is 331.89 per 100,000. Confirmed Lung and Bronchus cancer state age adjusted rate is 29.55 per 100,000.

For Confirmed Rectal cancer, the low exposure age adjusted rate is 212.08 per 100,000, the high exposure age adjusted rate is 949.69 per 100,000, and the total exposure age adjusted rate is 525.62per 100,000. Confirmed Rectal cancer state age adjusted rate is 8.79 per 100,000.

For Confirmed Non-Hodgkin's Lymphoma cancer, the low exposure age adjusted rate is 144.77 per 100,000, the high exposure age adjusted rate is 2219.33 per 100,000, and the total exposure age adjusted rate is 734.71 per 100,000. Confirmed Non-Hodgkin's Lymphoma cancer state age adjusted rate is 18.08 per 100,000.

For Confirmed Stomach cancer, no data were obtained for low exposure, the high exposure age adjusted rate is 669.40 per 100.000 people, and the total exposure age adjusted rate is 161.04 per 100,000. Confirmed Stomach cancer state age adjusted rate is 3.7 per 100,000.

For Confirmed Testis cancer, the low exposure age adjusted rate is 212.08 per 100,000, the high exposure age adjusted rate is 669.40 per 100,000, and the total exposure age adjusted rate is 322.10 per 100,000. Confirmed Testis cancer state age adjusted rate is 2.84 per 100,000.

For Confirmed Melanoma cancer, the low exposure age adjusted rate is 393.15 per 100,000, the high exposure age adjusted rate is 878.24 per 100,000, and the total exposure age adjusted rate is 639.45 per 100,000. Confirmed Melanoma cancer state age adjusted rate is 27.48 per 100,000.

For Confirmed Bladder cancer, no data were obtained for low exposure, the high exposure age adjusted rate is 695.56 per 100,000, and the total exposure age adjusted rate is 251.16 per 100,000. Confirmed Bladder cancer state age adjusted rate is 17.01 per 100,000.

For Confirmed Colon cancer, the low exposure age adjusted rate is 393.15 per 100,000, the high exposure age adjusted rate is 695.56 per 100,000, and the total exposure age adjusted rate is 502.34 per 100,000. Confirmed Colon cancer state age adjusted rate is 29.53 per 100,000.

For Confirmed Colorectal cancer, the low exposure age adjusted rate is 605.23 per 100,000, the high exposure age adjusted rate is 1648.27 per 100,000, and the total exposure age adjusted rate is 1027.98 per 100,000. Confirmed Colorectal cancer state age adjusted rate is 38.32 per 100,000.

For Confirmed Prostate cancer, the low exposure age adjusted rate is 2109.85 per 100,000, the high exposure age adjusted rate is 1504.66 per 100,000, and the total exposure age adjusted rate is 1943.37 per 100,000. Confirmed Prostate cancer state age adjusted rate is 78.01 per 100,000.

For Confirmed Hepatic cancer, no data were obtained for low exposure, the high exposure age adjusted rate is 1364.96 per 100,000, and the total exposure age adjusted rate is 412.00 per 100,000. Confirmed Hepatic cancer state age adjusted rate is 3.35 per 100,000.

For Confirmed Leukemia cancer, no data were obtained for low exposure, high exposure, or total exposure. Confirmed Leukemia cancer state age adjusted rate is 15.13 per 100,000.

For Confirmed Renal cancer, no data were obtained for low exposure, high exposure, or total exposure. Confirmed Renal cancer state age adjusted rate is 11.47 per 100,000.

For Confirmed Lymphoma cancer, no data were obtained for low exposure, the high exposure age adjusted rate is 880.54 per 100,000, and the total exposure age adjusted rate is 331.89 per 100,000. Confirmed Lymphoma cancer state age adjusted rate is 20.75 per 100,000.

Table 49. Age Adjusted Cancer Rates per 100,000 for Low and Medium/High Exposure among Police Officers

	Low Exposure	Medium/High Exposure	Total	State Age Adjusted Rates
Total Confirmed Cancer	4420.61	12215.69	7069.59	400.34
Hodgkin's Lymphoma	212.08	0.00	161.04	2.67
Thyroid	356.85	257.38	355.82	14.08
Esophageal	204.86	1648.52	616.40	3.81
Breast	349.64	0.00	194.78	56.44
Other	605.23	1338.79	734.33	76.56
Lung and Bronchus	0.00	695.56	331.89	29.55
Rectum	212.08	952.94	526.26	8.79
Non-Hodgkin's Lymphoma	144.77	2219.33	895.77	18.08
Stomach	0.00	669.40	161.04	3.7
Testis	356.85	926.78	516.88	2.84
Melanoma	537.92	1735.60	963.23	27.48
Bladder	0.00	695.56	251.16	17.01
Colon	393.15	695.56	502.34	29.53
Colorectal	605.23	1648.52	1028.62	38.32
Prostate	2503.64	2203.49	2446.37	78.01
Hepatic	0.00	1364.96	251.16	3.35
Leukemia	0.00	695.56	251.16	15.13
Renal	0.00	1549.94	492.93	11.47
Lymphoma	144.77	1761.12	744.50	20.75
Skin	5141.75	4664.40	4985.11	27.48
Total	5817.03	16450.29	9397.01	400.34
Confirmed Hodgkin's Lymphoma	212.08	0.00	161.04	2.67
Confirmed Thyroid	249.01	254.13	194.14	14.08
Confirmed Esophageal	0.00	1645.27	615.75	3.81
Confirmed Breast	204.86	0.00	113.41	56.44
Confirmed Other	393.15	1338.79	251.16	76.56
Confirmed Lung and Bronchus	0.00	695.56	331.89	29.55
Confirmed Rectum	212.08	949.69	525.62	8.79
Confirmed NHL	144.77	2219.33	734.71	18.08
Confirmed Stomach	0.00	669.40	161.04	3.7
Confirmed Testis	212.08	669.40	322.10	2.84
Confirmed Melanoma	393.15	878.24	639.45	27.48

Confirmed Bladder	0.00	695.56	251.16	17.01
Confirmed Colon	393.15	695.56	502.34	29.53
Confirmed Colorectal	605.23	1645.27	1027.98	38.32
Confirmed Prostate	2109.85	1504.66	1943.37	78.01
Confirmed Hepatic	0.00	1364.96	412.20	3.35
Confirmed Leukemia	0.00	0.00	0.00	15.13
Confirmed Renal	0.00	0.00	0.00	11.47
Confirmed Lymphoma	0.00	880.54	331.89	20.75

Age adjusted estimates are per 100,000

Firefighter Age adjusted Rates

For Total confirmed cancer, the low exposure age adjusted rate is 658.18 per 100,000, the high exposure age adjusted rate is 3119.85 per 100,000, and the total exposure age adjusted rate is 3431.95 per 100,000. Total confirmed cancer state age adjusted rate is 400.34 per 100,000. For Hodgkin's Lymphoma cancer, the low exposure age adjusted rate is 511.26 per 100,000, the high exposure age adjusted rate is 13549.17 per 100,000, and the total exposure age adjusted rate is 985.38 per 100,000. Hodgkin's Lymphoma cancer state age adjusted rate is 2.67 per 100,000.

For Thyroid cancer, the low exposure age adjusted rate is 380.55 per 100,000, the high exposure age adjusted rate is 290.95 per 100,000, and the total exposure age adjusted rate is 257.87 per 100,000. Thyroid cancer state age adjusted rate is 14.08 per 100,000.

For Esophageal cancer, no data were obtained for low exposure, high exposure, or total exposure age adjusted rates. Esophageal cancer state age adjusted rate is 3.81 per 100,000. For Breast cancer, no data were obtained for low exposure, high exposure, or total exposure age adjusted rates. Breast cancer state age adjusted rate is 56.44 per 100,000.

For Other cancer, the low exposure age adjusted rate is 380.55 per 100,000, the high exposure age adjusted rate is 154.87 per 100,000, and the total exposure age adjusted rate is 218.35 per 100,000. Other cancer state age adjusted rate is 76.56 per 100,000.

For Lung and Bronchus cancer, no data were obtained for low exposure, high exposure, or total exposure age adjusted rates. Lung and Bronchus cancer state age adjusted rate is 29.55 per 100,000. For Rectal cancer, no data were obtained from low exposure, the high exposure age adjusted rate is 309.75 per 100,000, and the total exposure age adjusted rate is 218.35 per 100,000. Rectal cancer state age adjusted rate is 8.79 per 100,000.

For Non-Hodgkin's Lymphoma cancer, the low exposure age adjusted rate is 156.35 per 100,000, for high exposure no data were obtained, and the total exposure age adjusted rate is 117.04 per 100,000. Non-Hodgkin's Lymphoma cancer state age adjusted rate is 18.08 per 100,000.

For Stomach cancer, no data were obtained for low exposure or high exposure, but the total exposure age adjusted rate is 109.17 per 100,000. Stomach cancer state age adjusted rate is 3.7 per 100,000.

For Testis cancer, no data were obtained for low exposure, high exposure, or total exposure age adjusted rates. Testis cancer state age adjusted rate is 2.84 per 100,000.

For Melanoma cancer, no data were obtained from low exposure, the high exposure age adjusted rate is 1372.42 per 100,000, and the total exposure age adjusted rate is 618.86 per 100,000. Melanoma cancer state age adjusted rate is 27.48 per 100,000. For Bladder cancer, no data were obtained for low exposure, the high exposure age adjusted rate is 882.18 per 100,000, and the total exposure age adjusted rate is 769.56 per 100,000. Bladder cancer state age adjusted rate is 17.01 per 100,000.

For Colon cancer, no data were obtained for low exposure, high exposure, or total exposure age adjusted rates. Colon cancer state age adjusted rate is 29.53 per 100,000. For Colorectal cancer, no data were obtained for low exposure, the high exposure age adjusted rate is 309.75 per 100,000, and the total exposure age adjusted rate is 218.35 per 100,000. Colorectal cancer state age adjusted rate is 38.32 per 100,000.

For Prostate cancer, the low exposure age adjusted rate is 608.38 per 100,000, the high exposure age adjusted rate is 1773.84 per 100,000, and the total exposure age adjusted rate is 1582.76 per 100,000. Prostate cancer state age adjusted rate is 78.01 per 100,000.

For Hepatic cancer, no data were obtained for low exposure, high exposure, or total exposure age adjusted rates. Hepatic cancer state age adjusted rate is 3.35 per 100,000.

For Leukemia cancer, no data were obtained for low exposure, the high exposure age adjusted rate is 154.87 per 100,000, and the total exposure age adjusted rate is 109.17 per 100,000. Leukemia cancer state age adjusted rate is 15.13 per 100,000.

For Renal cancer, no data were obtained for low exposure, the high exposure age adjusted rate is 154.87 per 100,000, and the total exposure age adjusted rate is 109.17 per 100,000. Renal cancer state age adjusted rate is 11.47 per 100,000.

For Lymphoma cancer, the low exposure age adjusted rate is 511.26 per 100,000, the high exposure age adjusted rate is 441.09 per 100,000, and the total exposure age adjusted rate is 877.45 per 100,000. Lymphoma cancer state age adjusted rate is 20.75 per 100,000.

For Skin cancer, the low exposure age adjusted rate is 1673.67 per 100,000, the high exposure age adjusted rate is 3323.67 per 100,000, and the total exposure age adjusted rate is 2940.30 per 100,000. Skin cancer state age adjusted rate is 27.48 per 100,000.

For Total cancer, the low exposure age adjusted rate is 2527.23 per 100,000, the high exposure age adjusted rate is 18618.06 per 100,000, and the total exposure age adjusted rate is 5503.84 per 100,000. Total cancer state age adjusted rate is 400.34 per 100,000.

For Confirmed Hodgkin’s Lymphoma cancer, the low exposure age adjusted rate is 501.81 per 100,000, for high exposure no data were obtained, and the total exposure age adjusted rate is 483.90 per 100,000. Confirmed Hodgkin’s Lymphoma cancer state age adjusted rate is 2.67 per 100,000.

For Confirmed Thyroid cancer, no data were obtained for low exposure, high exposure, or total exposure age adjusted rates. Confirmed Thyroid cancer state age adjusted rate is 14.08 per 100,000.

For Confirmed Esophageal cancer, no data were obtained for low exposure, high exposure, or total exposure age adjusted rates. Confirmed Esophageal cancer state age adjusted rate is 3.81 per 100,000. For Confirmed Breast cancer, no data were obtained for low exposure, high exposure, or total exposure age adjusted rates.

For Confirmed Other cancer, no data were obtained for low exposure, the high exposure age adjusted rate is 153.10 per 100,000, and the total exposure age adjusted rate is 1082.88 per 100,000. Confirmed Other cancer state age adjusted rate is 76.56 per 100,000.

For Confirmed Lung and Bronchus cancer, no data were obtained for low exposure, high exposure, or total exposure age adjusted rates. Confirmed Lung and Bronchus cancer state age adjusted rate is 29.55 per 100,000.

For Confirmed Rectal cancer, no data were obtained for low exposure, the high exposure age adjusted rate is 306.19 per 100,000, and the total exposure age adjusted rate is 216.58 per 100,000. Confirmed Rectal cancer state age adjusted rate is 8.79 per 100,000.

For Confirmed Non-Hodgkin's Lymphoma cancer, the low exposure age adjusted rate is 156.35 per 100,000, for high exposure no data were obtained, and the total exposure age adjusted rate is 117.05 per 100,000. Confirmed Non-Hodgkin's Lymphoma cancer state age adjusted rate is 18.08 per 100,000.

For Confirmed Stomach cancer, no data were obtained for low exposure or high exposure, but the total exposure age adjusted rate is 1082.88 per 100,000. Confirmed Stomach cancer state age adjusted rate is 3.7 per 100,000.

For Confirmed Testis cancer, no data were obtained for low exposure, high exposure, or total exposure age adjusted rates. Confirmed Testis cancer state age adjusted rate is 2.84 per 100,000.

For Confirmed Melanoma cancer, no data were obtained for low exposure, the high exposure age adjusted rate is 441.09 per 100,000, and the total exposure age adjusted rate is 376.76 per 100,000. Confirmed Melanoma cancer state age adjusted rate is 27.48 per 100,000.

For Confirmed Bladder cancer, no data were obtained for low exposure, the high exposure age adjusted rate is 882.18 per 100,000, and the total exposure age adjusted rate is 753.52 per 100,000. Confirmed Bladder cancer state age adjusted rate is 17.01 per 100,000.

For Confirmed Colon cancer, no data were obtained for low exposure, high exposure, or total exposure age adjusted rates. Confirmed Colon cancer state age adjusted rate is 29.53 per 100,000.

For Confirmed Colorectal cancer, no data were obtained for low exposure or high exposure, the high exposure age adjusted rate is 306.19 per 100,000, and the total exposure age adjusted rate is 216.58 per 100,000. Confirmed Colorectal cancer state age adjusted rate is 38.32 per 100,000.

For Confirmed Prostate cancer, no data were obtained for low exposure, the high exposure age adjusted rate is 1617.19 per 100,000, and the total exposure age adjusted rate is 2133.82 per 100,000. Confirmed Prostate cancer state age adjusted rate is 78.01 per 100,000.

For Confirmed Hepatic cancer, no data were obtained for low exposure, high exposure, or total exposure age adjusted rates. Confirmed Hepatic cancer state age adjusted rate is 3.35 per 100,000.

For Confirmed Leukemia cancer, no data were obtained for low exposure, the high exposure age adjusted rate is 153.10 per 100,000, and the total exposure age adjusted rate is 1082.88 per 100,000. Confirmed Leukemia cancer state age adjusted rate is 15.13 per 100,000.

For Confirmed Renal cancer, no data were obtained for low exposure, high exposure, or total exposure. Confirmed Renal cancer state age adjusted rate is 11.47 per 100,000.

For Confirmed Lymphoma cancer, no data were obtained for low exposure, the high exposure age adjusted rate is 441.09 per 100,000, and the total exposure age adjusted rate is 376.76 per 100,000. Confirmed Lymphoma cancer state age adjusted rate is 20.75 per 100,000.

Table 50. Age Adjusted Cancer Rates per 100,000 for Low and Medium/High Exposure among Firefighters

Cancer Type	Low Exposure	Medium/High Exposure	Total	State Age Adjusted Rates
Total Confirmed Cancer	658.18	3119.85	3431.95	400.34
Hodgkin's Lymphoma	511.26	13549.17	985.38	2.67
Thyroid	380.55	290.95	257.87	14.08
Esophageal	0.00	0.00	0.00	3.81

Breast	0.00	0.00	0.00	56.44
Other	380.55	154.87	218.35	76.56
Lung and Bronchus	0.00	0.00	0.00	29.55
Rectum	0.00	309.75	218.35	8.79
Non-Hodgkin's Lymphoma	156.35	0.00	117.04	18.08
Stomach	0.00	0.00	109.17	3.7
Testis	0.00	0.00	0.00	2.84
Melanoma	0.00	1372.42	618.86	27.48
Bladder	0.00	882.18	769.56	17.01
Colon	0.00	0.00	0.00	29.53
Colorectal	0.00	309.75	218.35	38.32
Prostate	608.38	1773.84	1582.76	78.01
Hepatic	0.00	0.00	0.00	3.35
Leukemia	0.00	154.87	109.17	15.13
Renal	0.00	154.87	109.17	11.47
Lymphoma	511.26	441.09	877.45	20.75
Skin	1673.67	3323.67	2940.30	27.48
Total	2527.23	18618.06	5503.84	400.34
Confirmed Hodgkin's Lymphoma	501.81	0.00	483.90	2.67
Confirmed Thyroid	0.00	0.00	0.00	14.08
Confirmed Esophageal	0.00	0.00	0.00	3.81
Confirmed Breast	0.00	0.00	0.00	56.44
Confirmed Other	0.00	153.10	1082.88	76.56
Confirmed Lung and Bronchus	0.00	0.00	0.00	29.55
Confirmed Rectum	0.00	306.19	216.58	8.79
Confirmed NHL	156.35	0.00	117.05	18.08
Confirmed Stomach	0.00	0.00	1082.88	3.7
Confirmed Testis	0.00	0.00	0.00	2.84
Confirmed Melanoma	0.00	441.09	376.76	27.48
Confirmed Bladder	0.00	882.18	753.52	17.01
Confirmed Colon	0.00	0.00	0.00	29.53
Confirmed Colorectal	0.00	306.19	216.58	38.32
Confirmed Prostate	0.00	1617.19	2133.82	78.01
Confirmed Hepatic	0.00	0.00	0.00	3.35
Confirmed Leukemia	0.00	153.10	1082.88	15.13
Confirmed Renal	0.00	0.00	0.00	11.47
Confirmed Lymphoma	0.00	441.09	376.76	20.75

Age adjusted estimates are per 100,000

<u>Other Non-Occupational Factors related to Any Reported Cancer</u>

The key factor addressed in this study is the exposures of combustion products and/or Methamphetamine among current active and retired firefighters and police officers. Other factors that might confound the effect of exposure on risk of cancer cases are: 1) demographic factors, such as age of respondents, gender, marital status, educational level, retirement, and race, 2) physical-health conditions factors, such as Body Mass Index (BMI), smoking status, use of smokeless tobacco, alcohol consumption, aspirin tablet taken per week, family cancer history, heart disease, diabetics, chronic bronchitis, other health conditions, sleep at night, and sleep hours, and 3) psychological factors, such as felt uneasy, felt nervous, mentally exhausted, physically exhausted, and job satisfactions. All of the independent variables except age of respondents and BMI are categorical variables. The dependent variables are unconfirmed and confirmed cancer cases in 21 types of cancer (1. Thyroid, 2. Esophageal, 3. Breast, 4. Other, 5. Lung and Bronchus, 6. Hodgkins and Lymphoma, 7. Rectum, 8. Non-Hodgkin's Lymphoma Cancer, 9. Stomach, 10. Testis, 11. Melanoma, 12. Bladder, 13. Colon, 14. Colorectal, 15. Prostate, 16. Hepatic, 17. Leukemia, 18. Renal, 19. Lymphoma, 20. Skin, 21. Any Cancer).

Logistic and Poisson regression are compared to assess the relative risks of the 3 factors (demographic, physical-health, and psychological factor). Only the significant variables ($P<=0.05$) will be included to account for the possible confounding effects of the association between the exposure and risk of cancers.

In this report, both Logistic and Poisson regression can be used alternatively for modeling dichotomous outcome because their parameter estimates, and their significances are quite the same. At this stage, only unconfirmed cancer for peace officers and firefighters is reported. Statistically significant variables (OR, 95% CI) for 21 types of unconfirmed cancer for firefighters are:

1) Total cancer: The variables that we found statistically significant are age of respondent (1.09, 1.05-1.13), and diabetes (6.72, 2.60-17.43),

2) Thyroid: The variable that we found statistically significant is only female gender (37.50, 2.23-630.50).

3) Esophageal: We have not found statistically significant variables.

4) Breast: We have not found statistically significant variables.

5) Other Cancer: The variables that we found statistically significant are diabetes (14.74, 0.90-240.73) and chronic bronchitis (20.36, 1.237-335.06).

6) Lung and Bronchus: We have not found statistically significant variables.

7) Hodgkin’s Lymphoma: The variables that we found statistically significant are marital status for never married category (17.57, 1.07-288.99), and aspirin tablet taken 5 days per week (24.73, 1.47-414.72),

8) Rectum: The variable that we found statistically significant is diabetes (14.73, 0.90-240.73).

9) Non-Hodgkin's Lymphoma: We have not found statistically significant variables.

10) Stomach: We have not found statistically significant variables.

11) Testis: We have not found statistically significant variables.

12) Melanoma: We have not found statistically significant variables.

13) Bladder: The variables that we found statistically significant are age of respondents (1.15, 1.034-1.272), and diabetes (14.73, 0.90-240.73)

14) Colon: We have not found statistically significant variables.

15) Colorectal: The variables that we found statistically significant are BMI (1.19, 0.99-1.43) and diabetes (14.73, 0.90-240.73).

16) Prostate: The variables that we found statistically significant are age of respondents (1.11, 1.05-1.18), aspirin tablet taken 8 days per week (35.09, 4.25-289.49), and diabetes (5.01, 0.97-25.80)

17) Hepatic: We have not found statistically significant variables.

18) Leukemia: The variable that we found statistically significant is BMI (0.52, 0.27-1.02)
19) Renal. The variables that we found statistically significant is age of respondents (1.13, 0.99-1.30).

20) Lymphoma. The variable that we found statistically significant is diabetes (14.73, 0.90-240.73)

21) Skin. The variables that we found statistically significant are age of respondents (1.07, 1.03-1.11), and having an average hours of sleep of 4.5 hours (11.16, 1.442-86.48).

Statistically significant variables (OR, 95% CI) for 21 types of unconfirmed cancer for peace officers are:

1) Total cancer: The variables that we found statistically significant are age of respondent. (1.075, 1.047-1.105), Alcohol consumption for yes category (0.349, 0.154-0.792), take aspirin 7 days per week (5.287, 1.301-21.491), Often physically exhausted (6.111, 1.133-32.956), heart disease (1.964, 1.008-3.824).

2) Thyroid. The variable that we found to be statistically significant is take aspirin 5 days a week (15.0, 1.254-179.435).

3) Esophageal: We have not found statistically significant variables.

4) Breast: We have not found statistically significant variables.

5) Other cancer: The variable that we found to be statistically significant is BMI (1.162, 1.009-1.339).

6) Lung and Bronchus: We have not found statistically significant variables.

7) Hodgkin's Lymphoma: We have not found statistically significant variables.

8) Rectum: We have not found statistically significant variables.

9) Non-Hodgkin's Lymphoma: The variable that we found to be statistically significant is Age of respondent (1.090, 1.012-1.175),

10) Stomach: We have not found statistically significant variables.

11) Testicular: The variable that we found to be statistically significant was taking aspirin 3 days a week (18.813, 1.125-314.685).

12) Melanoma: The variable that we found to be statistically significant is Age of respondent (1.071, 1.003-1.144)

13) Bladder: The variable that we found to be statistically significant is Age of respondent (1.368, 0.979-1.909).

14) Colon: The variable that we found to be statistically significant is Age of respondent (1.132, 1.003-1.278).

15) Colorectal: The variable that we found to be statistically significant is Age of respondent (1.086, 1.008-1.170).

16) Prostate: The variables that we found to be statistically significant are Age of respondent (1.131, 1.064-1.203), Moving to part time law enforcement (18.875, 1.079-330.102), sleeping for 8.5 hours a day (16.0, 1.118-229.046), having heart disease (3.752, 0.987-14.257).

17) Hepatic: We have not found statistically significant variables.

18). Leukemia: We have not found statistically significant variables.

19) Renal: The variables that we found to be statistically significant are BMI (1.18, 1.01-1.37), has heart disease (9.26, 0.83-1.03).

20) Lymphoma: The variable that we found to be statistically significant is always felt nervous (15.36, 0.89-262.45).

21) Skin: The variables that we found to be statistically significant are age of respondent (1.093, 1.06-1.13), Overweight BMI category (4.21, 0.96-18.31), High school graduate (3.72, 1.25-11.05),

has heart disease (2.85, 1.30-6.22), has chronic bronchitis (2.55, 1.14-5.68), has diabetes (2.45, 1.10-5.44).

Discussion

This research project has successfully met all goals. It has built upon prior studies to include numerous quality improvements that provide for better quality data than are found in most prior studies. This project achieved goals including:

- ✓ Completion of a comprehensive, systematic review with grading of the quality of the epidemiological literature on prior reports of cancer risk among these workers.
- ✓ Identification and enumeration of the municipalities and a potential pool of police officers and firefighters that was far larger than anyone had envisioned.
- ✓ Enrollments of workers through a secure, web-based platform to allow questionnaires to be completed any time, any where
- ✓ Development of algorithms for quantification of worker exposures
- ✓ Categorization of exposures while blinding the industrial hygienists to the health status
- ✓ Histological confirmation of cancer type through the Utah Cancer Registry
- ✓ Telephone verification of health status data for any cases that did not match Cancer Registry data.

Previously, there was not a single quality epidemiological study of risks for cancers among these workers. This study found that among 553 officers participating out of a potential study population of 10,429 (5.30% participation rate), that other than skin cancer, the most common cancers reported were prostate, non-Hodgkin's lymphoma and rectal cancer. For many cancers, the low participation rate of the workers impaired the ability to measure risks among the police officers, although some of those types of cancers are also not common and power to detect effects had not been anticipated for some of them. However, the overall cancer rate was increased in the medium exposure group and was non-statistically significantly elevated in the high exposure group. Risks for lymphoma were elevated in the medium exposure group while also elevated, but not significantly, in the high exposure group. Risks for melanoma, non-Hodgkin's lymphoma, and colon and rectal cancers combined were not significantly elevated, but trended towards being positive.

Risk of cancer among firefighters due to combustion products has been long studied with many prior reports on risks for cancers among these workers, although none in the West. Prior studies have not consistently found the same types of cancers from study to study. This study found that among 549 firefighters participating out of a potential study population of 3,946 (13.91% participation rate), that other than skin cancer (n=19), the most common cancer reported was prostate. For many cancers, similarly with the police officers, the low participation rate of the workers impaired the ability to measure risks among the firefighters, although some of those types of cancers are also not common. However, the overall cancer rate was increased in the medium exposure group (3.1-fold) and was non-statistically significantly elevated in the high exposure group (2.4-fold). Risk estimates were stronger among confirmed cases (8.5- and 4.2-fold respectively). Skin cancers were significantly elevated in both the high (4-fold) and medium (3.4-fold) categories.

The main limitations in these studies were the low participation rates which were 4.68% for police officers and 13.91% for firefighters. The minimum participation rate that is generally accepted for quality epidemiological studies is 50%. However, precise estimates of risk for these workers could be gladly calculated with access to data on all workers (please see a suggestion in the Future Directions section below). Another limitation that is less considerable, but may be present is that the research team was only given names for the vast majority of workers, and in some cases not even names but random identification numbers, that we then matched up with our study identification numbers. Some workers may have been double-counted if they worked full-time professionally for more than one municipality during the study timeframe of 1980-2005. (E.g., we have no way of determining whether an Officer John Doe from Salt Lake City is the same Officer John Doe from Salt Lake County, unless that individual is participating in the study and informed us of this duplicity.) Also, the total number of police officers eligible to participate was high due to the large number of names that the Utah Dept. of Corrections (n=4,492). We have reason to believe that not all of these names are of eligible police officers, and may include a small percentage of clerical workers. These corrections officers were included as some had potential prior methamphetamine exposures, but most did not and were thought to serve as an excellent control population, which is a study strength.

Future Directions

There are options available for the future of this research project. Among these are:

- ✓ Complete analyses including individuals who enrolled too late to be included in this report to meet the statutory deadline
- ✓ Conduct studies of the entire workforces to obtain precise estimates for cancer risk for the entire population of Utah's firefighters and Utah's police officers (12-month timeline from receipt of information). This would appear to require amending the statute (HB009, 2006 G.S.)
- ✓ Archive study information in a secure location to allow access for a 10 or 20-year follow-up study.
- ✓ Destroy study information, which would effectively preclude additional work in this area.
- ✓ Preventive measures to reduce current exposures are an area of particular interest as well. We would welcome the opportunity to work with the officers to identify interventions that could future reduce risks for diseases.

We welcome opportunities to discuss this study, its results and potential future directions with interested parties.

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APPENDIX A

Previously Reported Risk Estimates
and Confidence Bounds

Summary of Reported Risk Estimates for Literature on Firefighters

Cancers	Demers 1992 SIR (95% CI)	Demers 1992 SMR (95% CI)	Figgs 1984-1989 OR (95% CI)	Delahunt 1995 RR (95% CI)
All hematopoietic cancer	*	*	*	*
All Lymphopoietic	*	*	*	*
Benign neoplasms	*	*	*	*
Benign/unspecified, brain	*	*	*	*
Biliary passages, liver gall bladder	*	*	*	*
Bladder and other urinary	1.05 (0.67-1.55)[f]	0.46 (0.05-1.65)[f]	*	*
Brain and nervous system	1.01 (0.37-2.20)[g]	1.00 (0.37-2.18)[g]	*	*
Breast	*	*	*	*
Buccal cavity and Pharynx	1.22 (0.73-1.90)[l]	1.00 (0.27-2.7)[l]	*	*
Cecum	*	*	*	*
Colon	1.00 (0.68-1.43)	0.68 (0.33-1.26)	*	*
Colon and rectum	*	*	*	*
Digestive organs and peritoneum	1.75 (0.98-2.89)[t1]	2.04 (1.05-3.56)[t1]	*	*
Esophageal cancer	1.06 (0.34-2.47)	1.13 (0.37-2.63)	*	*
Genitourinary cancer	*	*	*	*
Non-Hodgkins Lymphoma	*	*	5.60 (2.50-12.30)	*
Hodgkin's disease	*	*	*	*
Intestinal cancer	*	*	*	*
Kidney and renal pelvis	0.78 (0.31-1.61)	0.91 (0.25-2.33)	*	3.51 (0.54-5.93)[u]
Laryngeal cancer	1.14 (0.52-2.17)	1.06 (0.13-3.82)	*	*
Bones and joints	*	*	*	*
Leukemia	1.05 (0.50-1.93)	1.25 (0.54-2.46)	*	*
Lip	*	*	*	*
Respiratory system	*	*	*	*
Lung	0.92 (0.71-1.17)[c1]	1.01 (0.77-1.29)[c1]	*	*
Lymphatic system	*	*	*	*
Lymphosarcoma and reticulosarcoma	*	*	*	*
Malignant melanoma of skin	1.21 (0.68-2.00)	1.64 (0.53 3.83)	*	*
Multiple myeloma	*	*	*	*
Other and unspecified malignant neoplasms	*	*	*	*
Other cancers	*	*	*	*
Other digestive cancer	*	*	*	*
Other lymphatic and hematopoietic	0.64 (0.34-1.12)	1.07 (0.53-1.92)	*	*
Other malignant neoplasms	*	*	*	*
Other skin	*	*	*	*
Pancreatic cancer	1.06 (0.49-2.01)	1.11 (0.53-2.04)	*	*
Prostate	1.37 (1.11-1.69)	1.14 (0.65-1.85)	*	*
Rectum and rectosigmoid junction	0.95 (0.55-1.52)[l1]	1.48 (0.48-3.45)[l1]	*	*
Soft tissue sarcoma	*	*	*	*
Thyroid	*	*	*	*
Unspecified nervous system tumours	*	*	*	*
Total Cancers	*	*	*	*

Summary of Reported Risk Estimates for Literature on Firefighters cont.

Cancers	Berg 1975 SMR	Berg 1975 PMR	Demers 1993 OR (95% CI) All respondents	Demers 1993 OR (95% CI) Self-responding
All hematopoietic cancer	*	*	*	*
All Lymphopoietic	*	*	*	*
Benign neoplasms	*	*	*	*
Benign/unspecified, brain	*	*	*	*
Biliary passages, liver gall bladder	*	*	*	*
Bladder and other urinary	*	*	*	*
Brain and nervous system	*	*	*	*
Breast	*	*	*	*
Buccal cavity and Pharynx	*	*	*	*
Cecum	*	*	*	*
Colon	*		*	*
Colon and rectum	279 (p<0.01)	172 (p<0.01)	*	*
Digestive organs and peritoneum	*	*	*	*
Esophageal cancer	*	*	*	*
Genitourinary cancer	*	*	*	*
Non-Hodgkins Lymphoma	*	*	*	*
Hodgkin's disease	*	*	*	*
Intestinal cancer	*	*	*	*
Kidney and renal pelvis	*	*	*	*
Laryngeal cancer	*	*	*	*
Bones and joints	*	*	*	*
Leukemia	*	*	*	*
Lip	*	*	*	*
Respiratory system	*	*	*	*
Lung	*	*	*	*
Lymphatic system	*	*	*	*
Lymphosarcoma and reticulosarcoma	*	*	*	*
Malignant melanoma of skin	*	*	*	*
Multiple myeloma	*	*	1.9 (0.5-9.4)	2.8 (0.5-14.5)
Other and unspecified malignant neoplasms	*	*	*	*
Other cancers	*	*	*	*
Other digestive cancer	*	*	*	*
Other lymphatic and hematopoietic	*	*	*	*
Other malignant neoplasms	*	*	*	*
Other skin	*	*	*	*
Pancreatic cancer	*	*	*	*
Prostate	*	*	*	*
Rectum and rectosigmoid junction	*	*	*	*
Soft tissue sarcoma	*	*	*	*
Thyroid	*	*	*	*
Unspecified nervous system tumours	*	*	*	*
Total Cancers	*	*	*	*

Summary of Reported Risk Estimates for Literature on Firefighters cont.

Cancers	Beumont 1991 Rate ratio (95% CI)	Morton 1984 SIR (Total Leukemia)	Morton 1984 SIR	Giles 1993 SIR (95% CI)
All hematopoietic cancer	*	*	*	*
All Lymphopoietic	*	*	*	*
Benign neoplasms	*	*	*	*
Benign/unspecified, brain	*	*	*	*
Biliary passages, liver gall bladder	1.91 (0.87-3.63)	*	*	*
Bladder and other urinary	0.57 (0.19-1.35)	*	*	1.02 (0.28-2.62)[v1]
Brain and nervous system	0.81 (0.26-1.90)	*	*	*
Breast	*	*	*	*
Buccal cavity and Pharynx	1.43 (0.71-2.57)	*	*	1.46 (0.53-3.18)[p]
Cecum	*	*	*	*
Colon	*	*	*	*
Colon and rectum	*	*	*	1.36 (0.62-2.59)
Digestive organs and peritoneum	1.27 (1.04-1.55)	*	*	*
Esophageal cancer	2.04 (1.05-3.57)	*	*	*
Genitourinary cancer	0.40 (0.18-0.77)[s]	*	*	1.15 (0.13-4.17)[r]
Non-Hodgkins Lymphoma	*	*	*	1.85 (0.50-4.74)
Hodgkin's disease	*	*	*	*
Intestinal cancer	0.99 (0.63-1.47)[t]	*	*	*
Kidney and renal pelvis	0.68 (0.19-1.74)[w]	*	*	*
Laryngeal cancer	0.80 (0.17-2.35)	*	*	*
Bones and joints	*	*	*	*
Leukemia	0.61 (0.22-1.33)[q1]	346 (p<0.01)	205 (Lymphatic)[r1] 445 (p<0.01) (Nonlymphatic)[s1]	0.00 (0.00-3.56)
Lip	6.17 (0.75-22.29)	*	*	*
Respiratory system	0.83 (0.64-1.06)	*	*	*
Lung	0.84 (0.64-1.08)[b1]	*	*	0.77 (0.28-1.68)[c1]
Lymphatic system	0.65 (0.35-1.09)[j1]	*	*	*
Lymphosarcoma and reticulosarcoma	0.89 (0.24-2.29)	*	*	*
Malignant melanoma of skin	1.69 (0.68-3.49)[k1]	*	*	1.08 (0.35-2.53)
Multiple myeloma	*	*	*	*
Other and unspecified malignant neoplasms	1.11 (0.76-1.58)	*	*	*
Other cancers	*	*	*	*
Other digestive cancer	*	*	*	*
Other lymphatic and hematopoietic	*	*	*	*
Other malignant neoplasms	*	*	*	*
Other skin	*	*	*	*
Pancreatic cancer	1.25 (0.73-2.00)	*	*	1.03 (0.01-5.75)
Prostate	0.38 (0.16-0.75)	*	*	2.09 (0.67-4.88)
Rectum and rectosigmoid junction	1.45 (0.77-2.49)[l1]	*	*	*
Soft tissue sarcoma	*	*	*	*
Thyroid	*	*	*	*
Unspecified nervous system tumours	*	*	*	*
Total Cancers	0.95 (0.84-1.08)	*	*	1.13 (0.84-1.48)

Summary of Reported Risk Estimates for Literature on Firefighters cont.

Cancers	Stang 2003 OR1 (95% CI) Ever	Sama 1990 SMOR (95% CI)	Bates 2007 OR (95% CI) No control exclusions	Bates 2007 OR (95% CI) Control exclusions
All hematopoietic cancer	*	*	*	*
All Lymphopoietic	*	*	*	*
Benign neoplasms	*	*	*	*
Benign/unspecified, brain	*	*	*	*
Biliary passages, liver gall bladder	*	*	*	*
Bladder and other urinary	*	159 (102-250)[f]	0.79 (0.68-0.92)[f]	0.85 (0.72-1.00)[f]
Brain and nervous system	*	86 (34-215)[g]	1.23 (0.97-1.56)[g]	1.35 (1.06-1.72)[g]
Breast	*	*	*	*
Buccal cavity and Pharynx	*	*	*	*
Cecum	*	*	1.03 (0.78-1.35)	1.09 (0.82-1.44)
Colon	*	120 (80-182)	*	*
Colon and rectum	*	*	0.84 (0.74-0.94)	0.90 (0.79-1.03)
Digestive organs and peritoneum	*	*	0.77 (0.58-1.02)[t1]	0.80 (0.61-1.07)[t1]
Esophageal cancer	*	*	1.37 (1.06-1.76)	1.48 (1.14-1.91)
Genitourinary cancer	4.0 (0.7-27.4)[r]	*	1.34 (1.04-1.74)[r]	1.54 (1.18-2.02)[r]
Non-Hodgkins Lymphoma	*	159 (89-284)	0.98 (0.84-1.15)	1.07 (0.90-1.26)
Hodgkin's disease	*	*	*	*
Intestinal cancer	*	*	*	*
Kidney and renal pelvis	*	*	0.98 (0.81-1.20)	1.07 (0.87-1.31)
Laryngeal cancer	*	*	*	*
Bones and joints	*	*	*	*
Leukemia	*	112 (48-259)	1.13 (0.92-1.37)	1.22 (0.99-1.49)
Lip	*	*	*	*
Respiratory system	*	*	*	*
Lung	*	122 (87-169)[c1]	0.92 (0.84-1.01)[d1]	0.98 (0.88-1.09)[d1]
Lymphatic system	*	*	*	*
Lymphosarcoma and reticulosarcoma	*	*	*	*
Malignant melanoma of skin	*	292 (170-503)[k1]	1.44 (1.28-1.62)[k1]	1.50 (1.33-1.70)[k1]
Multiple myeloma	*	*	0.97 (0.70-1.34)	1.03 (0.75-1.43)
Other and unspecified malignant neoplasms	*	*	*	*
Other cancers	*	*	*	*
Other digestive cancer	*	*	*	*
Other lymphatic and hematopoietic	*	*	*	*
Other malignant neoplasms	*	*	*	*
Other skin	*	*	*	*
Pancreatic cancer	*	98 (42-226	0.85 (0.66-1.09)	1.09 (0.82-1.44)
Prostate	*	*	1.20 (1.12-1.29)	1.22 (1.12-1.33)
Rectum and rectosigmoid junction	*	135 (84-219)[l1]	*	*
Soft tissue sarcoma	*	*	*	*
Thyroid	*	*	1.06 (0.75-1.51)	1.17 (0.82-1.67)
Unspecified nervous system tumours	*	*	*	*
Total Cancers	*	*	*	*

Summary of Reported Risk Estimates for Literature on Firefighters cont.

Cancers	Burnett 1994 PMR (95% CI) Under age 65	Burnett 1994 PMR (95% CI) Total	Ma 1998 MOR (95% CI) White firefighters	Ma 1998 MOR (95% CI) Black firefighters
All hematopoietic cancer	*	*	*	*
All Lymphopoietic	*	*	*	*
Benign neoplasms	*	*	*	*
Benign/unspecified, brain	*	*	*	*
Biliary passages, liver gall bladder	*	*	1.2 (0.9-1.7)[c]	*
Bladder and other urinary	101 (46,193)[f]	99 (70,137)[f]	1.2 (0.9-1.6)[f]	1.3 (*)[f]
Brain and nervous system	85 (52,134)	103 (73,141)	1.0 (0.8-1.4)	6.9 (3.0-16.0)
Breast	*	*	*	*
Buccal cavity and Pharynx	*	*	1.3 (*)[n]	*
Cecum	*	*	*	*
Colon	*	*	1.0 (0.9-1.2)	2.1 (1.1-4.0)
Colon and rectum	*	*	*	*
Digestive organs and peritoneum	*	*	1.2 (0.9-1.6)[t1]	1.2 (*)[t1]
Esophageal cancer	*	*	0.9 (0.7-1.3)	1.4 (*)
Genitourinary cancer	*	*	0.6 (*)[r]	*
Non-Hodgkins Lymphoma	161 (112,224)	132 (102,167)	1.4 (1.1-1.7)	0.8 (*)
Hodgkin's disease	*	*	2.4 (1.4-4.1)	*
Intestinal cancer	*	*	*	*
Kidney and renal pelvis	141 (90,210)[w]	144 (108,189)[w]	1.3 (1.0-1.7)	*
Laryngeal cancer	*	*	0.8 (0.4-1.3)	*
Bones and joints	*	*	1.0 (*)	*
Leukemia	171 (118,240)	119 (91,153)	1.1 (0.8-1.4)	*
Lip	*	*	5.9 (1.9-18.3)	*
Respiratory system	*	*	1.8 (*)[f1]	*
Lung	98 (86,112)[c1]	102 (94,111)[c1]	1.1 (1.0-1.2)[d1]	0.8 (0.5-1.3)[d1]
Lymphatic system	161 (129,199)[j1]	130 (111,151)[j1]	*	*
Lymphosarcoma and reticulosarcoma	*	*	*	*
Malignant melanoma of skin	167 (107,248)[k1]	163 (115,223)[k1]	1.4 (1.0-1.9)[k1]	*
Multiple myeloma	136 (68,243)	148 (102,207)	1.1 (0.8-1.6)	*
Other and unspecified malignant neoplasms	*	*	*	*
Other cancers	*	*	*	*
Other digestive cancer	*	*	*	*
Other lymphatic and hematopoietic	*	*	*	*
Other malignant neoplasms	*	*	*	*
Other skin	*	*	1.0 (0.5-1.9)	*
Pancreatic cancer	*	*	1.2 (1.0-1.5)	2.0 (0.9-4.6)
Prostate	*	*	1.2 (1.0-1.3)	1.9 (1.2-3.2)
Rectum and rectosigmoid junction	186 (110,294)[l1]	148 (105,205)[l1]	1.1 (0.5-1.6)[l1]	*
Soft tissue sarcoma	*	*	1.6 (1.0-2.7)	*
Thyroid	*	*	1.3 (*)[n1]	*
Unspecified nervous system tumours	*	*	*	*
Total Cancers	112 (104,121)	110 (106,114)	1.1 (1.1-1.2)	1.2 (0.9-1.5)

Summary of Reported Risk Estimates for Literature on Firefighters cont.

Cancers	Ma 2005 SMR (95% CI) Male	Hansen 1990 SMR (95% CI)	Tornling 1994 SMR (95% CI) Morality	Tornling 1994 SMR (95% CI) Incidence
All hematopoietic cancer	*	*	44 (9-127)	32 (6-92)
All Lymphopoietic	0.77 (0.56-1.05)	*	*	*
Benign neoplasms	*	*	*	*
Benign/unspecified, brain	*	*	*	*
Biliary passages, liver gall bladder	0.85 (0.41-1.56)[c]	*	149 (41-381)[d]	85 (23-218)[d]
Bladder and other urinary	1.79 (0.98-3.00)[f]	*	*	*
Brain and nervous system	0.66 (0.35-1.13)	*	279 (91-651)[g]	137 (44-230)[g]
Breast	7.41 (1.99-19.0)	*	*	*
Buccal cavity and Pharynx	0.42 (0.17-0.87)	*	*	*
Cecum	*	*	*	*
Colon	1.14 (0.81-1.56)	*	85 (21-185)	90 (39-177)
Colon and rectum	*	*	*	*
Digestive organs and peritoneum	0.86 (0.70-1.06)[q]	*	121 (62-211)[t1]	192 (114-304)[t1]
Esophageal cancer	0.65 (0.31-1.20)	*	*	*
Genitourinary cancer	*	*	*	*
Non-Hodgkins Lymphoma	*	*	*	*
Hodgkin's disease	0.23 (0.00-1.30)	*	*	*
Intestinal cancer	*	*	*	*
Kidney and renal pelvis	*	*	110 (30-281)[w]	36 (4-129)[w]
Laryngeal cancer	*	*	*	*
Bones and joints	0.52 (0.01-2.91)[y]	*	*	*
Leukemia	0.84 (0.46-1.42)	*	*	*
Lip	*	*	*	*
Respiratory system	0.88 (0.75-1.03)	*	*	*
Lung	0.93 (0.79-1.09)[d1]	163 (75-310)[c1]	90 (53-142)[e1]	89 (51-145)[e1]
Lymphatic system	*	*	*	*
Lymphosarcoma and reticulosarcoma	0.65 (0.13-1.90)[i1]	*	*	*
Malignant melanoma of skin	0.89 (0.52-1.42)[k1]	*	*	79 (9-287)
Multiple myeloma	*	*	*	*
Other and unspecified malignant neoplasms	*	*	*	*
Other cancers	*	*	*	*
Other digestive cancer	*	*	*	*
Other lymphatic and hematopoietic	*	*	*	*
Other malignant neoplasms	*	96 (50-167)	*	*
Other skin	*	*	*	*
Pancreatic cancer	0.57 (0.29-0.99)	*	84 (27-196)	119 (44-260)
Prostate	1.08 (0.67-1.65)	*	121 (66-202)	114 (76-165)
Rectum and rectosigmoid junction	0.94 (0.38-1.93)[l1]	*	207 (89-408)[m1]	170 (81-312)[m1]
Soft tissue sarcoma	*	*	*	*
Thyroid	4.82 (1.30-12.3)	*	*	*
Unspecified nervous system tumours	*	*	*	*
Total Cancers	*	117 (72-178)	*	*

Summary of Reported Risk Estimates for Literature on Firefighters cont.

Cancers	Feuer 1986 PMR	Feuer 1986 PMR	Deschamps 1995 SMR (95% CI)	Baris 2001 SMR (95% CI)
All hematopoietic cancer	*	*	*	*
All Lymphopoietic	*	*	*	*
Benign neoplasms	*	*	*	1.65 (0.89-3.07)
Benign/unspecified, brain	*	*	*	*
Biliary passages, liver gall bladder	*	*	*	0.82 (0.41-1.64)[c]
Bladder and other urinary	*	*	*	1.25 (0.77-2.00)[f]
Brain and nervous system	*	*	*	0.61 (0.31-1.22)[g]
Breast	*	*	*	*
Buccal cavity and Pharynx	*	*	0.81 (0.10-2.93)[m]	1.36 (0.87-2.14)
Cecum	*	*	*	*
Colon	*	*	*	1.51 (1.18-1.93)
Colon and rectum	*	*	*	*
Digestive organs and peritoneum	1.45[q]	1.11[q]	1.14 (0.37-2.66)[q]	0.90 (0.61-1.35)[t1]
Esophageal cancer	*	*	*	0.56 (0.25-1.24)
Genitourinary cancer	*	*	3.29 (0.40-11.88)	*
Non-Hodgkins Lymphoma	*	*	*	1.41 (0.91-2.19)
Hodgkin's disease	*	*	*	*
Intestinal cancer	*	*	*	*
Kidney and renal pelvis	*	*	*	1.07 (0.61-1.88)[w]
Laryngeal cancer	*	*	*	0.75 (0.31-1.81)
Bones and joints	*	*	*	*
Leukemia	1.86	1.77	*	0.83 (0.50-1.37)
Lip	*	*	*	*
Respiratory system	0.98	0.92	1.12 (0.45-2.30)	*
Lung	*	*	*	1.13 (0.97-1.32)[d1]
Lymphatic system	*	*	*	*
Lymphosarcoma and reticulosarcoma	*	*	*	*
Malignant melanoma of skin	2.70 ($p<0.05$)[k1]	1.9[k1]	*	1.18 (0.64-2.20)[k1]
Multiple myeloma	*	*	*	1.68 (0.90-3.11)
Other and unspecified malignant neoplasms	*	*	*	*
Other cancers	*	*	*	*
Other digestive cancer	*	*	*	*
Other lymphatic and hematopoietic	*	*	*	*
Other malignant neoplasms	*	*	*	*
Other skin	*	*	*	*
Pancreatic cancer	*	*	*	0.96 (0.64-1.44)
Prostate	*	*	*	0.96 (0.68-1.37)
Rectum and rectosigmoid junction	*	*	*	0.99 (0.59-1.68)[l1]
Soft tissue sarcoma	*	*	*	*
Thyroid	*	*	*	*
Unspecified nervous system tumours	*	*	*	*
Total Cancers	1.15	1	0.89 (0.53-1.40)	1.10 (1.00-1.20)

Summary of Reported Risk Estimates for Literature on Firefighters cont.

Cancers	Heyer 1990 SMR (95% CI)	Demers 1992 SMR (95% CI)	Aronson 1994 SMR (95% CI)	Grimes 1991 Risk ratio (95% CI)
All hematopoietic cancer	*	*	*	*
All Lymphopoietic	*	*	*	*
Benign neoplasms	*	*	*	*
Benign/unspecified, brain	218 (26-789)	*	*	*
Biliary passages, liver gall bladder	*	1.19 (0.44-2.59)[b]	84 (10-305)[e]	*
Bladder and other urinary	*	0.23 (0.03-0.83)	128 (51-263)[f]	*
Brain and nervous system	95 (20-279)	2.07 (1.23-3.28)	201 (110-337)	3.78 (1.22-11.71)
Breast	*	*	*	*
Buccal cavity and Pharynx	*	0.81 (0.33-1.66)[l]	139 (38-357)[m]	*
Cecum	*	*	*	*
Colon	*	0.85 (0.54-1.26)	60 (30-108)	0.91 (0.37-2.20)
Colon and rectum	*	*	*	*
Digestive organs and peritoneum	106 (71-152)[q]	1.07 (0.61-1.73)[t1]	51 (20-105)[t1]	1.01 (0.65-1.57)[q]
Esophageal cancer	44 (1-250)	0.83 (0.30-1.80)	40 (5-143)	*
Genitourinary cancer	*	*	252 (52-737)[r]	2.28 (1.28-4.06)
Non-Hodgkins Lymphoma	*	*	*	*
Hodgkin's disease	*	1.05 (0.22-3.08)	47 (1-259)	*
Intestinal cancer	79 (32-164)	*	*	*
Kidney and renal pelvis	*	0.27 (0.03-0.97)[w]	43 (5-156)[x]	*
Laryngeal cancer	*	0.47 (0.06-1.70)	37 (1-206)	*
Bones and joints	*	*	*	*
Leukemia	173 (70-358)[q1]	1.27 (0.71-2.09)	120 (33-309)[o1]	*
Lip	*	*	*	*
Respiratory system	101 (69-143)	*	*	1.28 (0.82-2.00)
Lung	97 (65-139)[d1]	0.96 (0.77-1.17)[d1]	95 (71-124)[b1]	*
Lymphatic system	126 (65-222)[g1]	1.31 (0.92-1.81)[g1]	98 (58-156)[j1]	0.95 (0.36-2.50)
Lymphosarcoma and reticulosarcoma	*	1.42 (0.57-2.93)	204 (42-596)[i1]	*
Malign\ant melanoma of skin	*	0.98 (0.36-2.13)[k1]	73 (9-263)	*
Multiple myeloma	*	*	39 (1-215)	*
Other and unspecified malignant neoplasms	*	*	*	*
Other cancers	*	*	*	*
Other digestive cancer	*	*	*	*
Other lymphatic and hematopoietic	225 (47-660)	1.40 (0.72-2.44)	*	*
Other malignant neoplasms	*	*	238 (145-367)	*
Other skin	*	*	*	*
Pancreatic cancer	*	0.89 (0.49-1.49)	140 (77-235)	*
Prostate	*	1.34 (0.90-1.91)	132 (76-215)	2.61 (1.38-4.97)
Rectum and rectosigmoid junction	65 (8-237)[l1]	0.95 (0.41-1.87)[l1]	171 (91-293)[l1]	*
Soft tissue sarcoma	*	*	*	*
Thyroid	*	*	*	*
Unspecified nervous system tumours	*	2.20 (0.60-5.62)	*	*
Total Cancers	96 (77-118)	0.95 (0.85-1.07)	105 (91-120)	1.19 (0.96-1.49)

Summary of Reported Risk Estimates for Literature on Firefighters cont.

Cancers	Eliopulas 1984 SMR (95% CI)	Eliopulas 1984 SMPR (95% CI)	Guidotti 1993 SMR (95% CI)
All hematopoietic cancer	*	*	*
All Lymphopoietic	*	*	*
Benign neoplasms	*	*	*
Benign/unspecified, brain	*	*	*
Biliary passages, liver gall bladder	*	*	*
Bladder and other urinary	*	*	315.7 (86.0-808.3)[f]
Brain and nervous system	*	*	146.6 (30.3-428.5)[g]
Breast	*	*	*
Buccal cavity and Pharynx	*	*	113.6 (13.7-410.4)[k]
Cecum	*	*	*
Colon	*	*	*
Colon and rectum	*	*	161.4 (88.3-270.9)
Digestive organs and peritoneum	*	2.02 (0.65-4.70)[t1]	80.9 (29.7-176.0)[t1]
Esophageal cancer	*	*	*
Genitourinary cancer	*	1.08 (0.29-2.76)	*
Non-Hodgkins Lymphoma	*	*	*
Hodgkin's disease	*	*	*
Intestinal cancer	*	1.59 (0.43-4.07)	*
Kidney and renal pelvis	*	*	414.0 (166.4-853.1)[x]
Laryngeal cancer	*	*	*
Bones and joints	*	*	*
Leukemia	*	*	126.5 (60.6-232.5)[p1]
Lip	*	*	*
Respiratory system	0.84 (0.33-1.71)	1.04 (0.42-2.13)	*
Lung	*	*	142.0 (91.0-211.4)[c1]
Lymphatic system	*	1.88 (0.39-5.50)[h1]	*
Lymphosarcoma and reticulosarcoma	*	*	*
Malignant melanoma of skin	*	*	0.0 (0.0-331.2)[k1]
Multiple myeloma	*	*	*
Other and unspecified malignant neoplasms	*	*	*
Other cancers	1.21 (0.77-1.82)	2.97 (0.81-7.60)	*
Other digestive cancer	*	0.88 (0.18-2.58)	*
Other lymphatic and hematopoietic	*	*	*
Other malignant neoplasms	*	*	*
Other skin	*	*	*
Pancreatic cancer	*	*	155.1 (50.4-362.0)
Prostate	*	*	146.1 (63.1-287.9)
Rectum and rectosigmoid junction	*	*	*
Soft tissue sarcoma	*	*	*
Thyroid	*	*	*
Unspecified nervous system tumours	*	*	*
Total Cancers	1.09 (0.74-1.56)	1.37 (0.93-1.36)	126 (102.0-155.2)

Summary of Reported Risk Estimates for Literature on Firefighters cont.

Cancers	Vena 1987 Observed/ Expected (95% CI)	Musk 1978 SMR
All hematopoietic cancer	*	*
All Lymphopoietic	*	*
Benign neoplasms	*	*
Benign/unspecified, brain	*	*
Biliary passages, liver gall bladder	0.98 (0.11-3.52)[c]	*
Bladder and other urinary	2.86 (1.30-5.40)[f]	*
Brain and nervous system	2.36 (0.86-5.13)	103
Breast	*	*
Buccal cavity and Pharynx	*	*
Cecum	*	*
Colon	1.83 (1.05-2.97)	*
Colon and rectum	*	*
Digestive organs and peritoneum	1.38 (0.98-1.89)	80[q]
Esophageal cancer	1.34 (0.27-3.91)	*
Genitourinary cancer	*	92
Non-Hodgkins Lymphoma	*	*
Hodgkin's disease	*	*
Intestinal cancer	*	*
Kidney and renal pelvis	1.30 (0.26-3.80)[w]	*
Laryngeal cancer	*	*
Bones and joints	*	*
Leukemia	*	*
Lip	*	*
Respiratory system	0.94 (0.62-1.36)	88
Lung	*	*
Lymphatic system	0.55 (0.18-1.29)[g1]	63[g1]
Lymphosarcoma and reticulosarcoma	*	*
Malignant melanoma of skin	*	*
Multiple myeloma	*	*
Other and unspecified malignant neoplasms	*	*
Other cancers	*	*
Other digestive cancer	*	*
Other lymphatic and hematopoietic	*	*
Other malignant neoplasms	*	114
Other skin	*	*
Pancreatic cancer	0.38 (0.04-1.36)	*
Prostate	0.71 (0.23-1.65)	*
Rectum and rectosigmoid junction	2.08(0.83-4.28)[l1]	*
Soft tissue sarcoma	*	*
Thyroid	*	*
Unspecified nervous system tumours	*	*
Total Cancers	1.09 (0.89-1.32)	86

* No Data Available
SIR - Standard incident ratio
SMR - Standard mortality ratio
MOR - Mortality odds ratio
OR - Mortality odds ratio
RR - Occupational risk ratio
PMR - Proportionate mortality ratio
SMPR - Standard proportional mortality ratio
SMOR - Standard morbidity odds ratio

Summary of Reported Risk Estimates for Literature on Police Officers

Cancers	Demers 1992 SIR	Demers 1992 SMR	Delahunt 1995 RR
Oral/pharynx	1.22 (0.73-1.90)	1.00 (0.27-2.57)	*
Esophagus	1.06 (0.34-2.47)	1.13 (0.37-2.63)	*
Stomach	1.75 (0.98-2.89)	2.04 (1.05-3.56)	*
Colon	1.00 (0.68-1.43)	0.68 (0.33-1.26)	*
Rectum	0.95 (0.55-1.52)	1.48 (0.48-3.45)	*
Pancreas	1.06 (0.49-2.01)	1.11 (0.53-2.04)	*
Larynx	1.14 (0.52-2.17)	1.06 (0.13-3.82)	*
Lung	0.92 (0.71-1.17)	1.01 (0.77-1.29)	*
Malignant melanoma	1.21 (0.68-2.00)	1.64 (0.53 3.83)	*
Prostate	1.37 (1.11-1.69)	1.14 (0.65-1.85)	*
Bladder	1.05 (0.67-1.55)	0.46 (0.05-1.65)	*
Kidney and renal pelvis	0.78 (0.31-1.61)	0.91 (0.25-2.33)	*
Brain	1.01 (0.37-2.20)	1.00 (0.37-2.18)	*
Leukemia	1.05 (0.50-1.93)	1.25 (0.54-2.46)	*
Other lymphatic and hematopoietic	0.64 (0.34-1.12)	1.07 (0.53-1.92)	*
Non- Hodgkin's Lymphoma	*	*	*
Renal cancer	*	*	1.78 (0.54-5.93)
Multiple myeloma	*	*	*
Lymphatic Leukemia	*	*	*
Nonlymphatic Leukemia	*	*	*
Digestive	*	*	*
Respiratory	*	*	*
Skin	*	*	*
Total	*	*	*

Summary of Reported Risk Estimates for Literature on Police Officers cont.

Cancers	Berg 1975 SMR	Berg 1975 PMR	Demers 1993 OR (95% CI) All respondents	Demers 1993 OR (95% CI) Self-responding
Oral/pharynx	*	*	*	*
Esophagus	*	*	*	*
Stomach	*	*	*	*
Colon	139	94	*	*
Rectum	*	*	*	*
Pancreas	*	*	*	*
Larynx	*	*	*	*
Lung	*	*	*	*
Malignant melanoma	*	*	*	*
Prostate	*	*	*	*
Bladder	*	*	*	*
Kidney and renal pelvis	*	*	*	*
Brain	*	*	*	*
Leukemia	*	*	*	*
Other lymphatic and hematopoietic	*	*	*	*
Non- Hodgkin's Lymphoma	*	*	*	*
Renal cancer	*	*	*	*
Multiple myeloma	*	*	1.1 (0.6-2.1)	1.0 (0.4-2.0)
Lymphatic Leukemia	*	*	*	*
Nonlymphatic Leukemia	*	*	*	*
Digestive	*	*	*	*
Respiratory	*	*	*	*
Skin	*	*	*	*
Total	*	*	*	*

Summary of Reported Risk Estimates for Literature on Police Officers cont.

Cancers	Morton 1984 SIR (Total Leukemia)	Morton 1984 SIR	Feuer 1986 PMR	Feuer 1986 PMR
Oral/pharynx	*	*	*	*
Esophagus	*	*	*	*
Stomach	*	*	*	*
Colon	*	*	*	*
Rectum	*	*	*	*
Pancreas	*	*	*	*
Larynx	*	*	*	*
Lung	*	*	*	*
Malignant melanoma	*	*	*	*
Prostate	*	*	*	*
Bladder	*	*	*	*
Kidney and renal pelvis	*	*	*	*
Brain	*	*	*	*
Leukemia	260 (0.01<p<0.05)	*	0.63	0.56
Other lymphatic and hematopoietic	*	*	*	*
Non- Hodgkin's Lymphoma	*	*	*	*
Renal cancer	*	*	*	*
Multiple myeloma	*	*	*	*
Lymphatic Leukemia	*	149	*	*
Nonlymphatic Leukemia	*	342 (0.01<p<0.05)	*	*
Digestive	*	*	1.58 (p<0.05)	1.21
Respiratory	*	*	0.95	0.88
Skin	*	*	2.10 (p<0.05)	1.51
Total	*	*	1.11	0.95

* No Data Available
SIR - Standard incident ratio
SMR - Standard Mortality ratio
OR - Mortality odds ratio
RR - Occupational risk ratio
PMR - Proportionate mortality ratio

Appendix B

Participation by Municipality

Participating Fire Municipalities

City/Municipality	Invited	Participating	Not Participating	Number of Names Received	Returned Letters	% Returned
Farmington Fire	x	x		1	0	0%
Hurricane Fire	x	x		10	0	0%
Ivins	x	x		3	0	0%
Layton	x	x		197	27	14%
Logan	x	x		121	15	12%
Midvale	x	x		49	6	12%
Murray	x	x		76	2	3%
N. Davis/Clearfield	x	x		20	0	0%
Northview	x	x		49	2	4%
Ogden	x	x		246	63	26%
Orem	x	x		129	6	5%
Park City	x	x		111	2	2%
Provo	x	x		162	15	9%
Roy	x	x		194	62	32%
S. Davis Metro	x	x		67	2	3%
S. Jordan	x	x		67	4	6%
S. Ogden	x		x	0	0	
S. Salt Lake	x	x		49	1	2%
Salt Lake City	x	x		964	371	38%
Sandy	x	x		72	0	0%
Santaquin*	x	x		0	0	
SL County Fire	x	x		500	182	36%
St. George	x		x	0	0	
Tooele City	x	x		59	5	8%
Unaffiliated Fire†				171	0	0%
Unified Fire Authority	x	x		400	4	1%
Utah State Univ. Fire	x	x		2	0	0%
Weber Fire Dist.	x	x		70	2	3%
West Jordan	x	x		88	2	2%
West Valley City	x	x		69	0	0%
Totals	29	27		3946	773	19.6%

*Santaquin does not employ firefighters full time, but was marked as participating because the city did respond to our request for participants.

†Unaffiliated Fire refers to firefighters who called in because they heard about the study, but either lost their invitation letter or did not receive one because they are from a non-participating municipality. Their participation pulls up the overall number of participant's names received.

Participating Police Officer Municipalities

City/Municipality	Invited	Participating	Not Participating	Number of Names Received	Returned Letters	% Returned
Alpine/Highland	x		x	0		
Alta Town Marshal	x		x	0		
American Fork	x		x	0		
Beaver Co. Sheriff	x		x	0		
Blanding	x		x	0		
Bountiful	x	x		62	5	8%
Box Elder Co. Sheriff	x		x	0		
Brian Head	x		x	0		
Brigham City	x	x		64	3	5%
BYU	x		x	0		
Cache Co. Sheriff	x		x	0		
Carbon Co. Sheriff	x		x	0		
Cedar City	x	x		65	5	8%
Centerfield	x		x	0		
Centerville	x	x		14	1	7%
Clearfield	x	x		64	9	14%
Clinton	x		x	0		
College of Eastern Utah	x		x	0		
Daggett Co. Sheriff	x		x	0		
Davis Co. Sheriff	x		x	0		
Dixie College	x		x	0		
Draper City	x		x	0		
Duchesne Co. Sheriff	x	x		32	14	44%
East Carbon	x		x	0		
Emery Co. Sheriff	x	x		52	13	25%
Enoch City	x	x		1		0%
Ephraim	x		x	0		
Escalante	x		x	0		
Fairview	x		x	0		
Farmington	x	x		13	0	0%
Fountain Green	x		x	0		
Garfield Co. Sheriff	x		x	0		
Garland	x		x	0		

Grand Co. Sheriff	x		x	0		
Granite School District	x		x	0		
Grantsville	x		x	0		
Gunnison	x		x	0		
Harrisville	x	x		23	0	0%
Heber	x		x	0		
Helper	x	x		40	0	0%
Hilldale	x		x	0		

City/Municipality	Invited	Participating	Not Participating	Number of Names Received	Returned Letters
Alpine/Highland	x		x	0	
Alta Town Marshal	x		x	0	
American Fork	x		x	0	
Beaver Co. Sheriff	x		x	0	
Blanding	x		x	0	
Bountiful	x	x		62	5
Box Elder Co. Sheriff	x		x	0	
Brian Head	x		x	0	
Brigham City	x	x		64	3
BYU	x		x	0	
Cache Co. Sheriff	x		x	0	
Carbon Co. Sheriff	x		x	0	
Cedar City	x	x		65	5
Centerfield	x		x	0	
Centerville	x	x		14	1
Clearfield	x	x		64	9
Clinton	x		x	0	
College of Eastern Utah	x		x	0	
Daggett Co. Sheriff	x		x	0	
Davis Co. Sheriff	x		x	0	
Dixie College	x		x	0	
Draper City	x		x	0	
Duchesne Co. Sheriff	x	x		32	14
East Carbon	x		x	0	
Emery Co. Sheriff	x	x		52	13
Enoch City	x	x		1	
Ephraim	x		x	0	
Escalante	x		x	0	
Fairview	x		x	0	
Farmington	x	x		13	0
Fountain Green	x		x	0	
Garfield Co. Sheriff	x		x	0	
Garland	x		x	0	
Grand Co. Sheriff	x		x	0	

Granite School District	x		x	0	
Grantsville	x		x	0	
Gunnison	x		x	0	
Harrisville	x	x		23	0
Heber	x		x	0	
Helper	x	x		40	0
Hilldale	x		x	0	

Participating Police Officer Municipalities Continued

City/Municipality	Invited	Participating	Not Participating	Number of Names Received	Returned Letters	% Returned
Hurricane	x	x		44	0	0%
Iron Co. Jail*	x	x		0		
Iron Co. Sheriff	x	x		39	0	0%
Ivins	x	x		3	0	0%
Juab Co. Sheriff	x		x	0		
Kamas City	x		x	0		
Kanab	x	x		24	7	29%
Kane Co. Sheriff	x	x		12	0	0%
Kaysville	x	x		28	2	7%
Layton	x	x		161	23	14%
LDS Security	x		x	0		
Leeds	x		x	0		
Lehi	x		x	0		
Logan	x	x		110	12	11%
Mantua	x		x	0		
Mapleton	x	x		36	3	8%
Midvale	x	x		287	139	48%
Millard Co. Sheriff	x	x		41	1	2%
Moab	x		x	0		
Monticello	x	x		27	0	0%
Morgan Co. Sheriff	x	x		39	3	8%
Moroni City	x		x	0		
Mt. Pleasant	x		x	0		
Murray	x	x		109	0	0%
Naples	x	x		7	0	0%
Nephi	x		x	0		
North Ogden	x	x		16	0	0%
North Park	x		x	0		
North Salt Lake	x		x	0		
Ogden City	x	x		184	16	9%
Orem	x	x		152	12	8%
Park City	x		x	0		
Parowan	x		x	0		
Payson	x		x	0		
Perry	x	x		4		0%
Piute Co. Sheriff	x	x		5	0	0%
Pleasant Grove	x	x		27	0	0%
Pleasant View	x	x		70	0	0%

Price	x	x		51	15	29%
Provo	x	x		204	30	15%

Participating Police Officer Municipalities Continued

City/Municipality	Invited	Participating	Not Participating	Number of Names Received	Returned Letters	% Returned
Rich Co. Sheriff	x		x	0		
Richfield	x	x		34	3	9%
Riverdale	x		x	0		
Roosevelt	x	x		27	1	4%
Roy	x	x		86	16	19%
Salem	x	x		17	2	12%
Salina	x		x	0		
Salt Lake City	x	x		637	36	6%
Salt Lake County Sheriff	x	x		789	105	13%
San Juan Co. Sheriff	x		x	0		
Sandy	x	x		209	23	11%
Sanpete Co. Sheriff	x	x		38	0	0%
Santa Clara	x		x	0		
Santaquin-Genola	x	x		25	0	0%
Saratoga Springs	x		x	0		
Sevier Co. Sheriff	x	x		90	8	9%
SLC Airport	x	x		0		
SLCC DPS Campus Police	x		x	0		
Smithfield	x	x		17	0	0%
Snow College	x		x	0		
South Jordan	x	x		51	17	33%
South Ogden	x	x		55	3	5%
South Salt Lake	x	x		172	25	15%
Southern Utah Univ.	x		x	0		
Spanish Fork	x	x		42	0	0%
Spring City	x		x	0		
Springville	x	x		78	43	55%
St. George	x	x		98	2	2%
Stockton	x		x	0		
Summit Co. Sheriff	x		x	0		
Sunset	x		x	0		
Syracuse	x		x	0		
Taylorsville	x	x		66	1	2%

Tooele City	x	x		57	0	0%
Tooele Co. Sheriff	x		x	0		
Tremonton	x	x		19	1	5%
Uinta Co. Sheriff	x		x	0		
Unaffiliated Police				19	0	0%
Univ. of Utah	x	x		55	13	24%
UT Dept. of Public Safety	x	x		1046	188	18%
UT Division of Wildlife	x		x	0		

Participating Police Officer Municipalities Continued

City/Municipality	Invited	Participating	Not Participating	Number of Names Received	Returned Letters	% Returned
UT Highway Patrol	x	x		23	0	0%
UT State Parks and Rec.	x	x		196	60	31%
UTA	x	x		196	0	0%
Utah Attorney General	x	x		28	0	0%
Utah Co. Sheriff	x	x		618	97	16%
Utah Dept. of Corrections	x	x		3103	620	20%
Utah State Univ.	x	x		11		0%
UVSC	x		x	0		
Vernal	x	x		62	0	0%
Veterans Admin. PD	x		x	0		
Wasatch Co. Sheriff	x		x	0		
Washington City	x	x		3	0	0%
Washington Co. Sheriff	x		x	0		
Wayne Co. Sheriff	x		x	0		
Weber Co. Sheriff	x		x	0		
Weber State Univ.	x		x	0		
Wellington	x		x	0		
Wendover	x		x	0		
West Bountiful	x	x		26	6	23%
West Jordan	x		x	0		
West Valley City	x	x		326	35	11%
Willard	x		x	0		

Woods Cross	x		x	0		
Totals	144	70		10429	1618	15.5%

* Iron County Jail is run by the Iron County Sheriff's Office and so employees are listed with the Iron County Sheriff's Office numbers.

Appendix C

Invitation Letters, Consent Forms Questionnaires and Exposure Matrices

Letters to Municipalities

DATE

Municipality Contact Person
Municipality Name
Municipality Name Address

Dear **Municipality Contact Person**:

On March 17, 2006, Governor Jon Huntsman, Jr. signed 2SHB009 of the 2006 Utah General Legislative Session into law. This allocated funds to the Utah Labor Commission to research the exposures and effects of combustion products and/or Methamphetamines among firefighters and police officers. The Rocky Mountain Center for Occupational & Environmental Health, located in the University of Utah's department of Family and Preventive Medicine, has been authorized by the Utah Labor Commission to conduct this research study and present finding in a report to be submitted to the Utah Labor Commission by October 15, 2008. Currently, relatively little is known about the hazards that these municipal employees face when exposed to these chemicals. By investigating these occupational risks it may be possible to reduce or remove those hazards.

This will be a retrospective cohort study with 8000 participants, 4000 police officers and 4000 firefighters, selected based upon their employment as a full time police officers or firefighters working in any municipality along the Wasatch Front. All full time eligible police officers and firefighters who were employed for a year or more between 1980 and 2001 in any municipality operating along the Wasatch Front in the state of Utah will be approached for enrollment. There will be no limit of age, gender, or duration of employment as long as individuals were employed for at least a year. We will include both genders and individuals of all racial and ethnic groups without any specific targeting for enrollment of various gender/ethnic groups. Records will be obtained from employers, including records to identify all police officers and firefighters from 1980 to the present, from all Utah municipalities. The primary comparison group will be within the cohort (high exposure vs. low exposure), however we will also compare with standardized rates for Wasatch front counties, the state of Utah, and national incidence rates for all and site specific cancers.

This study has been approved by the University of Utah's Institutional Review Board, which reviews all University research that involves people. All information obtained through the study will be kept strictly confidential.

As the employer of **Municipality's** firefighters and police officers, we are writing to ask if you will allow researchers to contact you, or the appropriate authorized person for **Municipality's Name** regarding enrollment of your municipality's firefighters and police officers in this study. If you, or the authorized representative of **Municipality's Name** agree to be contacted by a member of the research team to discuss this project, this does not mean that you are agreeing to have **your Municipality** participate in the study; it only means that you have given permission for a member of our research team to contact you to discuss the project and answer your questions. Please complete the enclosed participation form and return it to our office in the postage-paid envelope provided. One of our staff members will contact you by telephone if we do not hear from you within two weeks.

Thank you for your serious consideration of this request. Our research will be greatly enhanced by the investment of time from each of the municipalities along the Wasatch Front. If you have questions or need further information, please call Matthew Thiese at 801.587.3322 or Steve Oostema at 801.585.0451. Your help is greatly appreciated.

Sincerely,

Kurt T. Hegmann, MD, MPH
Director, Rocky Mountain Center for Occupational & Environmental Health

Enclosures

Letters to Sheriffs/Chiefs

Dear «TITLE» «NAME»,

On March 17, 2006, Governor Jon Huntsman, Jr. signed 2SHB009 of the 2006 Utah General Legislative Session into law which allocated funds to research the exposures and effects of combustion products and/or methamphetamines among currently active and retired firefighters and police officers (particularly drug enforcement officers). The Rocky Mountain Center for Occupational & Environmental Health (RMCOEH), located in the University of Utah has been authorized to conduct this research study. Currently, relatively little is known about the hazards that these municipal employees face when exposed to these chemicals. One of the primary goals of this study is to clarify any relationship between methamphetamine exposure and health. If this study demonstrates a strong correlation between methamphetamine exposure and studied illnesses, results may support a presumption of eligibility for worker compensation coverage for these exposures.

This study will include 8000 participants, 4000 police officers and 4000 firefighters, selected based upon their employment as full time police officers or firefighters working in Utah. All full time eligible police officers and firefighters who were employed for a year or more between 1980 and now in any municipality operating in the state of Utah will be approached for enrollment. We will also be working with the Utah Cancer Registry to obtain histories of cancer. While the primary goal of this study is to look at the association of on the job exposure to these chemicals with cancer as a primary outcome, we will also be looking into other health-related outcomes. The RMCOEH would like to formally invite «MUNICIPALITY» to participate in this ground breaking research.

We have had some difficulties in attempting to contact the appropriate governmental contacts for many of the municipalities and governmental agencies that would be involved with this study. As such, we are getting short on time available to complete this study. We recently received your name as a potential contact. We are writing to you in hopes that you can direct us to the appropriate personnel who can potentially give us approval, along with providing us the names of officers to contact and invite.

As this is an epidemiologically based study, it is important that we obtain information from as many former and current police officers and firefighters as possible, whether they have had health problems or not, so that we may get the most accurate results possible. We need to know the total number and names of all the full-time officers who worked in «MUNICIPALITY» from 1980 to 2004. This is needed so that we can accurately calculate and report prevalence rates of various diseases that we find and then compare them to other cities, counties, state and national statistics. Therefore it is important to have every officer, regardless if they are active, retired, if they later decide not to participate, or are even deceased (surviving relatives will be contacted), so that we will have an accurate number of potential participants, as well as a count of who was working during the specified time period. With this information, we can then extrapolate to find accurate prevalence rates.

Therefore, we are ultimately requesting that you, or the appropriate personnel, email or send to us (address below) via US mail, or other delivery service, a list of names of all former and current officers who were active in «MUNICIPALITY» during the years 1980 to 2004. After receiving the names, we will mail the potential study participants (or surviving relatives) letters inviting them to participate either via the internet (a web-based questionnaire) or through a telephone interview (we are setting up a toll-free 800 number) to answer questions.

We greatly appreciate and look forward to the participation of «MUNICIPALITY» in this important research project. If you or your designee could contact us to let us know if you plan to participate, it would help in planning. As well, if you have any questions, please feel free to contact Matthew Thiese or Steve Oostema, at the RMCOEH (numbers or email listed below; the study Principal Investigator is Dr. Kurt Hegmann, 801-587-3333, and he will return after a conference on November 20). By investigating these occupational risks it may be possible to reduce or remove those hazards which these brave men and women face.

Sincerely,

Kurt T. Hegmann, MD, MPH

Matthew S. Thiese, MSPH, PhD Candidate
Research Associate
801.587.3322 (office)
801.581-7224 (fax)
matt.thiese@hsc.utah.edu

Steven J. Oostema, MS
Study Coordinator
801.585.0451 (office)
801.581-7224 (fax)
steve.oostema@hsc.utah.edu

Rocky Mountain Center for Occupational and Environmental Health
University of Utah
391 Chipeta Way, Suite C
Salt Lake City, UT 84108

Email to Municipalities

Dear **Municipality** Staff,

On March 17, 2006, Governor Jon Huntsman, Jr. signed 2SHB009 of the 2006 Utah General Legislative Session into law which allocated funds to research the exposures and effects of combustion products and/or methamphetamines among currently active and retired firefighters and police officers (particularly drug enforcement officers). The Rocky Mountain Center for Occupational & Environmental Health, located in the University of Utah has been authorized to conduct this research study. Currently, relatively little is known about the hazards that these municipal employees face when exposed to these chemicals.

This study will include 8000 participants, 4000 police officers and 4000 firefighters, selected based upon their employment as full time police officers or firefighters working in Utah. All full time eligible police officers and firefighters who were employed for a year or more between 1980 and 2001 in any municipality operating in the state of Utah will be approached for enrollment. We will also be working with the Utah Cancer Registry to obtain histories of cancer. While the primary goal of this study is to look at the association of on the job exposure to these chemicals with cancer as a primary outcome, we will also be looking into other health-related outcomes.

The Rocky Mountain Center for Occupational & Environmental Health would like to formally invite **Municipality Fire/Police** department to participate in this ground breaking research. I am writing to you, the staff of **Municipality**, in hopes that you can direct me to the appropriate personnel who can give us approval to contact and invite those firefighters who may be willing to participate in this study. It is important that we obtain information from as many former and current **firefighters/police officers** as possible, whether they have had health problems or not, so that we may get the most accurate results possible.

Thank you for your time, and if you have any questions, please feel free to contact Matthew Thiese or myself at the contact information listed below. By investigating these occupational risks it may be possible to reduce or remove those hazards which these brave men and women face.

Sincerely,

Steven J. Oostema, MS
Study Coordinator
Rocky Mountain Center for Occupational & Environmental Health
University of Utah
801.585.0451 (office)
801.581-7224 (fax)

Matthew S. Thiese, MSPH, PhD Candidate
Research Associate
Rocky Mountain Center for Occupational & Environmental Health
University of Utah
matt.thiese@hsc.utah.edu
801.587.3322 (office)

801.581-7224 (fax)

UTAH GOVERNMENT RECORDS REQUEST FORM

TO: Utah Department of Corrections
(Name of government office holding the records and/or name of agency contact person.)

Address of government office: HR/Department of Corrections
14717 Minuteman Dr. Draper, UT, 84020

Description of records sought (records must be described with reasonable specificity):

____

____

____

- I would like to inspect (view) the records.
- I would like to receive a copy of the records. I understand that I may be responsible for fees associated with copying charges or research charges as permitted by UCA 63G-2-203. I authorize costs of up to $.
- UCA 63G-2-203 (4) encourages agencies to fulfill a records request without charge. Based on UCA 63G-2-203 (4), I am requesting a waiver of copy costs because:
- releasing the record primarily benefits the public rather than a person. Please explain:
  - ____
  - ____
- I am the subject of the record.
- I am the authorized representative of the subject of the record.
- My legal rights are directly affected by the record and I am impoverished.
  - (Please attach information supporting your request for a waiver of the fees.)

- If the requested records are not public, please explain why you believe you are entitled to access.
- I am the subject of the record.
- I am the person who provided the information.
- I am authorized to have access by the subject of the record or by the person who submitted the information. Documentation required by UCA 63G-2-202, is attached.

- Other. Please explain:
  - ____
  - ____

- I am requesting expedited response as permitted by UCA 63G-2-204 (3)(b). (Please attach information that shows your status as a member of the media and a statement that the records are required for a story for broadcast or publication; or other information that demonstrates that you are entitled to expedited response.)

Requester's Name:____

Mailing Address:____

Daytime telephone number:____________________Date:________________________

Signature:____

If records are filed by Social Security Number, please provide that number:__________

Final Attempt to Contact Municipality Letters

Date

Mayor __________________
Address
City, UT 84__

Dear Mayor _____________:

On March 17, 2006, Governor Jon Huntsman, Jr. signed 2SHB009 of the 2006 Utah General Legislative Session into law. This allocated funds to the Utah Labor Commission to research the exposures and effects of combustion products and/or Methamphetamines among firefighters and police officers. The Rocky Mountain Center for Occupational & Environmental Health, located in the University of Utah's Department of Family and Preventive Medicine, has been authorized by the Utah Labor Commission to conduct this research study and present findings in a report to be submitted to the Utah Labor Commission and Legislature by October 15, 2008.

This is our final attempt to contact **Municipality** regarding participation in this research. We are hoping to enroll all eligible police officers and firefighters into the study. All full time eligible police officers and firefighters who were employed for a year or more between 1980 to the present in any municipality operating in the State of Utah are eligible for enrollment. This study has been approved by the University of Utah's Institutional Review Board, which reviews all University research that involves people. All individual's information obtained through the study will be kept strictly confidential.

As Mayor of **Municipality**, we are writing to ask if you, or the appropriate authorized person for **Municipality**, will consider enrollment of your municipality's police department in this study. Please contact us at 801.581.4800 to get information on the enrollment process and any further information regarding this study.

Thank you for your consideration of this final request. Our research will be greatly enhanced by the investment of time from each of Utah's municipalities. If you have questions or need further information, please call Matthew Thiese at 801.587.3322, Steve Oostema at 801.585.0451, or myself. Your help is greatly appreciated.

Sincerely,

Kurt T. Hegmann, MD, MPH
Director, Rocky Mountain Center for Occupational & Environmental Health

Invitation Letter to Participant

Date

Dear (Person's Name)

On March 17, 2006, Governor Jon Huntsman, Jr. signed 2SHB009 of the 2006 Utah General Legislative Session into law which allocated funds to research the exposures and effects of combustion products and/or Methamphetamines among currently active and retired firefighters and police officers. The Rocky Mountain Center for Occupational & Environmental Health, located in the University of Utah has been authorized to conduct this research study. Currently, relatively little is known about the hazards that these municipal employees face when exposed to these chemicals. By investigating these occupational risks it may be possible to reduce or remove those hazards.

This study will include 8000 participants, 4000 police officers and 4000 firefighters, selected based upon their employment as a full time police officers or firefighters working in Utah. All full time eligible police officers and firefighters who were employed for a year or more between 1980 and 2001 in any municipality operating in the state of Utah will be approached for enrollment.

If you are receiving this letter and your spouse, who was a former firefighter or police officer is deceased, please accept our condolences. However, if you would be able to complete some of the information for this study, it would be most helpful to us. Please call Toni Chambers at (801)581-4800 for more information.

If you are a current or former firefighter or police officer, we would like you to participate in this ground breaking research. **It is important that we obtain information from as many former police officers and firefighters as possible, whether they have had health problems or not, so that we may get the most accurate results possible.** Participation would consist of an online consenting process and answering an online questionnaire. The questionnaire consists of questions regarding what municipality you worked for, exposures while on the job, some lifestyle factors and questions regarding your physical and mental health. To participate, we would ask that you please visit our web site, and log in using the following ID and password.

V https://secure.uuhsc.utah.edu/rmcoeh/consent/

ID Number:
Password:

In addition, the Utah cancer registry has asked to be provided with the participant's social security number, because that is the number used in their database for the past 30 years. For security reasons, we would prefer that you call (801)581-4800 to provide your social security number via telephone (or call toll free, 800-444-8638, ext. 14800). We will work diligently to protect that number by not keeping it on computers and will destroy it at the earliest date possible. This study has been approved by the University of Utah's Institutional Review Board. All information obtained through the study will be kept strictly confidential. We ask that you would please respond by June 21, 2008. If you have questions or need further information, please call Matthew Thiese at (801) 587-3322 or me at (801)587-3333. Your help is greatly appreciated.

Sincerely,

Kurt Hegmann

Kurt T. Hegmann, MD, MPH
Center Director

Consent Form

<u>Consent Form</u>
An Exposure Study of Firefighters & Police Officers

<u>BACKGROUND:</u>
You are being invited to take part in a research study. Before you decide to participate it is important for you to understand why the research is being done and what it will involve. Please take the time to read the following information carefully and discuss it with the researchers if you wish. Ask us if there is anything that is not clear or if you would like more information. Take time to decide whether or not you volunteer to take part in this research study.

The purpose of this research is to study the effects of combustion products and/or Methamphetamines that police officers and firefighters are exposed to. Currently, relatively little is known about the hazards that these employees face when exposed to these chemicals. By discovering these hazards it may be possible to reduce or remove those hazards.

<u>STUDY PROCEDURE</u>:
If you agree to participate, you will be asked to fill out a questionnaire. The questionnaire asks demographic questions about yourself, along with questions regarding your general health.

The questionnaire will take up to about 60 minutes. Job exposure data, including the number of fires fought, methamphetamine lab busts, etc. will also be collected from records. Researchers will collect on-site samples and select participants may be asked to wear sampling devices while performing their job duties. Since we are particularly interested in cancer outcomes, we also plan to obtain cancer information from the Utah Cancer Registry. We also plan to obtain any medical and/or physical exam records from the municipality or municipalities for which you worked as a firefighter or police officer.

Thus, the total time of your participation will be approximately 1 hour over the two years. Approximately 30,000 workers will participate in the study.

RISKS:
We cannot absolutely guarantee that the information will remain confidential for the entirety of the study. There is a remote chance that there will be a loss of confidentiality however, we cannot anticipate any situation where this will happen. We will be vigilant (cautious, watchful, careful) to keep your records secure and confidential at all times.

<u>BENEFITS:</u>
We cannot promise any direct benefits to you from your being in the study. However, possible benefits include helping us to make recommendations that may significantly reduce your

exposure and make your job safer. The Utah State Legislature may use the information from this study to suggest a presumption of work-relatedness of some cancers.

ALTERNATIVE PROCEDURES:
You may choose to not participate in this study.

CONFIDENTIALITY:
We will keep all records strictly confidential and private. However, representatives from the University's Institutional Review (Research) Board may inspect and/or copy the records that contain personal health information. Results of the study may be published; however, your name and other identifying information will be kept private. Your employer will not have access to or be given any personal and/or identifying information regarding your participation in this study.

PERSON TO CONTACT:
If you have questions, complaints or concerns about this study, or if you think you may have been injured from being in this study, you can contact Dr. Kurt Hegmann at (801) 587-3333. Dr. Hegmann can be reached at this number Monday through Friday, 8 AM to 5 PM, Excluding holidays. Or you can contact Dr. Eric Wood at (801) 581-7780. Dr. Wood can be reached at this number Monday through Friday, 8 AM to 5 PM, Excluding holidays. Or you can contact Dr. Edward Holmes at (801) 585-3673. Dr. Holmes can be reached at this number Monday through Friday, 8 AM to 5 PM, Excluding holidays. You may contact us toll free at 1-800-444-8638 24 hours a day.

INSTITUTIONAL REVIEW BOARD:
Contact the Institutional Review Board (IRB) if you have questions regarding your rights as a research participant. Also, contact the IRB if you have questions, complaints or concerns which you do not feel you can discuss with the investigator. The University of Utah IRB may be reached by phone at (801) 581-3655 or by e-mail at irb@hsc.utah.edu.

RESEARCH-RELATED INJURY
If you are injured from being in this study, medical care is available to you at the University of Utah, as it is to all sick or injured people. The University of Utah does not have a program to pay you if you are hurt or have other bad results from being in the study. The costs for any treatment or hospital care would be charged to you or your insurance company (if you have insurance), to the study sponsor or other third party (if applicable), to the extent those parties are responsible for paying for medical care you receive. Since this is a research study, some health insurance plans may not pay for the costs.

The University of Utah is a part of the government. If you are injured in this study, and want to sue the University or the doctors, nurses, students, or other people who work for the University, special laws may apply. The Utah Governmental Immunity Act is a law that controls when a person needs to bring a claim against the government, and limits the amount of money a person may recover. See Section 63-30d-101 through 63-30d-904 of the Utah Code.

VOLUNTARY PARTICIPATION:
Participation in the study is strictly voluntary. If you decide not to participate in the study, it will involve no penalty or affect your job in any way. Further, you may withdraw from the study at any time without any penalty and without giving any reason. This will not affect the relationship you have with the investigator, staff, standard of care you receive, or your employer.

UNFORESEEABLE RISKS:
No risks other than the normal risks that accompany your job and lifestyle are foreseeable. There may be risks that we do not anticipate. However, every effort will be made to minimize any risks.

RIGHT OF INVESTIGATOR TO WITHDRAW:
You may withdraw from the study at any time without penalty. Drs. Hegmann, Wood, and Holmes may withdraw you without your approval, though the only remote reason for withdrawal is the sponsor could withdraw the funding.

COSTS TO SUBJECTS AND COMPENSATION:
There are no costs or compensation for your participation, however, it will take roughly one hour to complete the enrollment process.

NEW INFORMATION:
If there is anything that would affect your willingness to participate, we will inform you.

NUMBER OF SUBJECTS:
We expect about 8000 people to participate.

APPROVAL TO USE YOUR PROTECTED HEALTH INFORMATION

Signing this document means you allow us, the researchers in this study, authorized members of the **University's** workforce who need the information to perform their duties (for example: to ensure integrity of the research) and others working with us to use information about your health for this research study. Since cancer is one of the disease outcomes of interest in our study, we may also use cancer information obtained from the Utah Cancer Registry. You can choose whether or not you will participate in this research study. However, in order to participate you have to sign this consent and authorization form.
This is the information we will use:

- Current and past diagnoses (including cancer information) and symptoms
- General health information including blood pressure reading, height and weight, and medical information gathered from medical records, previous physical exams, etc.

The University's Institutional Review Board (the committee that oversees research studying people) will have access to your information for this research project.
If we share your information with anyone outside the University of Utah Health Sciences Center, you will not be identified by name, social security number, address, telephone number, or any other information that would directly identify you, unless required by law.

In records and information disclosed outside of the University of Utah Health Sciences Center, your information will be assigned a random unique code number. We will keep the key to the code in a locked file. We will destroy the key to the code at the end of the research study.
You may cancel this approval to use your health information. **This must be done in writing.** You must either give your cancellation in person to the Principal Investigator or the Principal Investigator's staff, or mail it to Kurt T. Hegmann 391 Chipeta Way, Ste C. Salt Lake City, UT 84108. If you cancel this approval, we will not be able to collect new information about you, and you will be withdrawn from the research study. However, we can continue to use information we have already started to use in our research, as needed to maintain the integrity of the research.
This approval lasts until this study is finished.

CONSENT:

1. I confirm that I have read and understand this consent and authorization document and have had the opportunity to ask questions.

2. I understand that my participation is voluntary and that I am free to withdraw at any time, without giving any reason, without my medical care or legal rights being affected.

3. I understand that sections of any of my medical notes and/or records may be looked at by responsible individuals from the University of Utah or from regulatory authorities where it is relevant to my taking part in this research. I give permission for these individuals to have access to my medical records.

4. I will be given a signed copy of the consent and authorization form to keep.

I agree to participate in this research study and allow you to use and disclose health information about me for this study, as you have explained in this document.

____
Participant's Name

____ ____________
Participant's Signature Date

____
Name of Person Obtaining Authorization and Consent

____ ____________
Signature of Person Obtaining Authorization and Consent Date

Web-based Consent Form

Consent Form
An Exposure Study of Firefighters & Police Officers

BACKGROUND

You are being invited to take part in a research study. Before you decide to participate it is important for you to understand why the research is being done and what it will involve. Please take the time to read the following information carefully and discuss it with the researchers if you wish. Ask us if there is anything that is not clear or if you would like more information. Take time to decide whether or not you volunteer to take part in this research study.

The purpose of this research is to study the effects of combustion products and/or Methamphetamines that police officers and firefighters are exposed to. Currently, relatively little is known about the hazards that these employees face when exposed to thes chemicals. By discovering these hazards it may be possible to reduce or remove those hazards.

STUDY PROCEDURE

If you agree to participate, you will be asked to fill out a questionnaire. The questionnaire asks demographic questions about yourself, along with questions regarding your general health.

The questionnaire will take up to about 60 minutes. Job exposure data, including the number of fires fought, methamphetamine lab busts, etc. will also be collected from records. Researchers will collect on-site samples and select participants may be asked to wear sampling devices while performing their job duties. Since we are particularly interested in cancer outcomes, we also plan to obtain cancer information from the Utah Cancer Registry. We also plan to obtain any medical and/or physical exam records from the municipality or municipalities for which you worked as a firefighter or police officer.

Thus, the total time of your participation will be approximately 1 hour over the two years. Approximately 8000 workers will participate in the study.

RISKS

We cannot absolutely guarantee that the information will remain confidential for the entirety of the study. There is a remote chance that there will be a loss of confidentiality however, we cannot anticipate any situation where this will happen. We will be vigilant (cautious, watchful, careful) to keep your records secure and confidential at all times.

BENEFITS

We cannot promise any direct benefits to you from your being in the study. However, possible benefits include helping us to make recommendations that may significantly reduce your exposure and make your job safer. The Utah State Legislature may use the information from this study to suggest a presumption of work-relatedness of some cancers.

ALTERNATIVE PROCEDURES

You may choose not to participate in this study.

CONFIDENTIALITY

We will keep all records strictly confidential and private. However, representatives from the University's Institutional Review (Research) Board may inspect and/or copy the records that contain personal health information. Results of the study may be published; however, your name and other identifying information will be kept private. Your employer will not have access to or be given any personal and/or identifying information and will be kept private. Your employer will not have access to or be given any personal and/or identifying information regarding your participation in this study.

PERSON TO CONTACT

If you have questions, complaints or concerns about this study, or if you think you may have been injured from being in this study, you can contact Dr. Kurt Hegmann at (801) 587-3333. Dr. Hegmann can be reached at this number Monday through Friday, 8 AM to 5 PM, Excluding holidays. Or you can contact Dr. Eric Wood at (801) 581-7780. Dr. Wood can be reached at this number Monday through Friday, 8 AM to 5 PM, Excluding holidays. Or you can contact Dr. Edward Holmes at (801) 585-3673. Dr. Holmes can be reached at this number Monday through Friday, 8 AM to 5 PM, Excluding holidays. You may contact us toll free at 1-800-444-8638 24 hours a day.

INSTITUTIONAL REVIEW BOARD

Contact the Institutional Review Board (IRB) if you have questions regarding your rights as a research participant. Also, contact the IRB if you have questions, complaints or concerns which you do not feel you can discuss with the investigator. The University of Utah IRB may be reached by phone at (801) 581-3655 or by e-mail at irb@hsc.utah.edu.

RESEARCH-RELATED INJURY

If you are injured from being in this study, medical care is available to you at the University of Utah, as it is to all sick or injured people. The University of Utah does not have a program to pay you if you are hurt or have other bad results from being in the study. The costs for any treatment or hospital care would be charged to you or your insurance company (if you have insurance), to the study sponsor or other third party (if applicable), to the extent those parties are responsible for paying for medical care you receive. Since this is a research study, some health insurance plans may not pay for the costs.

The University of Utah is a part of the government. If you are injured in this study, and want to sue the University or the doctors, nurses, students or other people who work for the University, special laws may apply. The Utah Governmental Immunity Act is a law that controls when a person needs to bring a claim against the government, and limits the amount of money a person may recover. See section 63-30d-101 through 63-30d-904 of the Utah Code.

VOLUNTARY PARTICIPATION

Participation in the study is strictly voluntary. If you decide not to participate in the study, it will involve no penalty or affect your job in any way. Further, you may withdraw from the study at any time without penalty and without giving any reason. This will not affect the relationship you have with the investigator, staff, standard of care you receive, or your employer.

UNFORSEEABLE RISKS

No risks other than the normal risks that accompany your job and lifestyle are foreseeable. There may be risks that we do not anticipate. However, every effort will be made to minimize any risks.

RIGHT OF INVESTIGATOR TO WITHDRAW

You may withdraw from the study at any time without penalty. Drs. Hegmann, Wood, and Holmes may withdraw you without your approval, though the only remote reason for withdrawal is the sponsor could withdraw the funding.

COSTS TO SUBJECTS AND COMPENSATION

There are no costs or compensation for your participation, however, it will take roughly one hour to complete the enrollment process.

NEW INFORMATION

If there is anything that would affect your willingness to participate, we will inform you.

NUMBER OF SUBJECTS

We expect about 30,000 people to participate.

APPROVAL TO USE YOUR PROTECTED HEALTH INFORMATION

Signing this document means you allow us, the researchers in this study, authorized members of the **University's** workforce who need the information to perform their duties (for example: to ensure integrity of the research) and others working with us to use information about your health for this rsearch study. Since cancer is one of the disease outcomes of interest in our study, we may also use cancer information obtained from the Utah Cancer Registry. You can choose whether or not you will participate in this research study. However, in order to participate you have to sign this consent and authorization form.

This is the information we will use:

- Current and past diagnoses (including cancer information) and symptoms
- General health information including blood pressure reading, height and weight, and medical information gathered from medical records, previous physical exams, etc.

The university's Institutional Review Board (the committee that oversees research studying people) will have access to your information for this research project.

If we share your information with anyone outside the University of Utah Health Sciences Center, you will not be identified by name, social security number, address, telephone number, or any other information that would directly identify you, unless required by law.

In records and information disclosed outside of the University of Utah Health Sciences Center, your information will be assigned a random unique code number. We will keep the key to the code in a locked file. We will destroy the key to the code at the end of the research study.

You may cancel this approval to use your health information. **This must be done in writing.** You must either give your cancellation in person to the Principal Investigator or the Principal Investigator's staff, or mail it to Kurt T. Hegmann 391 Chipeta Way, Ste C., Salt Lake City, UT 84108. If you cancel this approval, we will not be able to collect new information about you, and you will be withdrawn from the research study. However, we can continue to use information we have already started to use in our research, as needed to maintain the integrity of the research.

The approval lasts until this study is finished.

CONSENT

1. I confirm that I have read and understand this consent and authorization document and have had the opportunity to ask questions.
2. I understand that my participation is voluntary and that I am free to withdraw at any time, without giving any reason, without my medical care or legal rights being affected.
3. I understand that sections of any of my medical notes and/or records may be looked at by responsible individuals from the University of Utah or from regulatory authorities where it is relevant to my taking part in this research. I give permission for these individuals to have access to my medical records.
4. I may print out a copy of this consent form showing that I have checked a box agreeing to participate in this study, and have submitted this consent form electronically to the researchers in charge of this study.

* ☐ (Check this box) **By submitting this authorization form electronically I agree to participate in this research study and allow you to use and disclose health information about me for this study, as you have explained in this document.**

Submit

Firefighter Questionnaire

An Epidemiologic Study
of the Firefighters:
Baseline Questionnaire

Directions:

Please answer each question by pointing the arrow with the mouse and clicking with you index finger to either mark “yes” or “no” or to fill in a blank. If you need help or have any questions please ask one of our research assistants. We’re happy to help!

Subject ID # ______________________

Date: ___________________________

An Epidemiologic Study of the Firefighters:

1. Department/City: _______________________________
2. Precinct/Station: ________________________________
3. Job Title: ____________________________________
4. Age _____ years
5. Gender: ____Male ____Female
6. What year did you begin your firefighting duties? ___________
7. Have you stopped working as a full time firefighter? Yes / No
8. If "Yes," Did you (check one):
   __ Retire (Go to question 9)
   __ Quit before retiring (Go to question 12)
   __ Moved to part-time firefighter status (Go to question 15)
9. If "Retire": What year did you retire from being a full time firefighter? (Select Year)
10. Did you do any other full time work after retiring? Yes / No (If "Yes" go to question 11. If "No" go to question 16)
11. If "Yes" what full time job(s) did you have? List in chronological order from first job, after retiring, to the present.

Full time job	Year Started	Year Quit

Go to Question 16.

12. If "Quit": What year did you quit being a full time firefighter? (Select Year)
13. Did you do any other full time work after quitting? Yes / No (If "Yes" go to question 14. If "No" go to question 16)

14. If "Yes" what full time job(s) did you have? List in chronological order from first job, after quitting full time firefighting, to the present.

Full time job	Year Started	Year Quit

Go to Question 16.

15. (If Moved to part-time firefighter status): What year did you move to part-time firefighter status?
    (Select Year)

16. Were you ever a volunteer firefighter? ______ Yes ______ No
    If "Yes," for how long? _____ years ______ months

17. How long have/did you work for your current/last department? _____ years ______ months

18. Have you worked for another department? ______ Yes ______ No
    a. If "Yes" how many other departments did you work for? _____
    b. In reverse chronological order, how long did you work for each department?
        Dept. Name __________________________ _____ years ______ months
        Dept. Name __________________________ _____ years ______ months
        Dept. Name __________________________ _____ years ______ months
        Dept. Name __________________________ _____ years ______ months
        Dept. Name __________________________ _____ years ______ months

19. On average, how many fire calls, that were **<u>not</u>** structural do/did you participate in each month?
    _____ calls

20. On a typical **non-structural** burn, approximately how much time did you spend at the burn site?
    ______Hours _______ Mins.

21. Have you performed Hazmat duties? ______Yes ______No
    a. If yes, Have you ever had any unprotected exposures? ______ Yes ______ No
    b. Have you ever had symptoms from potential Hazmat chemical exposures? ______ Yes ______No

Describe:
____

The following questions specifically concern structural fires.

22. On average, how many structural fire calls do/did you participate in each month?
_____ calls

23. On a typical **structural** burn, approximately how much time did you spend at the burn site?
______Hours _______ Mins.

24. When participating in a structural fire call, did you ever enter the burning building? ___ Yes ___ No

 a. If "Yes," how often did you go into the burning structure?
 __ Usually (more than 75% of the calls)
 __ Often (51-75% of the calls)
 __ Sometimes (26-50% of the calls)
 __ Rarely (0-25% of the calls)

 b. Approximately how much time did you spend in the actual burning structure?
 ______Hours _______ Mins.

25. Did you ever enter a structural fire without "going on air" or "putting your regulator on?"
___ Yes ___ No

 a. If "Yes," approximately how many times? ________

26. In a typical structural fire do/did you remain "on air" or keep "your regulator on" for more than a few minutes after exiting the structure? ___ Yes ___ No

 a. If "Yes," how long did you typically remain "on air" or keep "your regulator on?"
 __ Until out to the curb
 __ Until the smoke was clear from the area
 __ Until overhaul was needed
 __ Other ____
___

27. **Not including overhaul,** what types of Personal Protective Equipment (PPE) do/did you ever wear when you were fighting a fire?

Type of PPE	Approximate year you began using this equipment	How Often did you wear it	Any comments about wearing this type of PPE
SCBA		__ Usually (more than 75% of the calls) __ Often (51-75% of the calls)	

		__ Sometimes (26-50% of the calls) __ Rarely (0-25% of the calls)	
Hood		__ Usually (more than 75% of the calls) __ Often (51-75% of the calls) __ Sometimes (26-50% of the calls) __ Rarely (0-25% of the calls)	
Turn Outs		__ Usually (more than 75% of the calls) __ Often (51-75% of the calls) __ Sometimes (26-50% of the calls) __ Rarely (0-25% of the calls)	
Helmet		__ Usually (more than 75% of the calls) __ Often (51-75% of the calls) __ Sometimes (26-50% of the calls) __ Rarely (0-25% of the calls)	

Other		__ Usually (more than 75% of the calls) __ Often (51-75% of the calls) __ Sometimes (26-50% of the calls) __ Rarely (0-25% of the calls)	
Other		__ Usually (more than 75% of the calls) __ Often (51-75% of the calls) __ Sometimes (26-50% of the calls) __ Rarely (0-25% of the calls)	

The following questions specifically concern overhaul (cleaning up after a fire, knocking down walls, etc.)

28. After a typical structural burn, do/did you ever participate in overhaul? ___ Yes ___ No
    If "No," Skip to question 32.

29. Approximately how much time do/did you spend doing overhaul after a typical structural burn?
    ______ Hours ______ Minutes

30. While doing overhaul on a typical burn, approximately how often do/did you "go on air?"
    __ Usually (more than 75% of the calls)
    __ Often (51-75% of the calls)
    __ Sometimes (26-50% of the calls)
    __ Rarely (0-25% of the calls)

31. While doing **overhaul** what types of Personal Protective Equipment (PPE) do/did you ever wear?

Type of PPE	Approximate year you began using this equipment	How Often did you wear it	Any comments about wearing this type of PPE
SCBA		__ Usually (more than 75% of the calls) __ Often (51-75% of the calls) __ Sometimes (26-50% of the calls) __ Rarely (0-25% of the calls)	
Hood		__ Usually (more than 75% of the calls) __ Often (51-75% of the calls) __ Sometimes (26-50% of the calls) __ Rarely (0-25% of the calls)	
Turn Outs		__ Usually (more than 75% of the calls) __ Often (51-75% of the calls) __ Sometimes (26-50% of the calls) __ Rarely (0-25% of the calls)	
Helmet		__ Usually (more than 75% of the calls)	

		__ Often (51-75% of the calls) __ Sometimes (26-50% of the calls) __ Rarely (0-25% of the calls)	

Other		__ Usually (more than 75% of the calls) __ Often (51-75% of the calls) __ Sometimes (26-50% of the calls) __ Rarely (0-25% of the calls)	
Other		__ Usually (more than 75% of the calls) __ Often (51-75% of the calls) __ Sometimes (26-50% of the calls) __ Rarely (0-25% of the calls)	

32. Were you ever specifically test fitted for a SCBA? ___ Yes ___ No

33. Do/did you recieve continuing SCBA training? ___ Yes ___ No

    a. If "Yes," how often do you recieve respirator training?
    __ More than one time per year
    __ Once a year
    __ Less than once a year

34. Approximately how many times in your life have you been decontaminated? ________

    a. If >0, what were you decontaminated for? ____
    ____
    ____
    ____

    b. How was decontamination accomplished? ____
    ____
    ____

35. Approximately how often do/did you have a complete medical evaluation (physical) to determine your ability to perform your duties as a firefighter?
    __ Twice a year
    __ Once a year
    __ Once every two years
    __ Once every five years

36. When was the last time you had a complete medical evaluation to determine your medical ability to perform your duties as a firefighter? ___________________________ (Approximate Month/Year)

37. Have you ever been told by a health care professional (medical doctor/chiropractor) that you have any of the following:

    a. Cancer ___ Yes ___ No
    If "Yes," what type(s) of cancer were you diagnosed with?

____

___ Don't Know what type (If don't know, what area of the body ________________)

Approximately when was this diagnosed? __________________(Day/Month/Year)

b. Heart Disease ___ Yes ___ No

Approximately when was this diagnosed? __________________(Day/Month/Year)

c. Chronic Bronchitis ___ Yes ___ No

i. Approximately when was this diagnosed? _________________ ______(Day/Month/Year)

ii. If "Yes," have you had a productive cough for 3 months or more in each of 2 successive years?

___ Yes ___ No

d. Diabetes ___ Yes ___ No

Approximately when was this diagnosed? __________________(Day/Month/Year)

i. If "Yes," with which of the following are you treating the Diabetes?

____ Insulin

____ Pills / Oral Agents

____ Both Insulin and Pills

____ Diet only (no insulin or pills)

f. High Blood Pressure ___ Yes ___ No

g. High cholesterol (Laboratory test result over 200 mg/dL) ___ Yes ___ No

i. Other:_________________________(please specify) ___ Yes ___ No

j. Other:_________________________(please specify) ___ Yes ___ No

k. Other:_________________________(please specify) ___ Yes ___ No

38. Approximately how many times have you had a colonoscopy or sigmoidoscopy? ____

39. On average, how many days per week do you get **at least 30 minutes** of aerobic exercise (i.e. walking, running, biking, swimming, etc.)? 0, 1, 2, 3, 4, 5, 6, or 7

40. Approximately how many days per week do you take at least one aspirin tablet? 0, 1, 2, 3, 4, 5, 6, or 7

41. What is the most you weighed in your life (excluding pregnancy)? _______ lbs.

42. Approximately what was your weight when you were 20 years old? ________ lbs.

43. What is your current weight? _______ lbs.

44. What is your current height? _________ Ft. ________ in.

45. Marital Status:
____ Never married (Single)
____ Currently married
____ Divorced
____ Separated
____ Widowed

46. What is the highest grade in school that you completed?
____ 8th grade or less
____ Some high school
____ High school graduate or GED
____ Some college
____ College graduate (Bachelor's Degree or higher)

47. Have you ever smoked tobacco?
___ Never
___ Yes, currently
___ Yes, in the past
If never, go on to the next number…otherwise
How old were you when you started smoking? _____ *years old*
How old were you when you quit smoking, if you quit?_____ *years old*
On average, how many cigarettes did/do you smoke per day?______

48. Have you ever used chewing/smokeless tobacco?
___ Never
___ Yes, currently
___ Yes, in the past
If never, go on to the next number…otherwise
How old were you when you started using chewing/smokeless tobacco? _____ *years old*
If you quit, how old were you when you quit using chewing/smokeless tobacco?_____ *years old*
On average, how many plugs/pouches did/do you take per day?______

49. Do you ever drink alcohol?
___ Never
___ I used to, but I quit
___ Yes
If "Never," go on to number 51. If "I used to, but I quit" go to 49a. If "Yes," go to 49b.

a. If "I used to, but I quit" then...
i. How old were you when you started drinking? _____ *years old*
ii. How old were you when you quit drinking? _____ *years old*

iii. On average, how much alcohol did you drink in an average week?
(1 drink = 12 oz. beer, 6 oz. wine, or 1 oz. liquor)
_____ 1-2 drinks per week
_____ 3-5 drinks per week
_____ 6-11 drinks per week
_____ 12-17 drinks per week
_____ 18-23 drinks per week
_____ 24-29 drinks per week
_____ 30 or more drinks per week

Go to Question 50.

b. If "Yes," how much alcohol do you drink in an average week?
(1 drink = 12 oz. beer, 6 oz. wine, or 1 oz. liquor)
_____ 1-2 drinks per week
_____ 3-5 drinks per week
_____ 6-11 drinks per week
_____ 12-17 drinks per week
_____ 18-23 drinks per week
_____ 24-29 drinks per week
_____ 30 or more drinks per week

Go to Question 50.

50. In the past, have you ever had a problem with alcohol? ____ Yes ____ No
   a. If yes, approximately how long ago? _________ Years _________ Months

51. My race/ethnicity is (check all that apply):
____ Caucasian or White
____ Hispanic or Latino
____ African American or Black
____ Asian
____ Pacific Islander or Native Hawaiian
____ Native American or Alaskan Native
____ Other (please specify)____________________________________
____ Decline to answer this question.

52. For women only:
Are you currently:
   a. Pregnant? ____ Yes ____ No
      i. If yes, when is your due date ________/_______/_______
      Month Day Year
   b. How many times have you been pregnant? _______
   c. How many children have you given birth to? ______

53. How many brothers do you have (biological)? ________

54. How many sisters do you have (biological)? ________

55. Has anyone in your family ever had cancer? ___ Yes ___ No
    a. If "Yes," whom and what type?

i.	Father	type(s):_______________	__unknown
ii.	Mother	type(s):_______________	__unknown
iii.	Paternal Grandfather	type(s):_______________	__unknown
iv.	Paternal Grandmother	type(s):_______________	__unknown
v.	Maternal Grandfather	type(s):_______________	__unknown
vi.	Maternal Grandmother	type(s):_______________	__unknown
vii.	Brother	type(s):_______________	__unknown
viii.	Sister	type(s):_______________	__unknown
ix.	Daughter	type(s):_______________	__unknown
x.	Son	type(s):_______________	__unknown

56. How often during the past month have you felt uneasy?
____ Never
____ Sometimes
____ Often
____ Always

57. How well do you sleep at night?
____ Very Well
____ Well
____ Fair
____ Poorly
____ Very Poorly

58. On average, about how many total hours of sleep do you get per night (don't count time you are laying awake or trying to fall asleep)?
____ <4 ____ 4.0 ____ 4.5 ____ 5.0 ____ 5.5 ____ 6.0 ____ 6.5
____ 7.0 ____ 7.5 ____ 8.0 ____ 8.5 ____ 9.0 ____ >9

59. How often during the past month have you felt nervous or anxious?
____ Never
____ Sometimes
____ Often
____ Always

If no longer working as a full time firefighter skip the final three questions..

60. How often are you **physically** exhausted after work?
____ Never
____ Sometimes
____ Often
____ Always

61. How often are you **mentally** exhausted after work?
____ Never
____ Sometimes
____ Often
____ Always

62. All in all, how satisfied are you with your job?
____ Very satisfied
____ Somewhat satisfied
____ A little satisfied
____ Not at all satisfied

Thank you for completing the questionnaire.

Police Officer Questionnaire

An Epidemiologic Study
of the Police Officers:
Baseline Questionnaire

Directions:

Please answer each question by pointing the arrow with the mouse and clicking with you index finger to either mark "yes" or "no" or to fill in a blank. If you need help or have any questions please ask one of our research assistants. We're happy to help!

Subject ID # ______________________

Date: ___________________________

An Epidemiologic Study of the Police Officers:

63. Department/City: ________________________________

64. Precinct/Station: ________________________________

65. Job Title: _____________________________________

66. Age _____ years

67. Gender: ____Male ____Female

68. What year did you begin your law enforcement officer duties? ______

69. Have you stopped working as a full time law enforcement officer? Yes / No

70. If "Yes," Did you (check one):
    __ Retire (Go to question 9)
    __ Quit before retiring (Go to question 12)
    __ Moved to part-time law enforcement officer status (Go to question 15)

71. If "Retire": What year did you retire from being a full time law enforcement officer? (Select Year)

72. Did you do any other full time work after retiring? Yes / No (If "Yes" go to question 11. If "No" go to question 16)

73. If "Yes" what full time job(s) did you have? List in chronological order from first job, after retiring, to the present.

Full time job	Year Started	Year Quit

Go to Question 16.

74. If "Quit": What year did you quit being a full time law enforcement officer? (Select Year)

75. Did you do any other full time work after quitting? Yes / No (If "Yes" go to question 14. If "No" go to question 16)

76. If "Yes" what full time job(s) did you have? List in chronological order from first job, after quitting full time law enforcement officer duties, to the present.

Full time job	Year Started	Year Quit

Go to Question 16.

77. (If Moved to part-time law enforcement officer status): What year did you move to part-time law enforcement officer status?
(Select Year)

78. Are you a retired police officer? ______ Yes ______ No
If "Yes," when did you retire? ________________________(approximate month/year)

79. How long have/did you work for your current/last department? _____ years ______ months

80. Have you worked for another department? ______ Yes ______ No
a. If "Yes" how many other departments did you work for? _____
b. In reverse chronological order, how long did you work for each department?
Dept. Name ___________________________ _____ years ______ months
Dept. Name ___________________________ _____ years ______ months
Dept. Name ___________________________ _____ years ______ months
Dept. Name ___________________________ _____ years ______ months
Dept. Name ___________________________ _____ years ______ months

81. Have you ever entered a methamphetamine "lab" or "cooking" facility? _____ Yes _____ No
If yes, how many days have you entered a meth "lab" or "cooking" facility in a typical month?
_____ Days

82. On a typical visit to a methamphetamine lab, approximately how much time did you spend at the site?
______Hours _______ Mins.

83. Have you perform any other Hazmat duties? ______Yes ______No
    a. If yes, describe:
    ____
    b. Have you ever had any unprotected exposures? ______ Yes ______ No
    c. Have you ever had symptoms from potential Hazmat chemical exposures? ______ Yes ______No
    Describe:
    ____

The following questions specifically concern methamphetamine lab busts. (Not including cleanings.)

84. On average, how many meth lab busts do/did you participate in each month?
    _____ calls

85. On a typical methamphetamine lab bust, approximately how much time did you spend at the methamphetamine lab?
    ______Hours _______ Mins.
86. When participating in a meth lab bust, did you ever enter the lab? ___ Yes ___ No

    a. If "Yes," how often did you go into the lab?
    __ Usually (more than 75% of the calls)
    __ Often (51-75% of the calls)
    __ Sometimes (26-50% of the calls)
    __ Rarely (0-25% of the calls)

    b. Approximately how much time did you spend in the actual lab?
    ______Hours _______ Mins.

87. Did you ever enter a lab without "going on air" or "putting your respirator on?"
    ___ Yes ___ No

    a. If "Yes," approximately how many times? ________

88. What types of Personal Protective Equipment (PPE) do/did you ever wear when you were doing a drug bust at a meth lab site?

Type of PPE	Approximate year you began using this equipment	How Often did you wear it	Any comments about wearing this type of PPE
SCBA		__ Usually (more than 75% of the calls) __ Often (51-75% of the calls) __ Sometimes (26-50% of the calls) __ Rarely (0-25% of the calls)	
Half face respirator		__ Usually (more than 75% of the calls)	

		__ Often (51-75% of the calls) __ Sometimes (26-50% of the calls) __ Rarely (0-25% of the calls)	
Gloves		__ Usually (more than 75% of the calls) __ Often (51-75% of the calls) __ Sometimes (26-50% of the calls) __ Rarely (0-25% of the calls)	
Long sleeved shirt and pants		__ Usually (more than 75% of the calls) __ Often (51-75% of the calls) __ Sometimes (26-50% of the calls) __ Rarely (0-25% of the calls)	
Other		__ Usually (more than 75% of the calls) __ Often (51-75% of the calls) __ Sometimes (26-50% of the calls) __ Rarely (0-25% of the calls)	
Other		__ Usually (more than 75% of the calls) __ Often (51-75% of the calls) __ Sometimes (26-50% of the calls) __ Rarely (0-25% of the calls)	

The following questions specifically concern cleaning up after a methamphetamine lab bust.

89. After a typical methamphetamine lab bust, do/did you ever participate in cleanup? ___ Yes ___ No
    If "No," Skip to question 31.

90. Approximately how much time do/did you spend doing cleanup after a typical meth lab bust?
    ______ Hours ______ Minutes

91. While doing typical methamphetamine lab cleanup, approximately how often do/did you use a respirator?
    __ Usually (more than 75% of the calls)
    __ Often (51-75% of the calls)
    __ Sometimes (26-50% of the calls)
    __ Rarely (0-25% of the calls)

92. While doing **overhaul** what types of Personal Protective Equipment (PPE) do/did you ever wear?

Type of PPE	Approximate year you began using this equipment	How Often did you wear it	Any comments about wearing this type of PPE
SCBA		__ Usually (more than 75% of the calls) __ Often (51-75% of the calls)	

		__ Sometimes (26-50% of the calls) __ Rarely (0-25% of the calls)	
Half face respirator		__ Usually (more than 75% of the calls) __ Often (51-75% of the calls) __ Sometimes (26-50% of the calls) __ Rarely (0-25% of the calls)	
Gloves		__ Usually (more than 75% of the calls) __ Often (51-75% of the calls) __ Sometimes (26-50% of the calls) __ Rarely (0-25% of the calls)	
Long sleeved shirt and pants		__ Usually (more than 75% of the calls) __ Often (51-75% of the calls) __ Sometimes (26-50% of the calls) __ Rarely (0-25% of the calls)	
Other		__ Usually (more than 75% of the calls) __ Often (51-75% of the calls) __ Sometimes (26-50% of the calls) __ Rarely (0-25% of the calls)	
Other		__ Usually (more than 75% of the calls) __ Often (51-75% of the calls) __ Sometimes (26-50% of the calls) __ Rarely (0-25% of the calls)	

93. Were you ever specifically test fitted for a SCBA? ___ Yes ___ No

94. Do/did you recieve continuing SCBA training? ___ Yes ___ No

a. If "Yes," how often do you recieve respirator training?
__ More than one time per year
__ Once a year
__ Less than once a year

95. Approximately how many times in your life have you been decontaminated? ________

a. If >0, what were you decontaminated for? ____
____
____
____

b. How was decontamination accomplished? ____
____
____

96. Approximately how often do/did you have a complete medical evaluation (physical) to determine your ability to perform your duties as a police officer?

__ Twice a year
__ Once a year
__ Once every two years
__ Once every five years

97. When was the last time you had a complete medical evaluation to determine your medical ability to perform your duties as a police officer? ______________________________ (Approximate Month/Year)

98. Have you ever been told by a health care professional (medical doctor/chiropractor) that you have any of the following:

a. Cancer ___ Yes ___ No
If "Yes," what type(s) of cancer were you diagnosed with?
____
___ Don't Know what type (If don't know, what area of the body ________________)
Approximately when was this diagnosed? ___________________(Day/Month/Year)

b. Heart Disease ___ Yes ___ No
Approximately when was this diagnosed? ___________________(Day/Month/Year)

c. Chronic Bronchitis ___ Yes ___ No

i. Approximately when was this diagnosed? __________________
______(Day/Month/Year)
ii. If "Yes," have you had a productive cough for 3 months or more in each of 2 successive years?
___ Yes ___ No

d. Diabetes ___ Yes ___ No
Approximately when was this diagnosed? ___________________(Day/Month/Year)

i. If "Yes," with which of the following are you treating the Diabetes?
____ Insulin
____ Pills / Oral Agents
____ Both Insulin and Pills
____ Diet only (no insulin or pills)

f. High Blood Pressure ___ Yes ___ No

g. High cholesterol (Laboratory test result over 200 mg/dL) ___ Yes ___ No

i. Other:___________________________(please specify) ___ Yes ___ No

j. Other:___________________________(please specify) ___ Yes ___ No

k. Other:__________________________(please specify) ___ Yes ___ No

99. Approximately how many times have you had a colonoscopy or sigmoidoscopy? ____

100. On average, how many days per week do you get **at least 30 minutes** of aerobic exercise (i.e. walking, running, biking, swimming, etc.)? 0, 1, 2, 3, 4, 5, 6, or 7

101. Approximately how many days per week do you take at least one aspirin tablet? 0, 1, 2, 3, 4, 5, 6, or 7

102. What is the most you weighed in your life (excluding pregnancy)? _______ lbs.

103. Approximately what was your weight when you were 20 years old? ________ lbs.

104. What is your current weight? _______ lbs.

105. What is your current height? _______ Ft. _________ in.

106. Marital Status:
____ Never married (Single)
____ Currently married
____ Divorced
____ Separated
____ Widowed

107. What is the highest grade in school that you completed?
____ 8th grade or less
____ Some high school
____ High school graduate or GED
____ Some college
____ College graduate (Bachelor's Degree or higher)

108. Have you ever smoked tobacco?

___ Never
___ Yes, currently
___ Yes, in the past

If never, go on to the next number…otherwise

How old were you when you started smoking? _____ *years old*
How old were you when you quit smoking, if you quit?_____ *years old*
On average, how many cigarettes did/do you smoke per day?______

109. Have you ever used chewing/smokeless tobacco?

___ Never
___ Yes, currently
___ Yes, in the past

If never, go on to the next number…otherwise

How old were you when you started using chewing/smokeless tobacco? _____ *years old*
If you quit, how old were you when you quit using chewing/smokeless tobacco?_____ *years old*
On average, how many plugs/pouches did/do you take per day?______

110. Do you ever drink alcohol?

___ Never
___ I used to, but I quit
___ Yes

If "Never," go on to number 50. If "I used to, but I quit" go to 48a. If "Yes," go to 48b.

a. If "I used to, but I quit" then...

i. How old were you when you started drinking? _____ *years old*
ii. How old were you when you quit drinking? _____ *years old*
iii. On average, how much alcohol did you drink in an average week?
(1 drink = 12 oz. beer, 6 oz. wine, or 1 oz. liquor)

_____ 1-2 drinks per week
_____ 3-5 drinks per week
_____ 6-11 drinks per week
_____ 12-17 drinks per week
_____ 18-23 drinks per week
_____ 24-29 drinks per week
_____ 30 or more drinks per week

Go to Question 49.

b. If "Yes," how much alcohol do you drink in an average week?
(1 drink = 12 oz. beer, 6 oz. wine, or 1 oz. liquor)

_____ 1-2 drinks per week
_____ 3-5 drinks per week
_____ 6-11 drinks per week
_____ 12-17 drinks per week
_____ 18-23 drinks per week

_____ 24-29 drinks per week
_____ 30 or more drinks per week

Go to Question 49.

111. In the past, have you ever had a problem with alcohol? ____ Yes ____ No
   a. If yes, approximately how long ago? _________ Years _________ Months

112. My race/ethnicity is (check all that apply):
   ____ Caucasian or White
   ____ Hispanic or Latino
   ____ African American or Black
   ____ Asian
   ____ Pacific Islander or Native Hawaiian
   ____ Native American or Alaskan Native
   ____ Other (please specify)___________________________________
   ____ Decline to answer this question.

113. For women only:
   Are you currently:
   a. Pregnant? ____ Yes ____ No
      i. If yes, when is your due date ________/_______/_______
         Month Day Year
   b. How many times have you been pregnant? _______
   c. How many children have you given birth to? ______

114. How many brothers do you have (biological)? ________

115. How many sisters do you have (biological)? ________

116. Has anyone in your family ever had cancer? ___ Yes ___ No
   a. If "Yes," whom and what type?

i.	Father	type(s):______________	__unknown
ii.	Mother	type(s):______________	__unknown
iii.	Paternal Grandfather	type(s):______________	__unknown
iv.	Paternal Grandmother	type(s):______________	__unknown
v.	Maternal Grandfather	type(s):______________	__unknown
vi.	Maternal Grandmother	type(s):______________	__unknown
vii.	Brother	type(s):______________	__unknown
viii.	Sister	type(s):______________	__unknown
ix.	Daughter	type(s):______________	__unknown
x.	Son	type(s):______________	__unknown

117. How often during the past month have you felt uneasy?
   ____ Never
   ____ Sometimes
   ____ Often
   ____ Always

118. How well do you sleep at night?
____ Very Well
____ Well
____ Fair
____ Poorly
____ Very Poorly

119. On average, about how many total hours of sleep do you get per night (don't count time you are laying awake or trying to fall asleep)?
____ <4 ____ 4.0 ____ 4.5 ____ 5.0 ____ 5.5 ____ 6.0 ____ 6.5
____ 7.0 ____ 7.5 ____ 8.0 ____ 8.5 ____ 9.0 ____ >9

120. How often during the past month have you felt nervous or anxious?
____ Never
____ Sometimes
____ Often
____ Always

If no longer working as a full time officer skip the final three questions..

121. How often are you **physically** exhausted after work?
____ Never
____ Sometimes
____ Often
____ Always

122. How often are you **mentally** exhausted after work?
____ Never
____ Sometimes
____ Often
____ Always

123. All in all, how satisfied are you with your job?
____ Very satisfied
____ Somewhat satisfied
____ A little satisfied
____ Not at all satisfied

Thank you for completing the questionnaire.

Questionnaire for Spouse (Surrogate) of Firefighter

Firefighter Spouse Questionnaire

124. What was the last Department/City your spouse worked for? ________________________________

125. What was the last Precinct/Station your spouse worked for?____________________________

126. What was the last Job Title your spouse held?_____________________________________

127. How old was your spouce when he/she passed away? _____ years

128. Spouse's Gender: ____Male ____Female

129. What year did your spouse begin firefighter duties? (Select Year)

130. Prior to passing away, did your spouse stop working as a full time firefighter? Yes / No

131. If "Yes," Did your spouse (check one):
__ Retire (Go to question 9)
__ Quit before retiring (Go to question 12)
__ Moved to part-time firefighter status (Go to question 14)

132. If "Retire": What year did your spouse retire from being a full time firefighter? (Select Year)

133. Did your spouse do any other full time work after retiring? Yes / No (If "Yes" go to question 11. If "No" go to question 16)

134. If "Yes" what full time job(s) did your spouse have? List in chronological order from first job, after retiring, to when he/she passed away.

Full time job	Year Started	Year Quit

Go to Question 16.

135. If "Quit": What year did your spouse quit being a full time firefighter? (Select Year)

136. Did your spouse do any other full time work after quitting? Yes / No (If “Yes” go to question 14. If “No” go to question 16)

137. If "Yes" what full time job(s) did your spouse have? List in chronological order from first job, after quitting full time firefighter duties, to when he/she passed away.

Full time job	Year Started	Year Quit

Go to Question 16.

138. (If Moved to part-time firefighter status): What year did your spouse move to part-time firefighter status?
(Select Year)

139. Was your spouse ever a volunteer firefighter? _______ Yes _______ No
If "Yes," then go to question 16a. If "No," go to question 17.

16a. For how long was your spouse a volunteer firefighter? ______ years _______ months

140. How long have/did your spouse work for his/her last department? ______ years _______ months

141. Did your spouse work for another department? _______ Yes _______ No _______ Don't know
If "Yes," then go to question 18a. If "No" or "Don't know" go to question 19.

9a. How many other departments did he/she work for? ______

9b. In reverse chronological order, how long did your spouse work for each department?
Dept. Name ______________________________ ______ years _______ months
Dept. Name ______________________________ ______ years _______ months
Dept. Name ______________________________ ______ years _______ months
Dept. Name ______________________________ ______ years _______ months
Dept. Name ______________________________ ______ years _______ months

19. Approximately how often did your spouse have a complete medical evaluation (physical) to determine his/her ability to perform duties as a firefighter?
__ Twice a year
__ Once a year
__ Once every two years
__ Once every five years
__ Don't know

20. Was your spouse ever told by a health care professional (medical doctor/chiropractor) that he/she had any of the following:

a. Cancer ___ Yes ___ No
b. Heart Disease ___ Yes ___ No
c. Chronic Bronchitis ___ Yes ___ No
d. Diabetes ___ Yes ___ No
e. High Blood Pressure ___ Yes ___ No
f. High cholesterol (Laboratory test result over 200 mg/dL) ___ Yes ___ No
g. Other:__________________________(please specify) ___ Yes ___ No
h. Other:__________________________(please specify) ___ Yes ___ No
i. Other:__________________________(please specify) ___ Yes ___ No

If any of answers 20a-d is "Yes," then go to corresponding page for that disease. If answer is "No" for all items 20a-d, go to question 21.

Cancer

20a(i). What type(s) of cancer were you diagnosed with?

(a)______________________

Approximate date of diagnosis ________/____________/____________
Month Day Year

(b)______________________

Approximate date of diagnosis ________/____________/____________
Month Day Year

(c)______________________

Approximate date of diagnosis ________/____________/____________
Month Day Year

___ Check here if you don't know what type of cancer(s) your spouse was diagnosed
with (If don't know, what area of the body was/were it/they located in?

(d)______________________

Approximate date of diagnosis ________/____________/____________
Month Day Year

(e)______________________

Approximate date of diagnosis ________/____________/____________
Month Day Year

(f)______________________

Approximate date of diagnosis ________/____________/____________
Month Day Year

Heart Disease

20b(i). Approximately when was this diagnosed?

__________________________Month

__________________________Date

__________________________Year

Chronic Bronchitis

20c(i). Approximately when was this diagnosed?

__________________________Month

__________________________Date

__________________________Year

20c(ii). Did your spouse have a productive cough for 3 months or more in each of 2 successive years?

___ Yes ___ No ___ Don't know

Diabetes

20d(i). Approximately when was this diagnosed?

__________________________Month

__________________________Date

__________________________Year

20d(ii). With which of the following did your spouse treat his/her Diabetes?

____ Insulin

____ Pills / Oral Agents

____ Both Insulin and Pills

____ Diet only (no insulin or pills)

21. In the last 6 months of your spouse's life, on average, how many days per week do he/she get **at least 30 minutes** of aerobic exercise (i.e. walking, running, biking, swimming, etc.)? 0, 1, 2, 3, 4, 5, 6, or 7

22. In the last 6 months of your spouse's life, approximately how many days per week did he/she take at least one aspirin tablet? 0, 1, 2, 3, 4, 5, 6, or 7

23. What was the most your spouse ever weighed (excluding pregnancy)? _______ lbs. _______ Don't know

24. Approximately what was your spouse's weight when he/she was 20 years old?

________ lbs. _____ Don't know

25. What was your spouse's current weight when he/she passed away? _______ lbs. ______ Don't know

26. What was your spouse's current height when he/she passed away? _________ Ft. _________ in.

27. What is the highest grade in school that your spouse completed?
____ 8th grade or less
____ Some high school
____ High school graduate or GED
____ Some college
____ College graduate (Bachelor's Degree or higher)

28. Did your spouse ever smoke tobacco?
___ Never
___ Yes, he/she was a current smoker at the time of his/her death.
___ Yes, but he/she quit before he/she passed away.
If "Never," then go to question 29. If "Yes, he/she was a current smoker at the time of his/her death" go to question 28a(i). If "Yes, but he/she quit before he/she passed away" then go to 28b(i).

28a(i). How old was your spouse when he/she started smoking? _____ *years old*

28a(ii) On average, how many cigarettes (NOT PACKS) did your spouse smoke per day?______
Go to Question 20.

28b(i). How old was your spouse when he/she started smoking? _____ *years old*

28b(ii). How old was your spouse when he/she quit smoking?_____ *years old*

28b(iii). On average, how many cigarettes (NOT PACKS) did your spouse smoke per day?______

29. Did your spouse ever use chewing / smokeless tobacco?
___ Never
___ Yes, he/she was a current user of smokeless tobacco at the time of his/her death.
___ Yes, but he/she quit before he/she passed away.
If "Never," then go to question 30. If "Yes, he/she was a current user of smokeless tobacco at the time of his/her death" go to question 29a(i). If "Yes, but he/she quit before he/she passed away" then go to 29b(i).

29a(i). How old was your spouse when he/she started using chewing / smokeless tobacco?
_____ *years old*. If you are unsure, please estimate an age.

29a(ii) On average, how many chewing / smokeless tobacco pouches or dips did your spouse use per day? ______ If you are unsure, please estimate an amount.
Go to Question 21.

29b(i). How old was your spouse when he/she started using chewing / smokeless tobacco?
_____ *years old.* If you are unsure, please estimate an age.

29b(ii). How old was your spouse when he/she quit using chewing / smokeless tobacco?
_____ *years old.* If you are unsure, please estimate an age.

29b(iii). On average, how many chewing / smokeless tobacco pouches or dips did your spouse use per day?______ If you are unsure, please estimate an amount.

30. Did your spouse ever drink alcohol?
___ Never.
___ My spouse used to, but quit before he/she passed away.
___ Yes, up until he/she passed away.
If "Never," go on to number 31. If "My spouse used to, but quit before he/she passed away." go to 30a(i). If "Yes, up until he/she passed away," go to 30b(i).

30a(i). How old was your spouse when he/she started drinking? _____ *years old*
If you are unsure, please estimate an age.

30a(ii). How old was your spouse when he/she quit drinking? _____ *years old*
If you are unsure, please estimate an age.

30a(iii). On average, how much alcohol did your spouse drink in an average week?
(1 drink = 12 oz. beer, 6 oz. wine, or 1 oz. liquor) If you are unsure, please estimate an amount.
_____ 1-2 drinks per week
_____ 3-5 drinks per week
_____ 6-11 drinks per week
_____ 12-17 drinks per week
_____ 18-23 drinks per week
_____ 24-29 drinks per week
_____ 30 or more drinks per week
Go to Question 31.

30b(i). On average, how much alcohol did your spouse drink in an average week?
(1 drink = 12 oz. beer, 6 oz. wine, or 1 oz. liquor) If you are unsure, please estimate an amount.
_____ 1-2 drinks per week
_____ 3-5 drinks per week

_____ 6-11 drinks per week
_____ 12-17 drinks per week
_____ 18-23 drinks per week
_____ 24-29 drinks per week
_____ 30 or more drinks per week

31. My spouse's race/ethnicity (check all that apply):
____ Caucasian or White
____ Hispanic or Latino
____ African American or Black
____ Asian
____ Pacific Islander or Native Hawaiian
____ Native American or Alaskan Native
____ Other (please specify)___________________________________
____ Decline to answer this question.

If answer to question 5 is "Female" go to question 32. If answer to question 5 is "Male" go to question 34.

32. How many times was your spouse pregnant? _______

33. How many children did your spouse give birth to? ______

34. How many brothers do you have (biological)? ________

35. How many sisters do you have (biological)? ________

36. Has anyone in your spouse's family ever had cancer? ___ Yes ___ No
If "Yes," go on to question 27a. If "No," go to question 28.

36a. Whom in your spouse's family had cancer and what type of cancer? If you don't know what type, click unknown.

i.	Father	type(s):_______________	__unknown
ii.	Mother	type(s):_______________	__unknown
iii.	Paternal Grandfather	type(s):_______________	__unknown
iv.	Paternal Grandmother	type(s):_______________	__unknown
v.	Maternal Grandfather	type(s):_______________	__unknown
vi.	Maternal Grandmother	type(s):_______________	__unknown
vii.	Brother	type(s):_______________	__unknown
viii.	Sister	type(s):_______________	__unknown
ix.	Daughter	type(s):_______________	__unknown
x.	Son	type(s):_______________	__unknown

37. In the last 6 months of your spouse's life, on average, about how many total hours of sleep did he/she get per night (don't count time laying awake or trying to fall asleep)?

____ <4 ____ 4.0 ____ 4.5 ____ 5.0 ____ 5.5 ____ 6.0 ____ 6.5

____ 7.0 ____ 7.5 ____ 8.0 ____ 8.5 ____ 9.0 ____ >9 ____ Don't know

Thank you for participating.

Questionnaire for Spouse (Surrogate) of Police Officer

Spouse Police Officer Questionnaire

142. What was the last Department/City your spouse worked for? ______________________________

143. What was the last Precinct/Station your spouse worked for?__________________________

144. What was the last Job Title your spouse held?___________________________________

145. How old was your spouce when he/she passed away? _____ years

146. Spouse's Gender: ____Male ____Female

147. What year did your spouse begin law enforcement officer duties? (Select Year)

148. Prior to passing away, did your spouse stop working as a full time law enforcement officer? Yes / No

149. If "Yes," Did your spouse (check one):
__ Retire (Go to question 9)
__ Quit before retiring (Go to question 12)
__ Moved to part-time law enforcement officer status (Go to question 14)

150. If "Retire": What year did your spouse retire from being a full time law enforcement officer? (Select Year)

151. Did your spouse do any other full time work after retiring? Yes / No (If "Yes" go to question 11. If "No" go to question 16)

152. If "Yes" what full time job(s) did your spouse have? List in chronological order from first job, after retiring, to when he/she passed away.

Full time job	Year Started	Year Quit

Go to Question 16.

153. If "Quit": What year did your spouse quit being a full time law enforcement officer? (Select Year)

154. Did your spouse do any other full time work after quitting? Yes / No (If “Yes” go to question 14. If “No” go to question 16)

155. If “Yes” what full time job(s) did your spouse have? List in chronological order from first job, after quitting full time law enforcement officer duties, to when he/she passed away.

Full time job	Year Started	Year Quit

Go to Question 16.

156. (If Moved to part-time law enforcement officer status): What year did your spouse move to part-time law enforcement officer status?
(Select Year)

157. How long have/did your spouse work for his/her current/last department? ______ years ______ months

158. Did your spouse work for another department? ______ Yes ______ No ______ Don’t know
If “Yes,” then go to question 17a. If “No,” go to question 18.

17a. How many other departments did he/she work for? _____

17b. In reverse chronological order, how long did your spouse work for each department?
Dept. Name ______________________________ _____ years ______ months
Dept. Name ______________________________ _____ years ______ months
Dept. Name ______________________________ _____ years ______ months
Dept. Name ______________________________ _____ years ______ months
Dept. Name ______________________________ _____ years ______ months

159. Did your spouse ever enter a methamphetamine “lab” or “cooking” facility? _____ Yes _____ No
If “Yes,” then go to question 18a. If “No,” or “Don’t know” go to question 19. _____ Don’t know

18a. Please estimate to the best of your ability how many days have your spouse enter a meth
“lab” or “cooking” facility in a typical month?
_____ Days

160. Approximately how often did your spouse have a complete medical evaluation (physical) to determine ability to perform his/her duties as a police officer?
__ Twice a year
__ Once a year

__ Once every two years
__ Once every five years
__ Don't know

161. Was your spouse ever told by a health care professional (medical doctor/chiropractor) that he/she had any of the following:

a.	Cancer	___ Yes ___ No
b.	Heart Disease	___ Yes ___ No
c.	Chronic Bronchitis	___ Yes ___ No
d.	Diabetes	___ Yes ___ No
e.	High Blood Pressure	___ Yes ___ No
f.	High cholesterol (Laboratory test result over 200 mg/dL)	___ Yes ___ No
g.	Other:__________________________(please specify)	___ Yes ___ No
h.	Other:__________________________(please specify)	___ Yes ___ No
i.	Other:__________________________(please specify)	___ Yes ___ No

If any of answers 20a-d is "Yes," then go to corresponding page for that disease. If answer is "No" for all items 20a-d, go to question 21.

Cancer

20a(i). What type(s) of cancer were you diagnosed with?

(a)______________________

Approximate date of diagnosis ________/__________/__________
Month Day Year

(b)______________________

Approximate date of diagnosis ________/__________/__________
Month Day Year

(c)______________________

Approximate date of diagnosis ________/__________/__________
Month Day Year

___ Check here if you don't know what type of cancer(s) your spouse was diagnosed
with (If don't know, what area of the body was/were it/they located in?

(d)______________________

Approximate date of diagnosis ________/__________/__________
Month Day Year

(e)______________________

Approximate date of diagnosis ________/__________/__________
Month Day Year

(f)______________________

Approximate date of diagnosis ________/___________/__________
Month Day Year

Heart Disease

20b(i). Approximately when was this diagnosed?
_________________________Month
_________________________Date
_________________________Year

Chronic Bronchitis

20c(i). Approximately when was this diagnosed?
_________________________Month
_________________________Date
_________________________Year

20c(ii). Did your spouse have a productive cough for 3 months or more in each of 2 successive years?
___ Yes ___ No ___ Don't know

Diabetes

20d(i). Approximately when was this diagnosed?
_________________________Month
_________________________Date
_________________________Year

20d(ii). With which of the following did your spouse treat his/her Diabetes?

____ Insulin
____ Pills / Oral Agents
____ Both Insulin and Pills
____ Diet only (no insulin or pills)

162. In the last 6 months of your spouse's life, on average, how many days per week do he/she get **at least 30 minutes** of aerobic exercise (i.e. walking, running, biking, swimming, etc.)? 0, 1, 2, 3, 4, 5, 6, or 7

163. In the last 6 months of your spouse's life, approximately how many days per week did he/she take at least one aspirin tablet? 0, 1, 2, 3, 4, 5, 6, or 7

164. What was the most your spouse ever weighed (excluding pregnancy)? _______ lbs. ________ Don't know

165. Approximately what was your spouse's weight when he/she was 20 years old?

________ lbs. _____ Don't know

166. What was your spouse's current weight when he/she passed away? _______ lbs. ______ Don't know

167. What was your spouse's current height when he/she passed away? ______ Ft. _________ in.

168. What is the highest grade in school that your spouse completed?
____ 8th grade or less
____ Some high school
____ High school graduate or GED
____ Some college
____ College graduate (Bachelor's Degree or higher)

169. Did your spouse ever smoke tobacco?
___ Never
___ Yes, he/she was a current smoker at the time of his/her death.
___ Yes, but he/she quit before he/she passed away.

If "Never," then go to question 29. If "Yes, he/she was a current smoker at the time of his/her death" go to question 28a(i). If "Yes, but he/she quit before he/she passed away" then go to 28b(i).

28a(i). How old was your spouse when he/she started smoking? _____ *years old*

28a(ii) On average, how many cigarettes (NOT PACKS) did your spouse smoke per day?______
Go to Question 20.

28b(i). How old was your spouse when he/she started smoking? _____ *years old*

28b(ii). How old was your spouse when he/she quit smoking?_____ *years old*

28b(iii). On average, how many cigarettes (NOT PACKS) did your spouse smoke per day?______

170. Did your spouse ever use chewing / smokeless tobacco?
___ Never
___ Yes, he/she was a current user of smokeless tobacco at the time of his/her death.
___ Yes, but he/she quit before he/she passed away.

If “Never,” then go to question 30. If “Yes, he/she was a current user of smokeless tobacco at the time of his/her death” go to question 29a(i). If “Yes, but he/she quit before he/she passed away” then go to 29b(i).

29a(i). How old was your spouse when he/she started using chewing / smokeless tobacco?

_____ *years old*. If you are unsure, please estimate an age.

29a(ii) On average, how many chewing / smokeless tobacco pouches or dips did your spouse use per day? ______ If you are unsure, please estimate an amount.

Go to Question 30.

29b(i). How old was your spouse when he/she started using chewing / smokeless tobacco?

_____ *years old.* If you are unsure, please estimate an age.

29b(ii). How old was your spouse when he/she quit using chewing / smokeless tobacco?

_____ *years old.* If you are unsure, please estimate an age.

29b(iii). On average, how many chewing / smokeless tobacco pouches or dips did your spouse use per day?______ If you are unsure, please estimate an amount.

171. Did your spouse ever drink alcohol?

___ Never.
___ My spouse used to, but quit before he/she passed away.
___ Yes, up until he/she passed away.

If “Never,” go on to number 31. If “My spouse used to, but quit before he/she passed away.” go to 30a(i). If “Yes, up until he/she passed away,” go to 30b(i).

30a(i). How old was your spouse when he/she started drinking? _____ *years old*
If you are unsure, please estimate an age.

30a(ii). How old was your spouse when he/she quit drinking? _____ *years old*
If you are unsure, please estimate an age.

30a(iii). On average, how much alcohol did your spouse drink in an average week?
(1 drink = 12 oz. beer, 6 oz. wine, or 1 oz. liquor) If you are unsure, please estimate an amount.

_____ 1-2 drinks per week
_____ 3-5 drinks per week
_____ 6-11 drinks per week
_____ 12-17 drinks per week
_____ 18-23 drinks per week
_____ 24-29 drinks per week
_____ 30 or more drinks per week

Go to Question 31.

30b(i). On average, how much alcohol did your spouse drink in an average week?
(1 drink = 12 oz. beer, 6 oz. wine, or 1 oz. liquor) If you are unsure, please estimate an amount.

_____ 1-2 drinks per week
_____ 3-5 drinks per week
_____ 6-11 drinks per week
_____ 12-17 drinks per week
_____ 18-23 drinks per week
_____ 24-29 drinks per week
_____ 30 or more drinks per week

172. My spouse's race/ethnicity (check all that apply):

____ Caucasian or White
____ Hispanic or Latino
____ African American or Black
____ Asian
____ Pacific Islander or Native Hawaiian
____ Native American or Alaskan Native
____ Other (please specify)___________________________________
____ Decline to answer this question.

If answer to question 5 is "Female" go to question 32. If answer to question 5 is "Male" go to question 34.

173. How many times was your spouse pregnant? _______

174. How many children did your spouse give birth to? ______

175. How many brothers do you have (biological)? ________

176. How many sisters do you have (biological)? ________

177. Has anyone in your spouse's family ever had cancer? ___ Yes ___ No
If "Yes," go on to question 36a. If "No," go to question 37.

36a. Whom in your spouse's family had cancer and what type of cancer? If you don't know what type, click unknown.

i. Father type(s):______________ __unknown
ii. Mother type(s):______________ __unknown

iii.	Paternal Grandfather	type(s):_______________	__unknown
iv.	Paternal Grandmother	type(s):_______________	__unknown
v.	Maternal Grandfather	type(s):_______________	__unknown
vi.	Maternal Grandmother	type(s):_______________	__unknown
vii.	Brother	type(s):_______________	__unknown
viii.	Sister	type(s):_______________	__unknown
ix.	Daughter	type(s):_______________	__unknown
x.	Son	type(s):_______________	__unknown

178. In the last 6 months of your spouse's life, on average, about how many total hours of sleep did he/she get per night (don't count time laying awake or trying to fall asleep)?

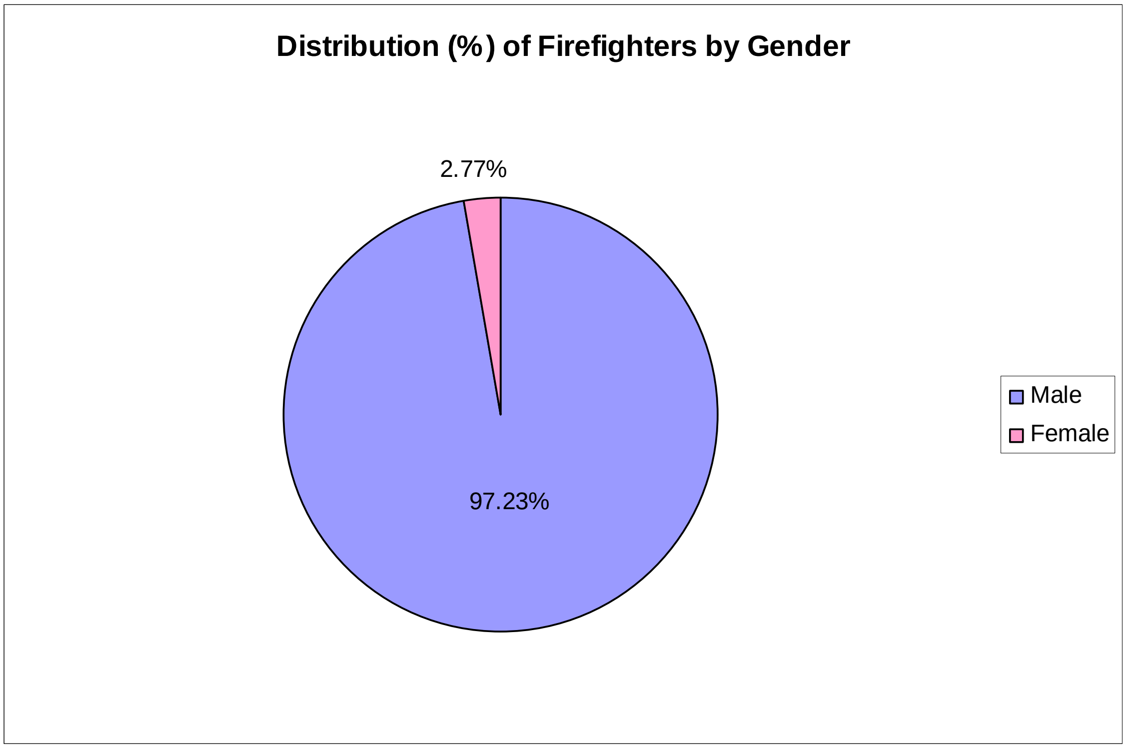
____ <4 ____ 4.0 ____ 4.5 ____ 5.0 ____ 5.5 ____ 6.0 ____ 6.5

____ 7.0 ____ 7.5 ____ 8.0 ____ 8.5 ____ 9.0 ____ >9 ____ Don't know

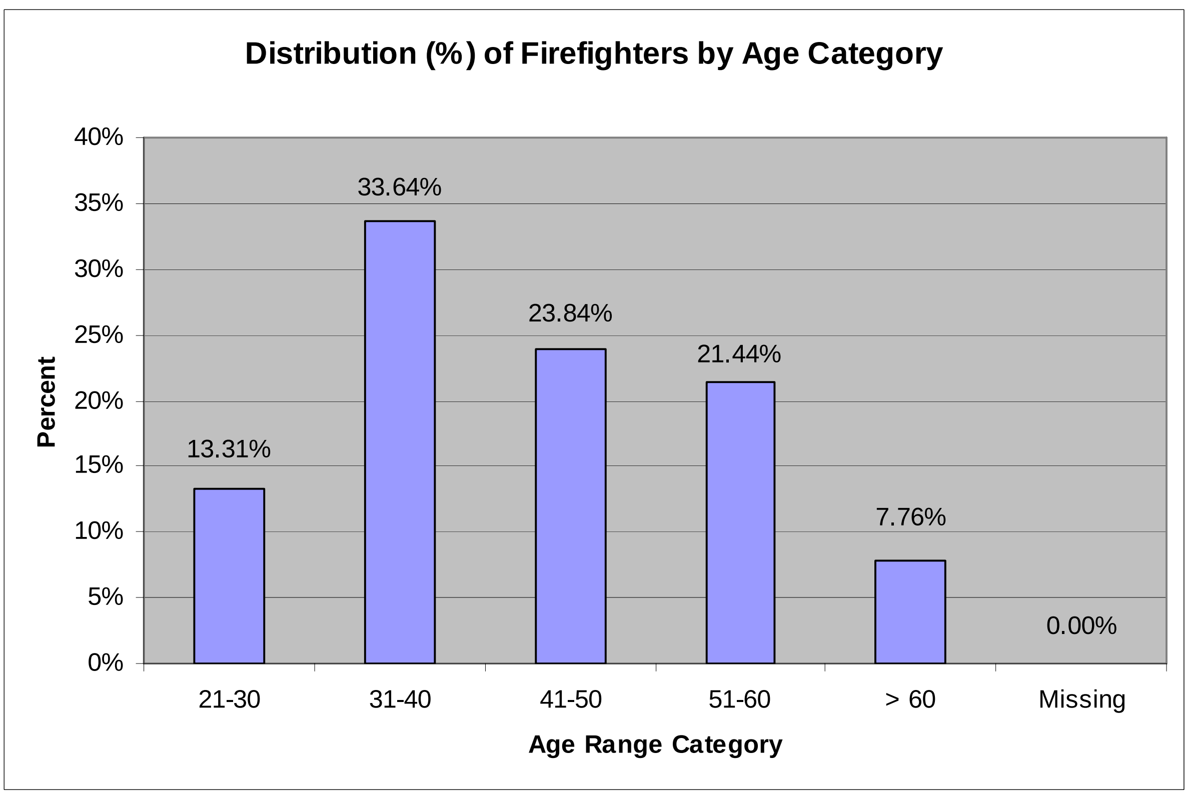
Thank you for participating.

Appendix D

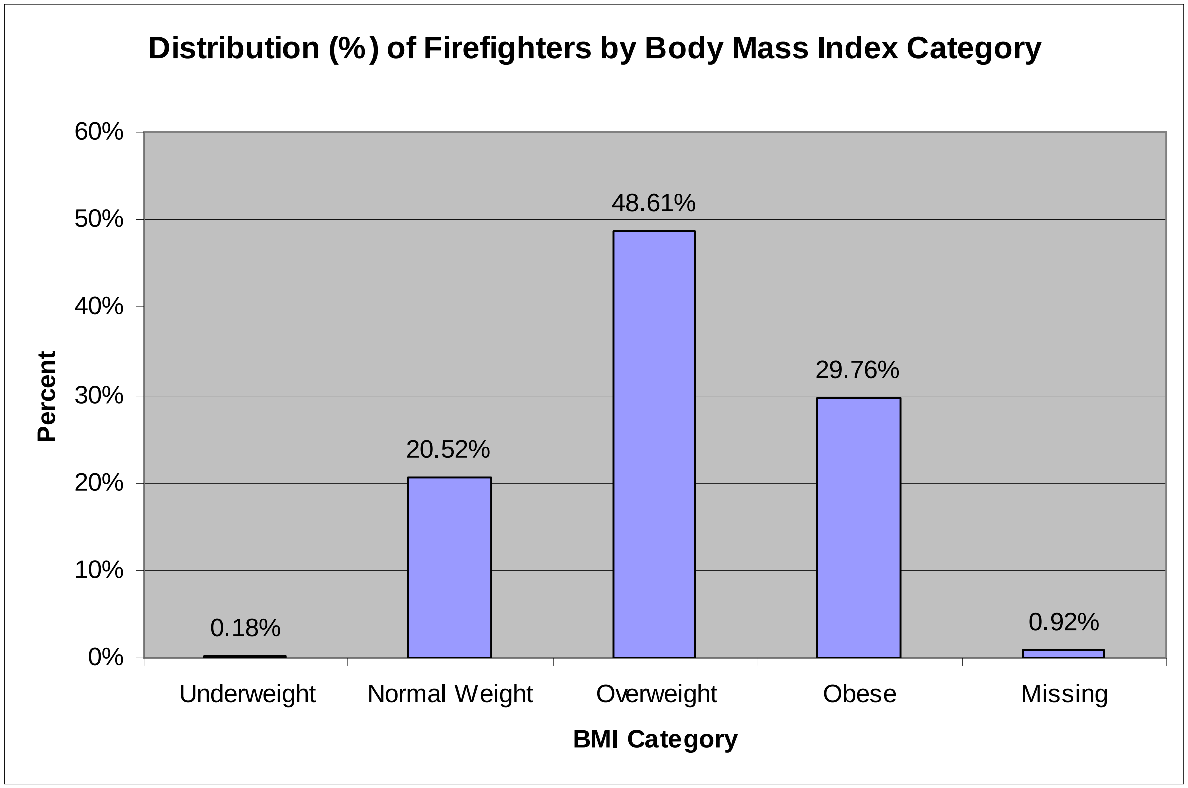
Demographic Data



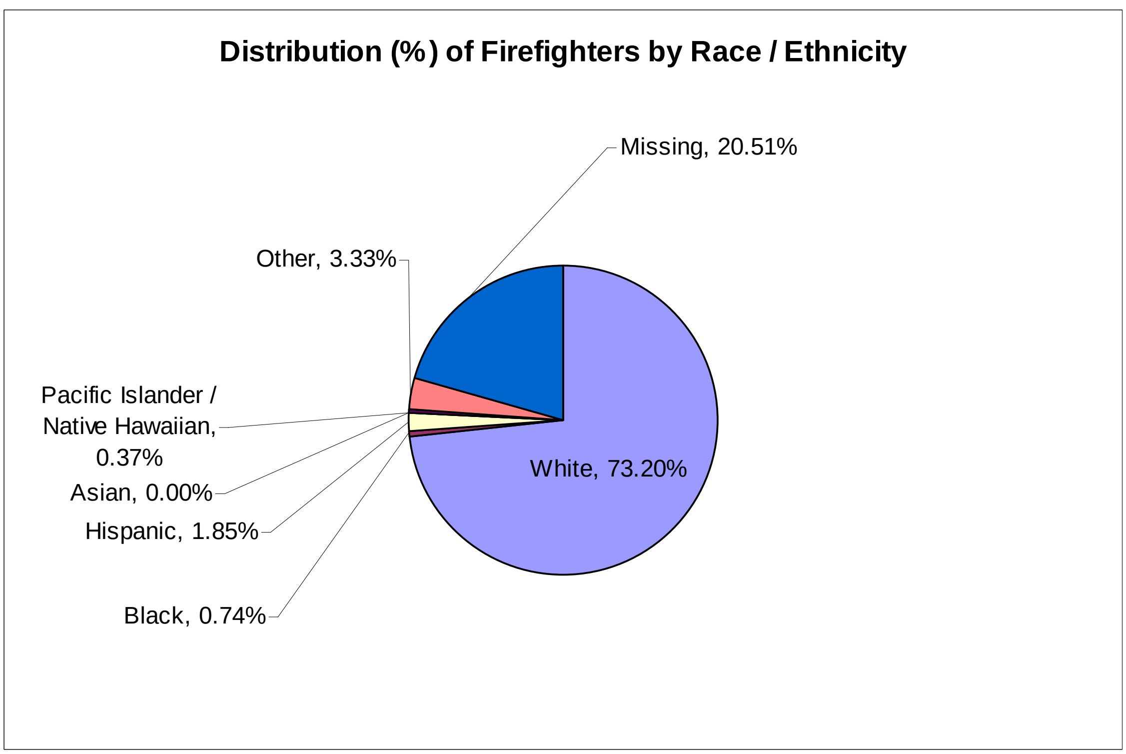
Graph 1. Percent Distribution of Firefighters by Gender



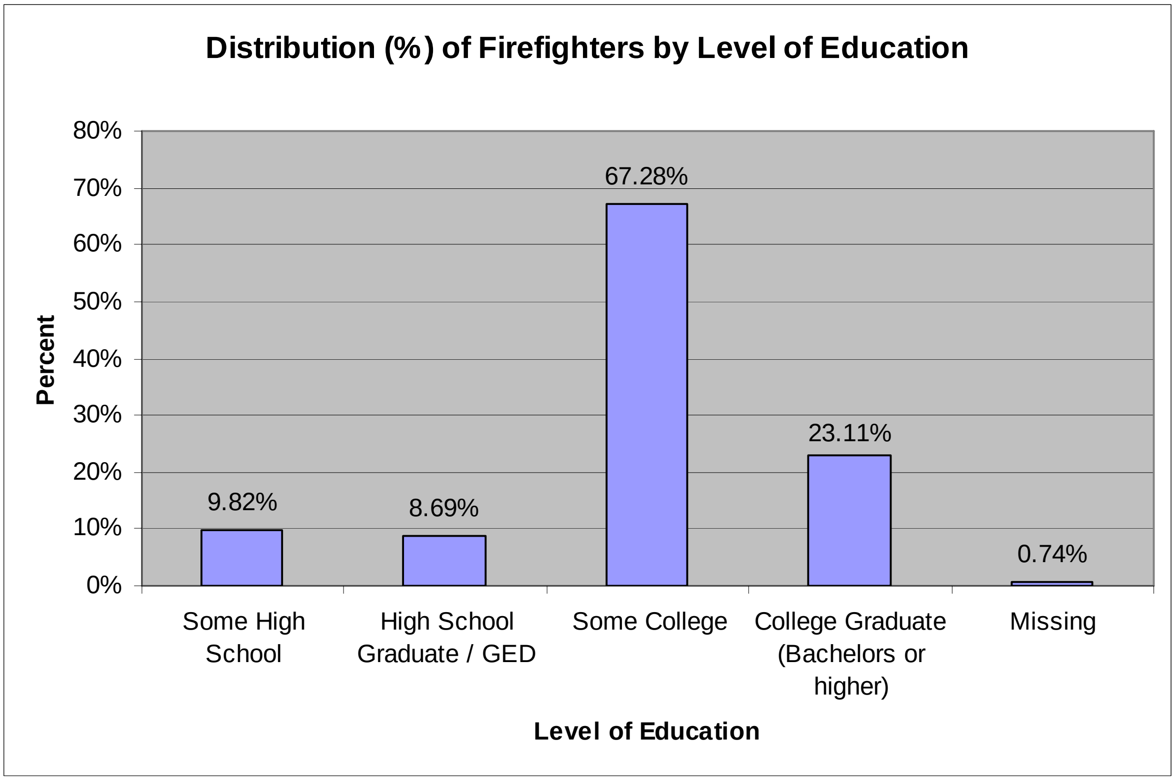
Graph 2. Distribution of Age for Firefighters



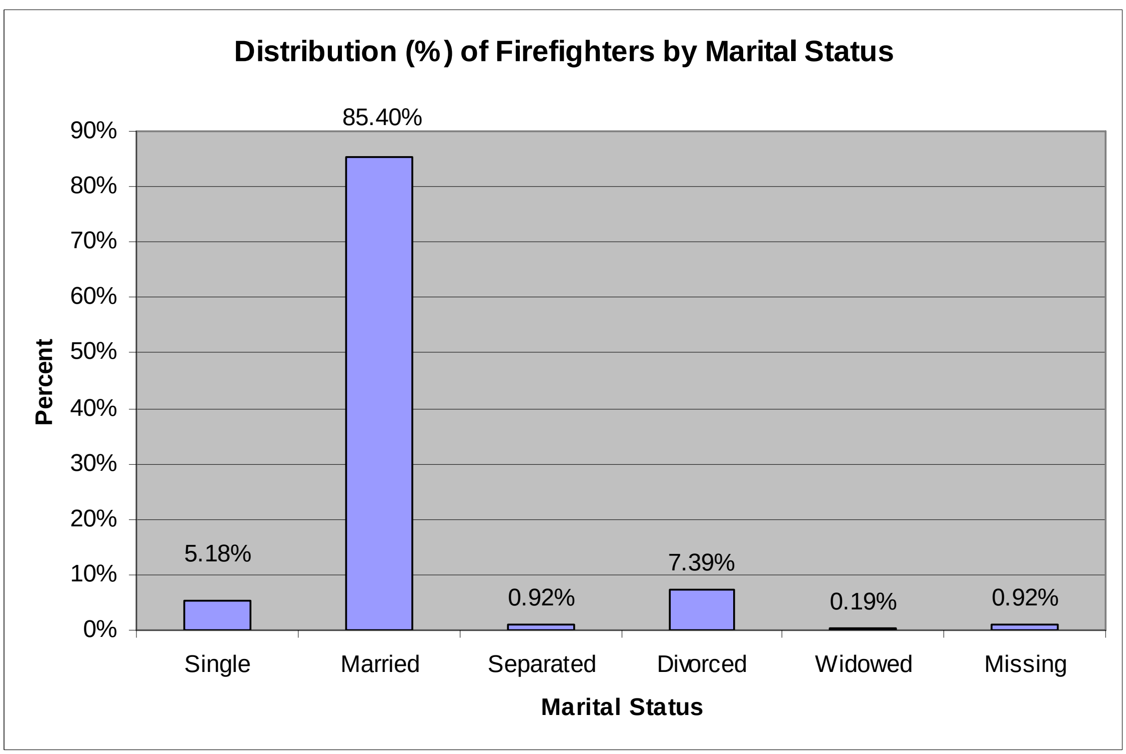
Graph 3. Percent Distribution of BMI for Firefighters



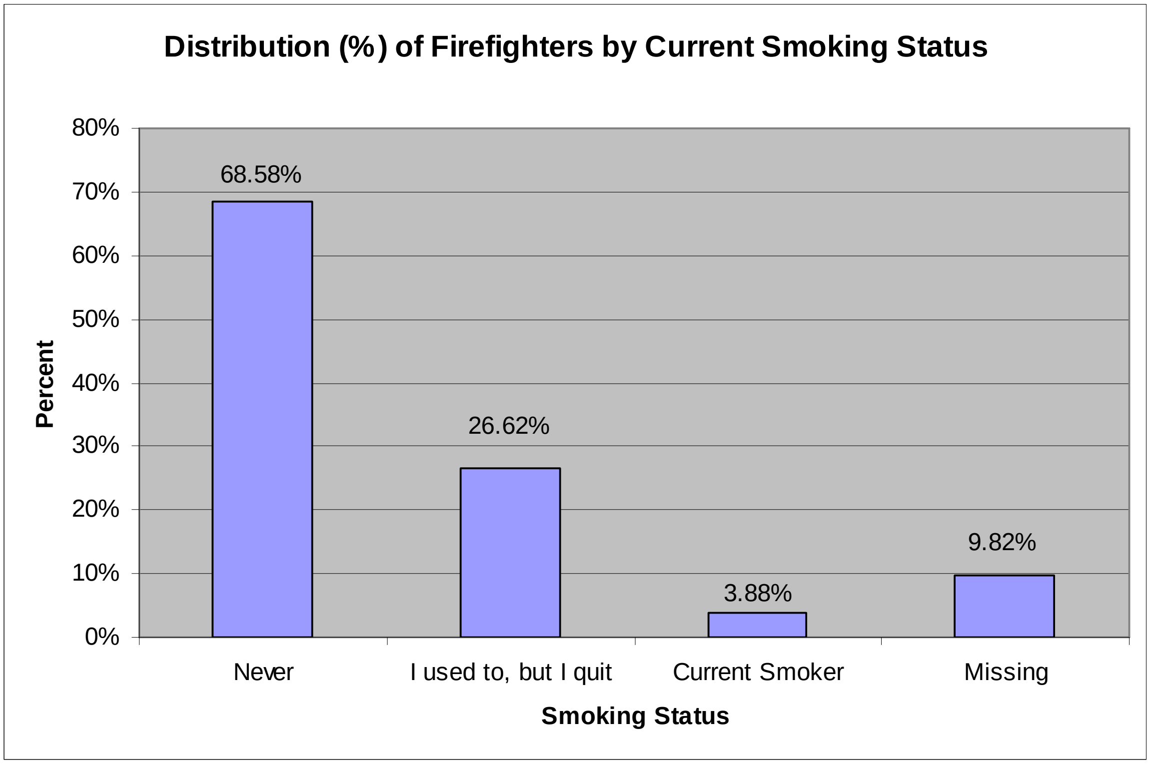
Graph 4. Percent Distribution by Race/Ethnicity for Firefighters



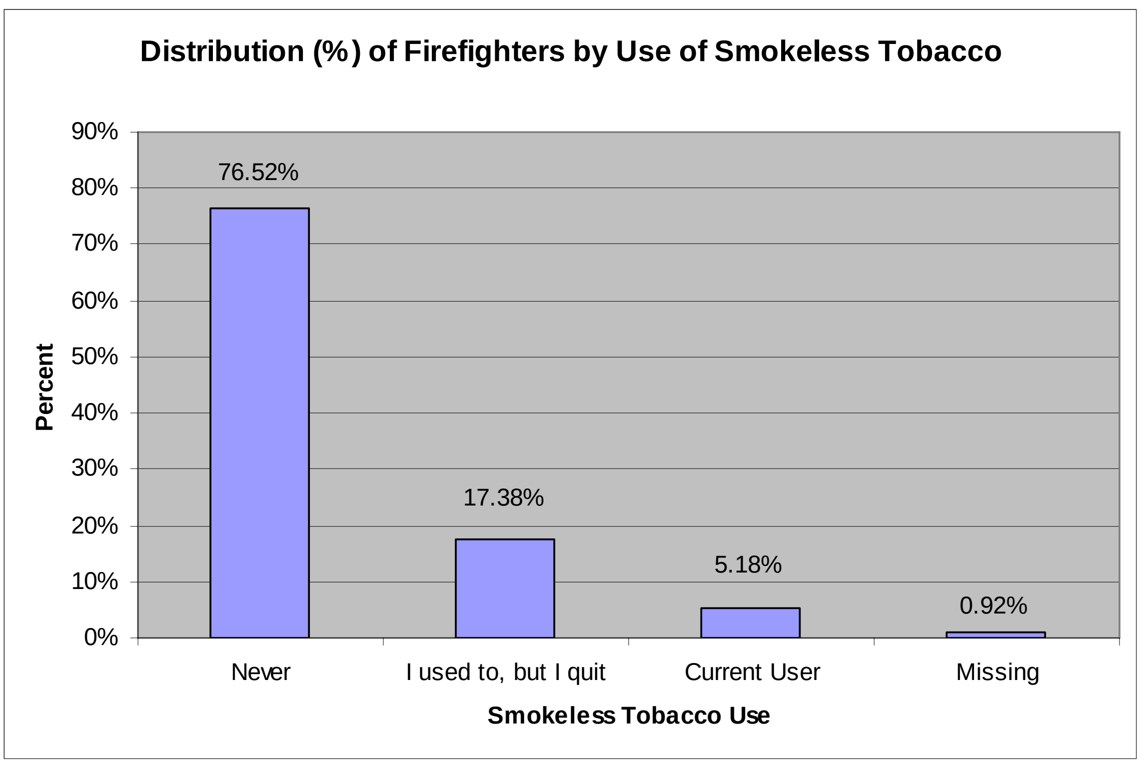
Graph 5. Percent Distribution by Level of Education for Firefighters



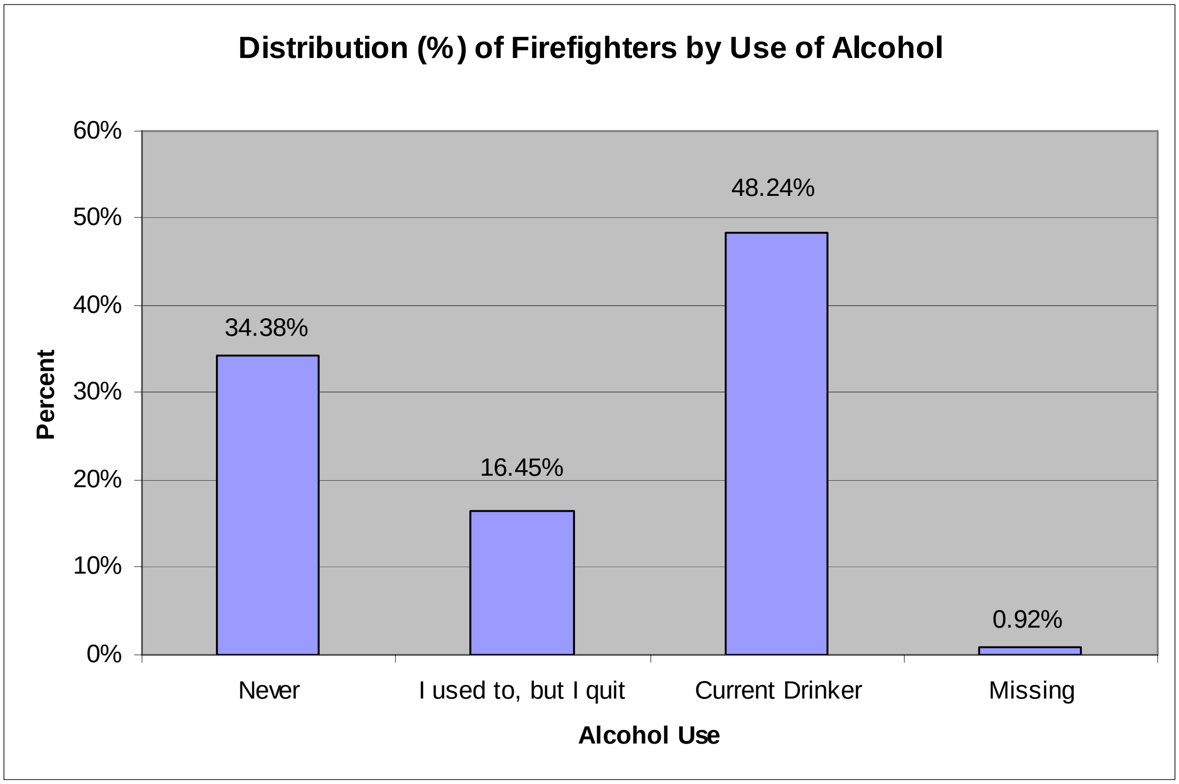
Graph 6. Percent Distribution by Marital Status for Firefighters



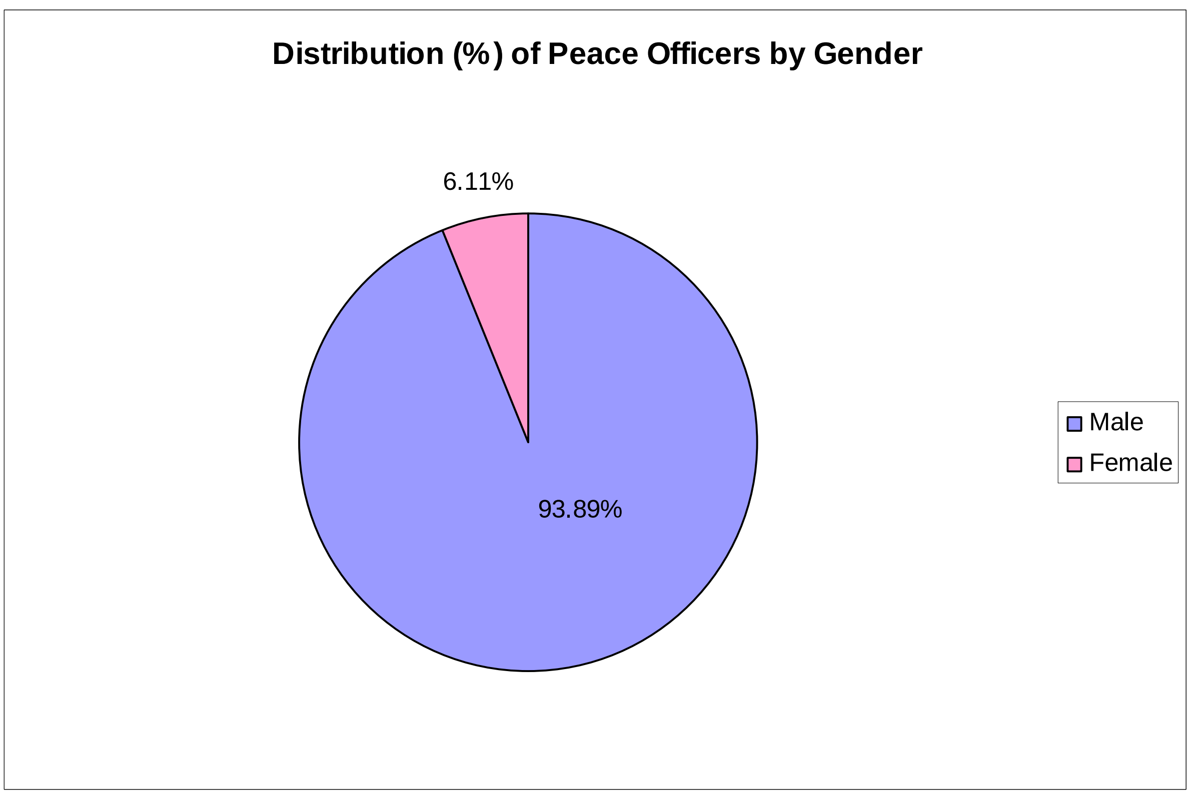
Graph 7. Percent Distribution by Current Smoking Status for Firefighters



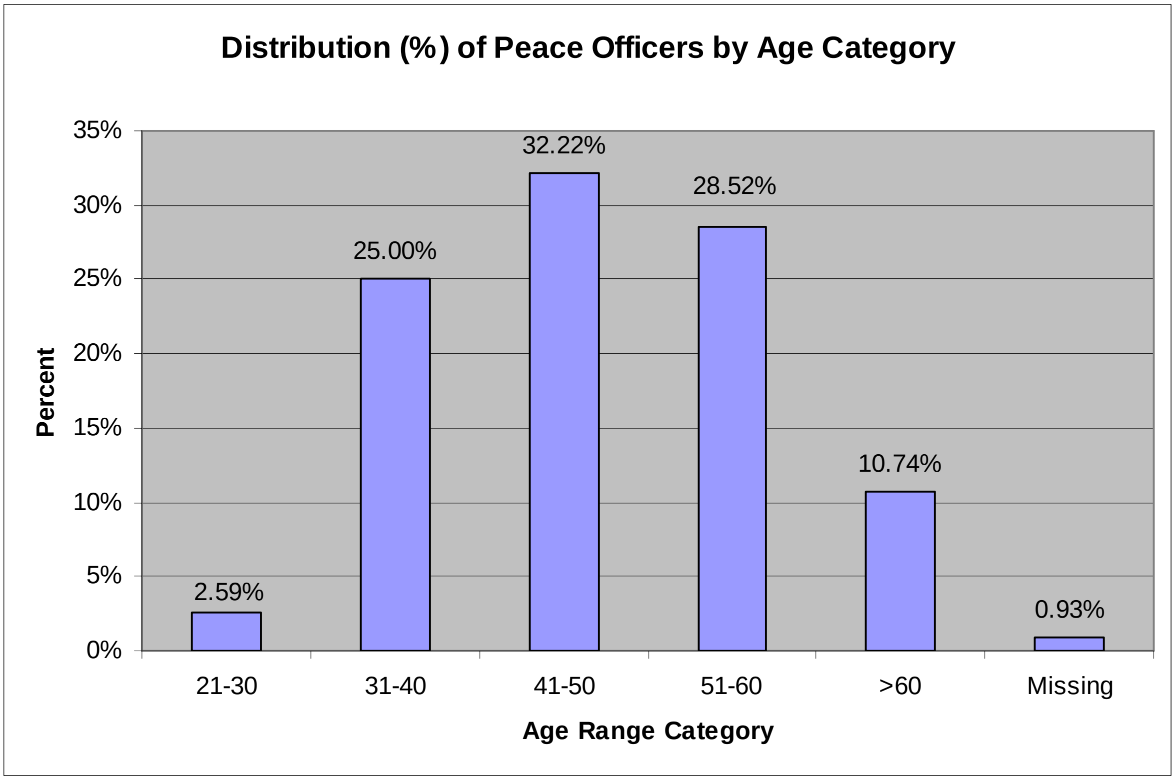
Graph 8. Percent Distribution by Use of Smokeless Tobacco for Firefighters



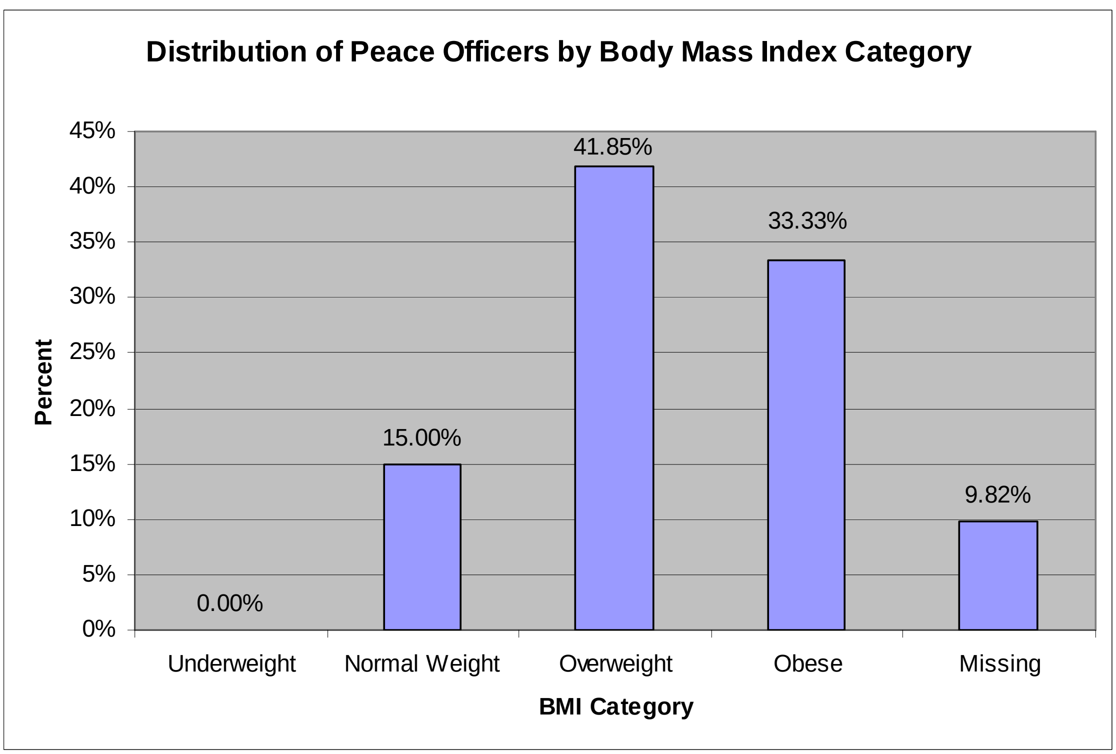
Graph 9. Percent Distribution by Use of Alcohol for Firefighters



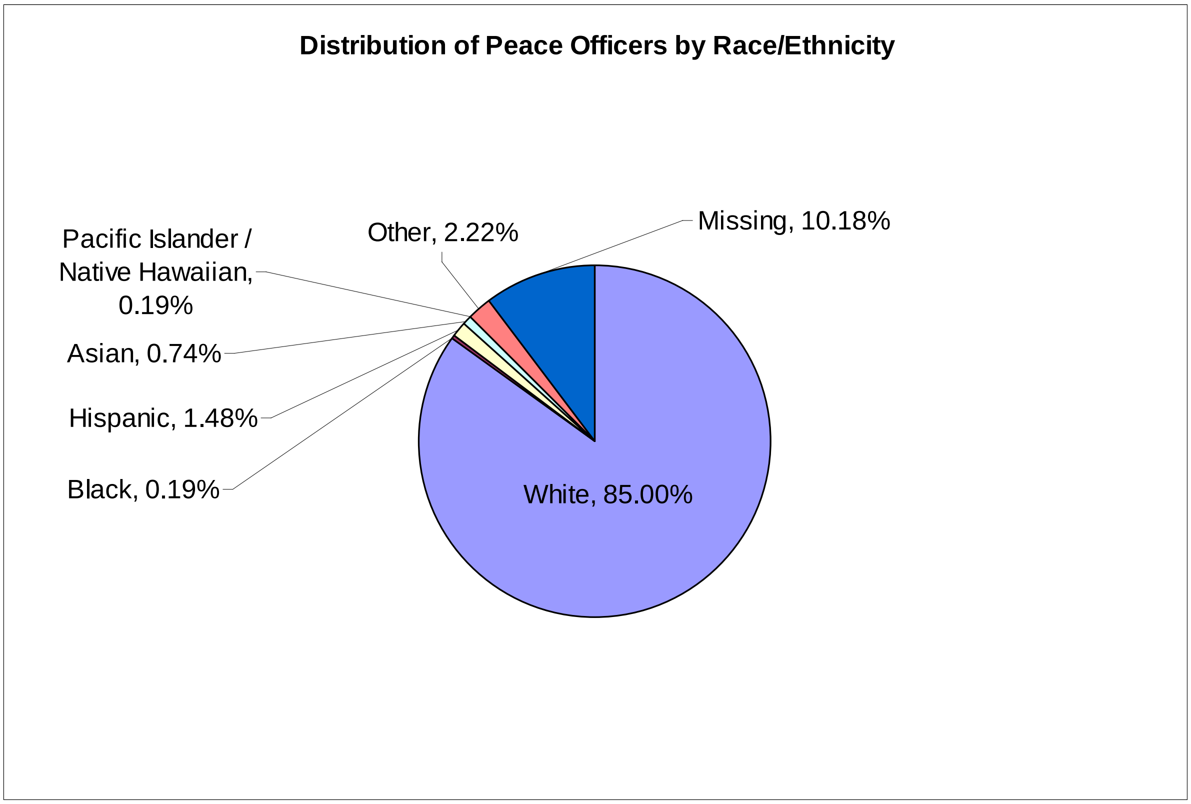
Graph 10. Percent Distribution of Police Officers by Gender



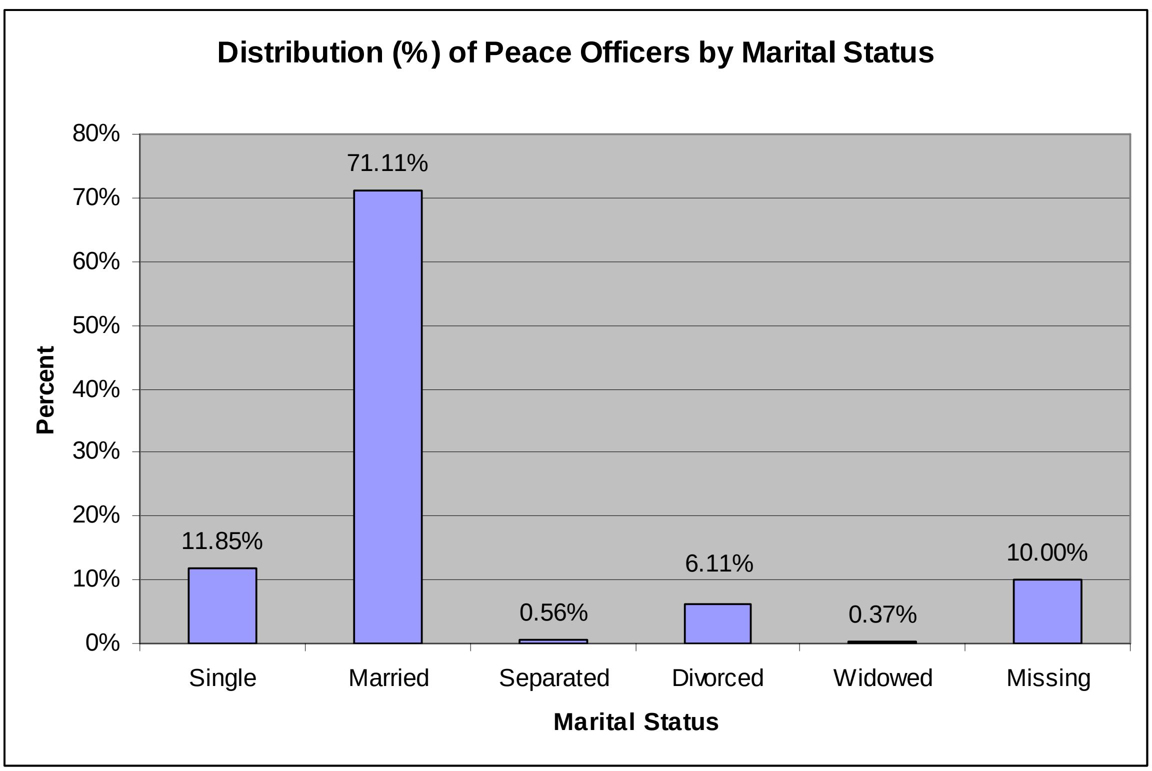
Graph 11. Distribution of Age for Police Officers



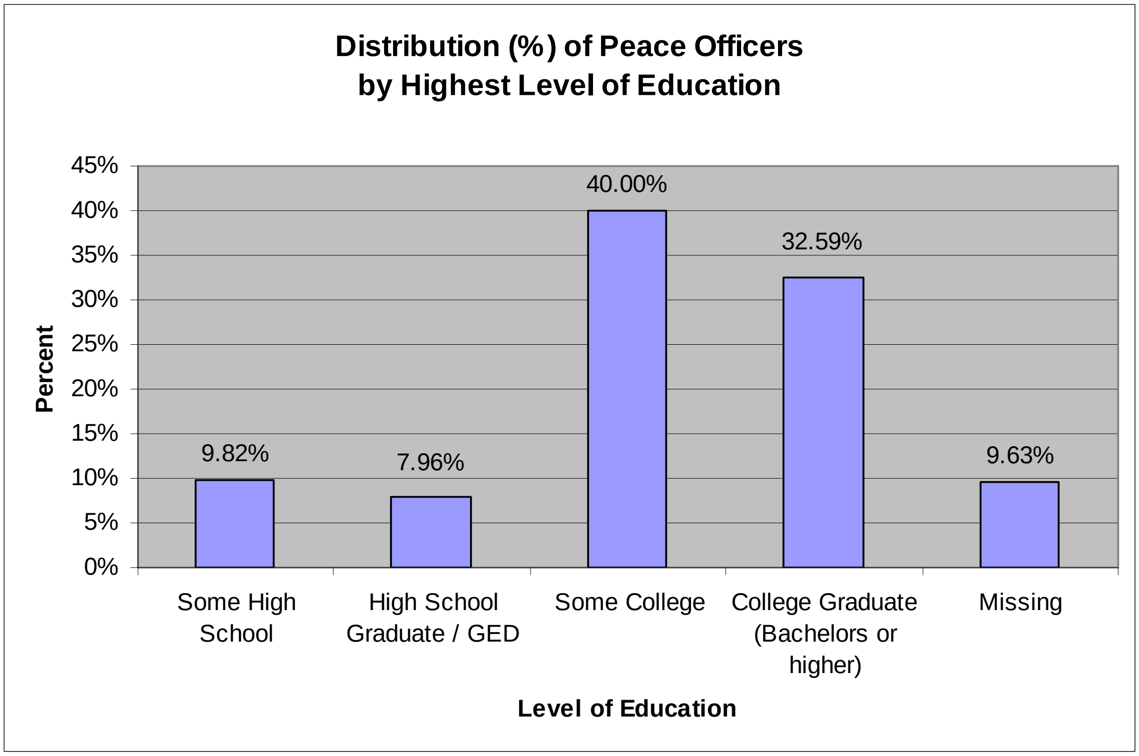
Graph 12. Percent Distribution of Police Officers by BMI Category



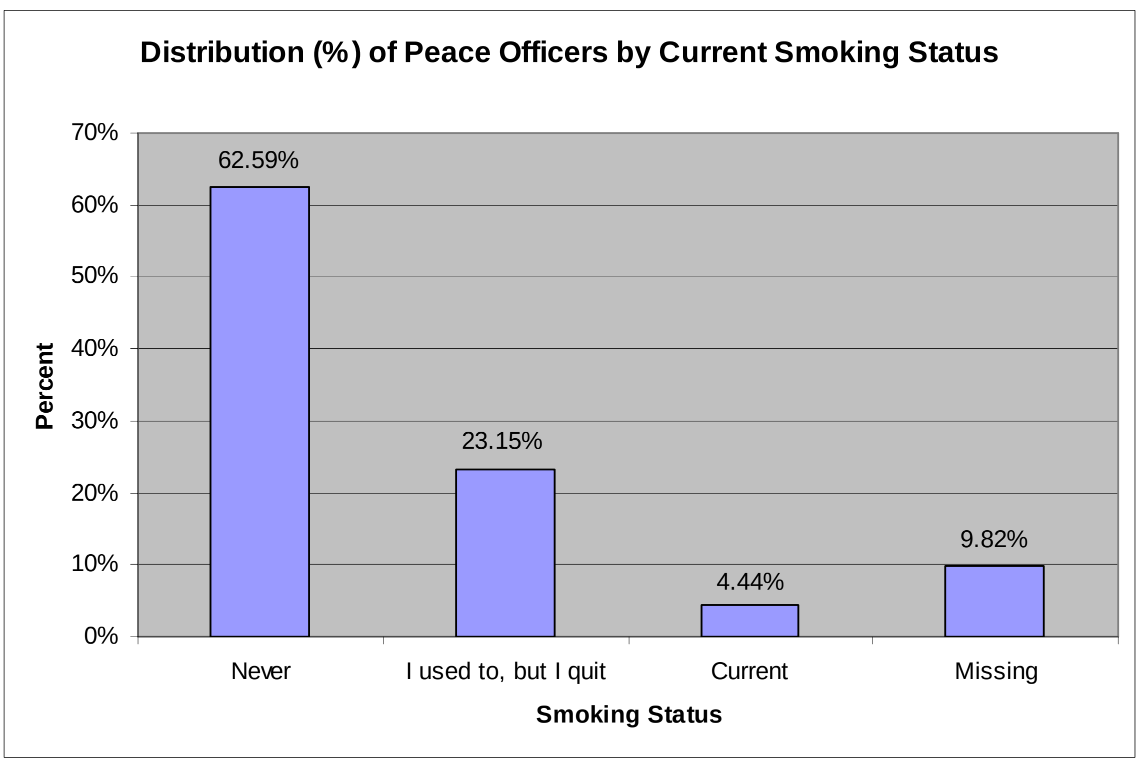
Graph 13. Percent Distribution by Race/Ethnicity for Police Officers



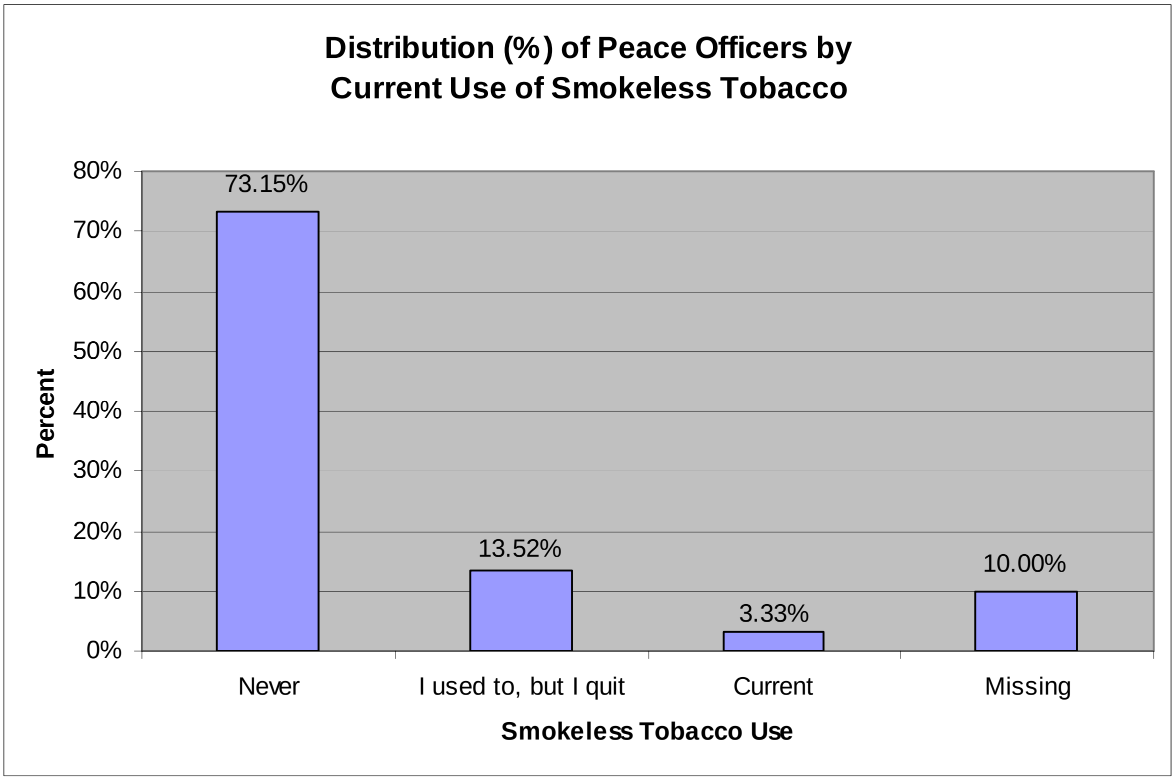
Graph 14. Percent Distribution by Marital Status for Police Officers



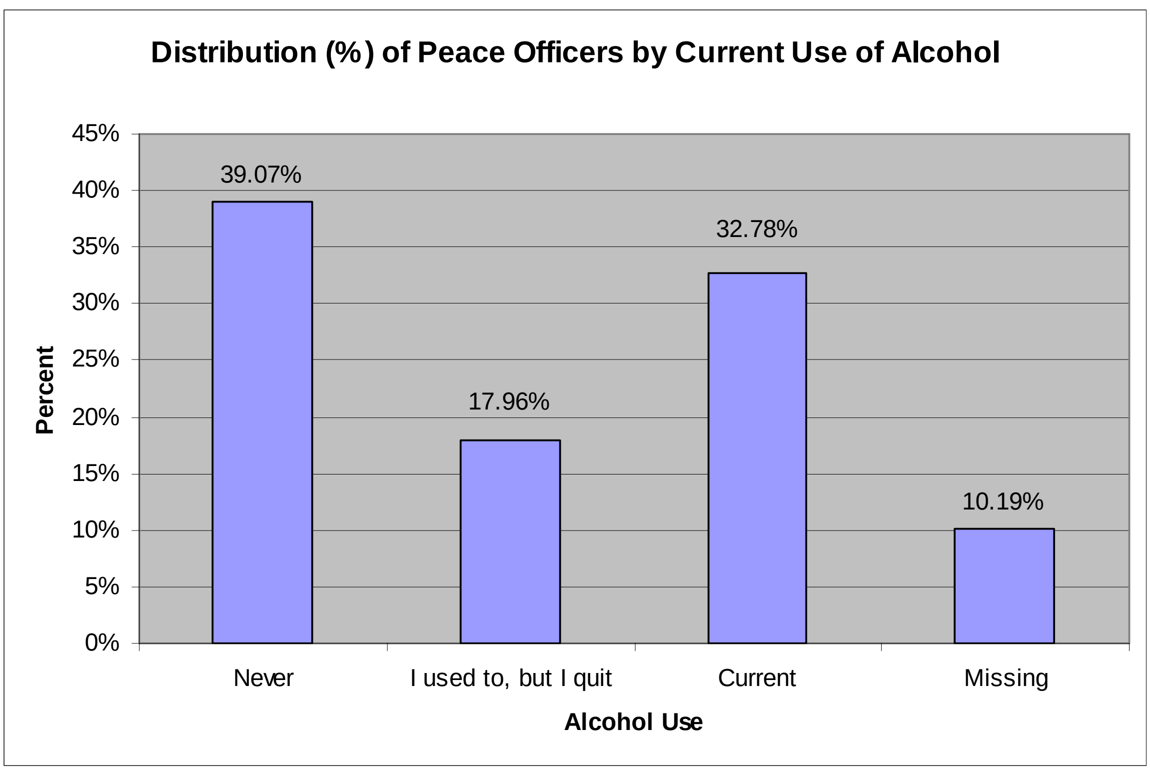
Graph 15. Percent Distribution by Level of Education for Police Officers



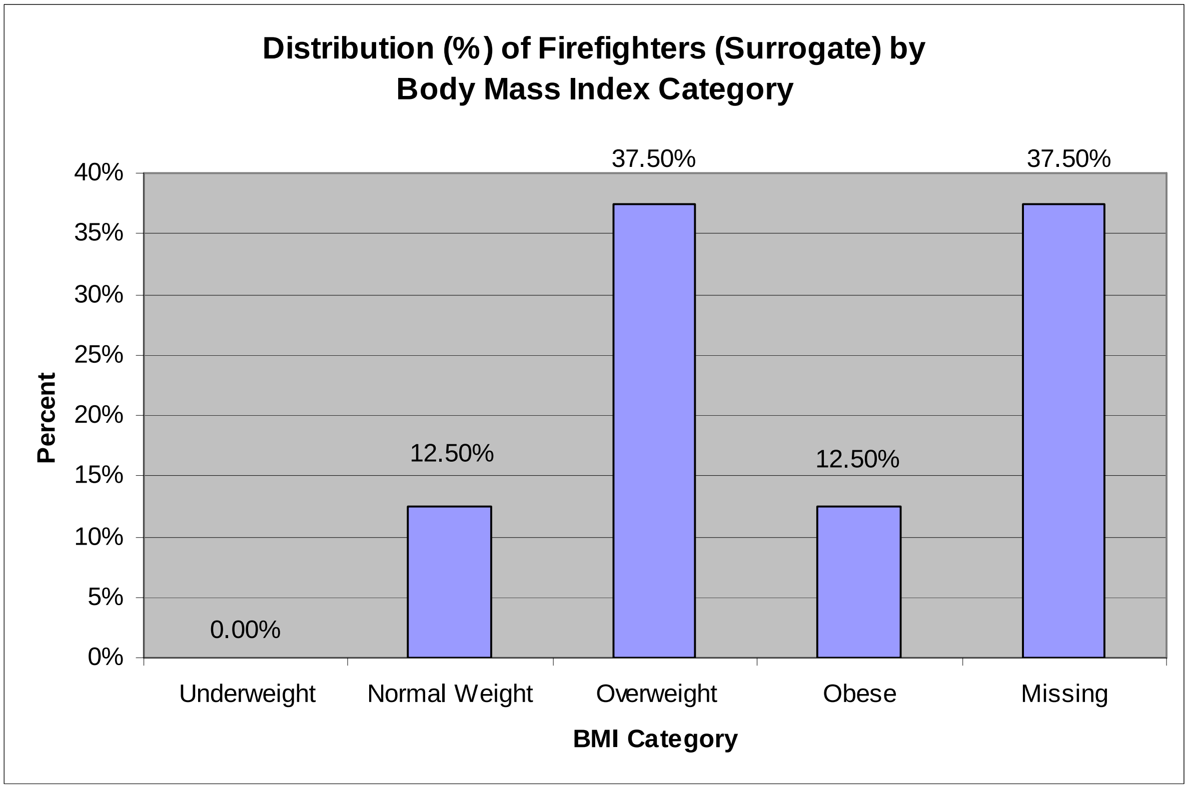
Graph 16. Percent Distribution by Current Smoking Status for Police Officers



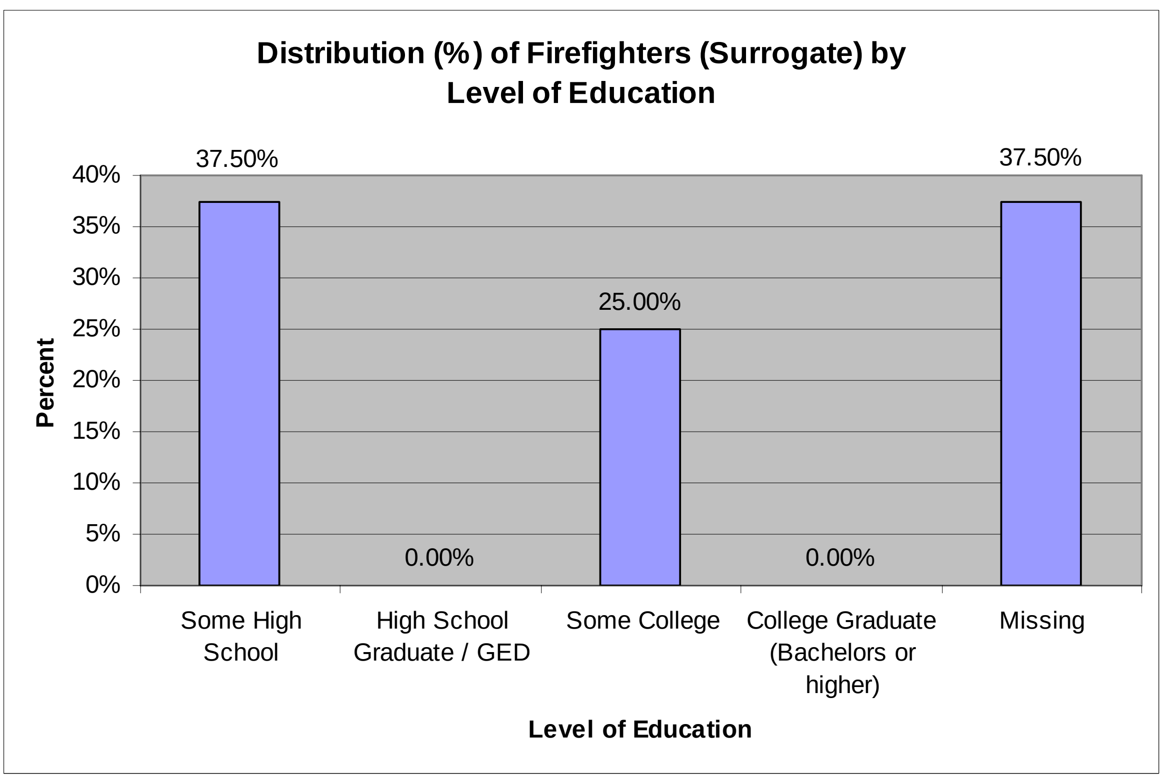
Graph 17. Percent Distribution by Use of Smokeless Tobacco for Police Officers



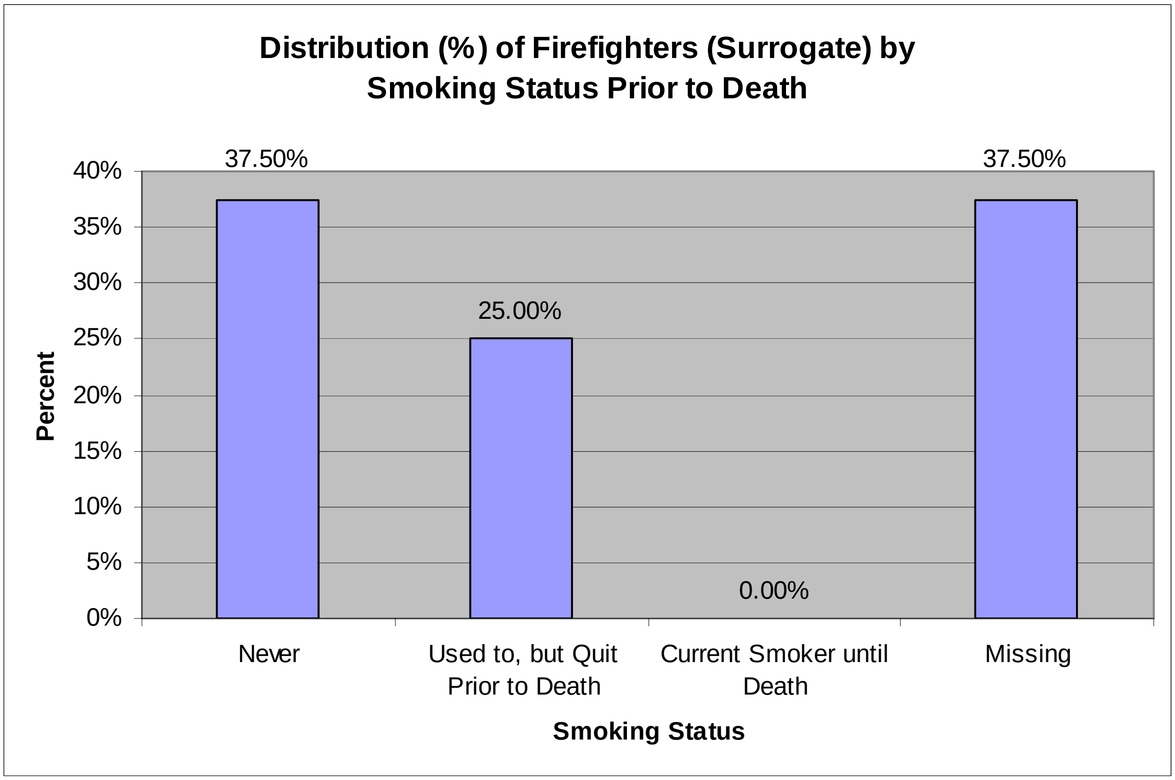
Graph 18. Percent Distribution by Use of Alcohol for Police Officers



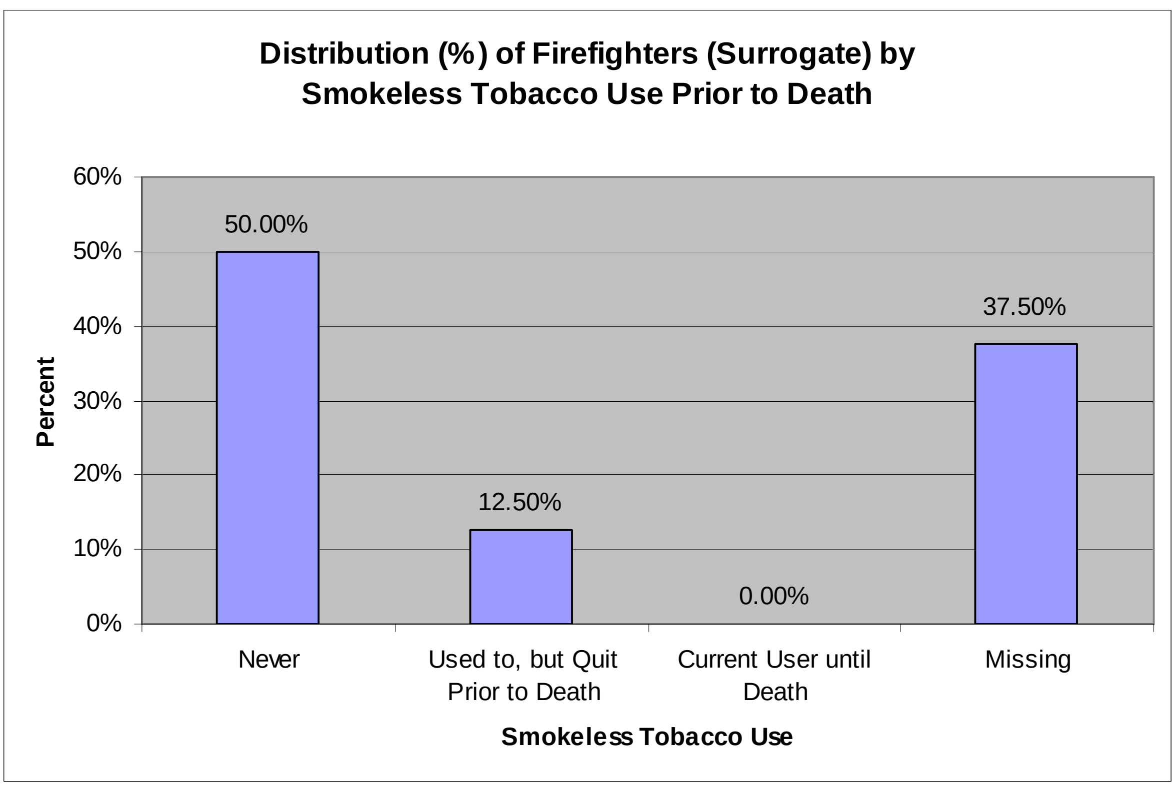
Graph 19. Percent Distribution of BMI for Firefighters (Surrogate)



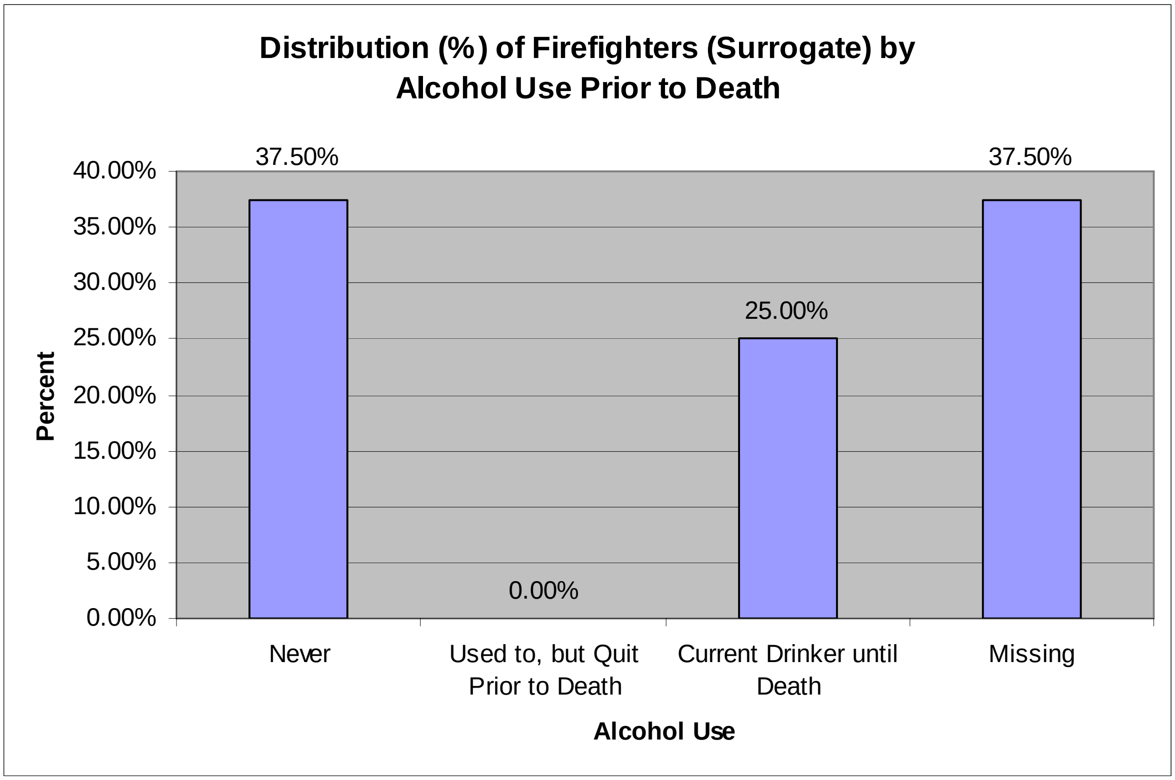
Graph 20. Percent Distribution by Level of Education for Firefighters (Surrogate)



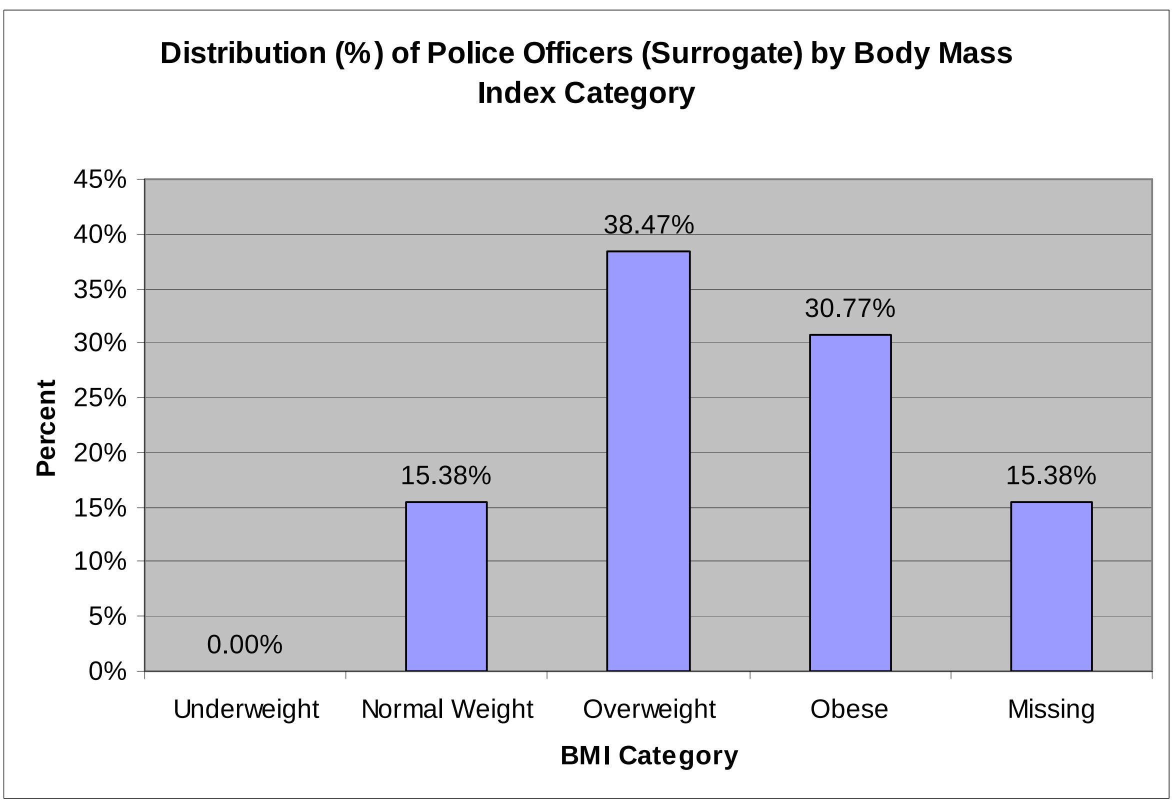
Graph 21. Percent Distribution by Smoking Status for Firefighters (Surrogate)



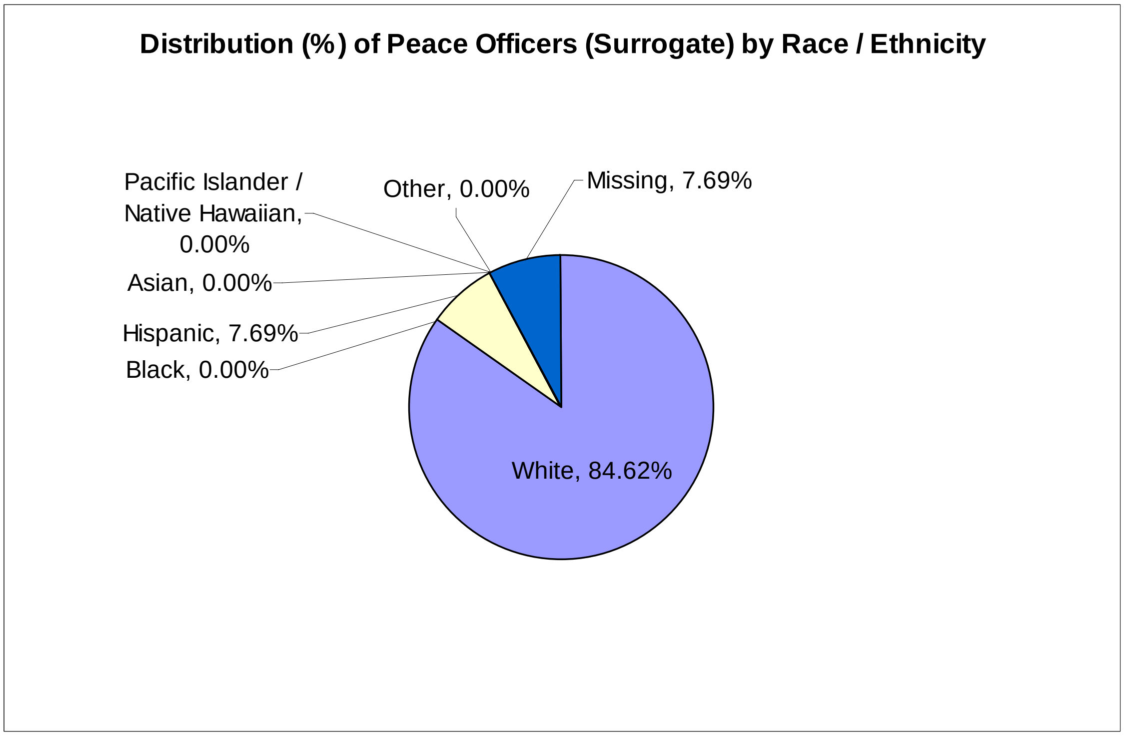
Graph 22. Percent Distribution by Use of Smokeless Tobacco for Firefighters (Surrogate)



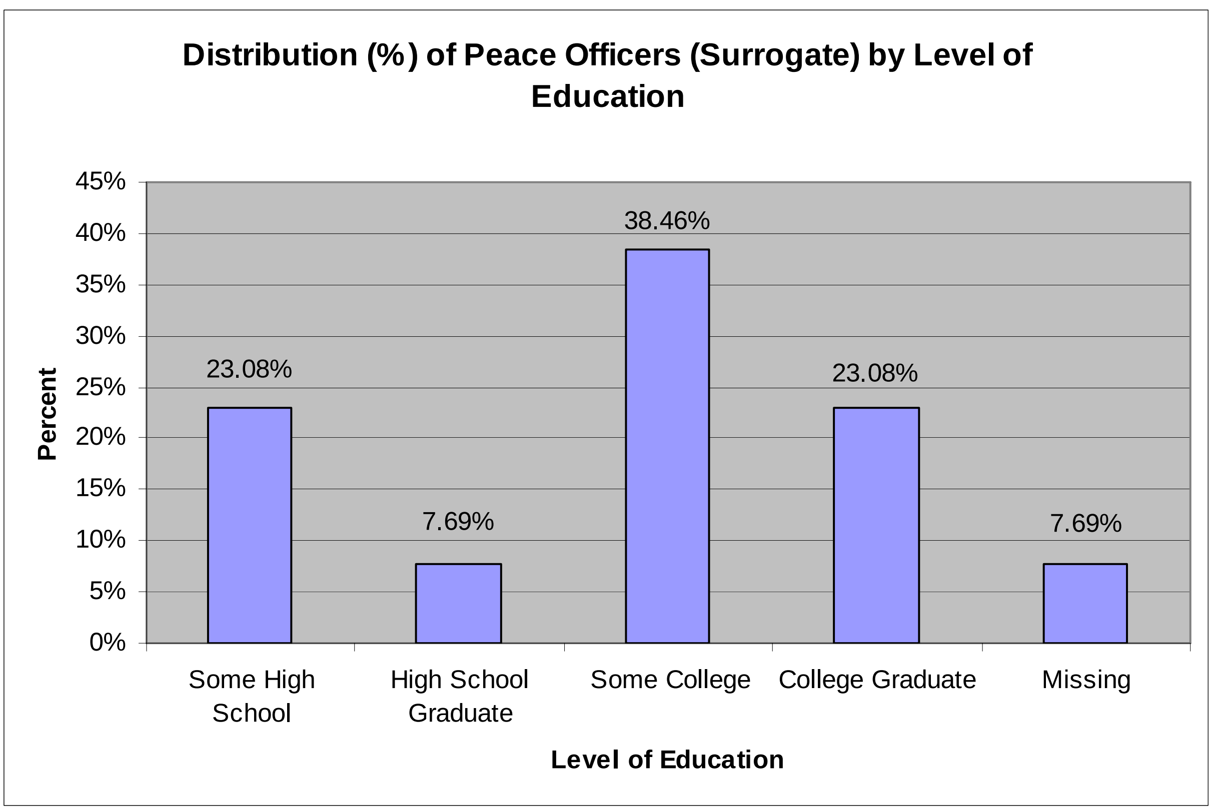
Graph 23. Percent Distribution by Use of Alcohol for Firefighters (Surrogate)



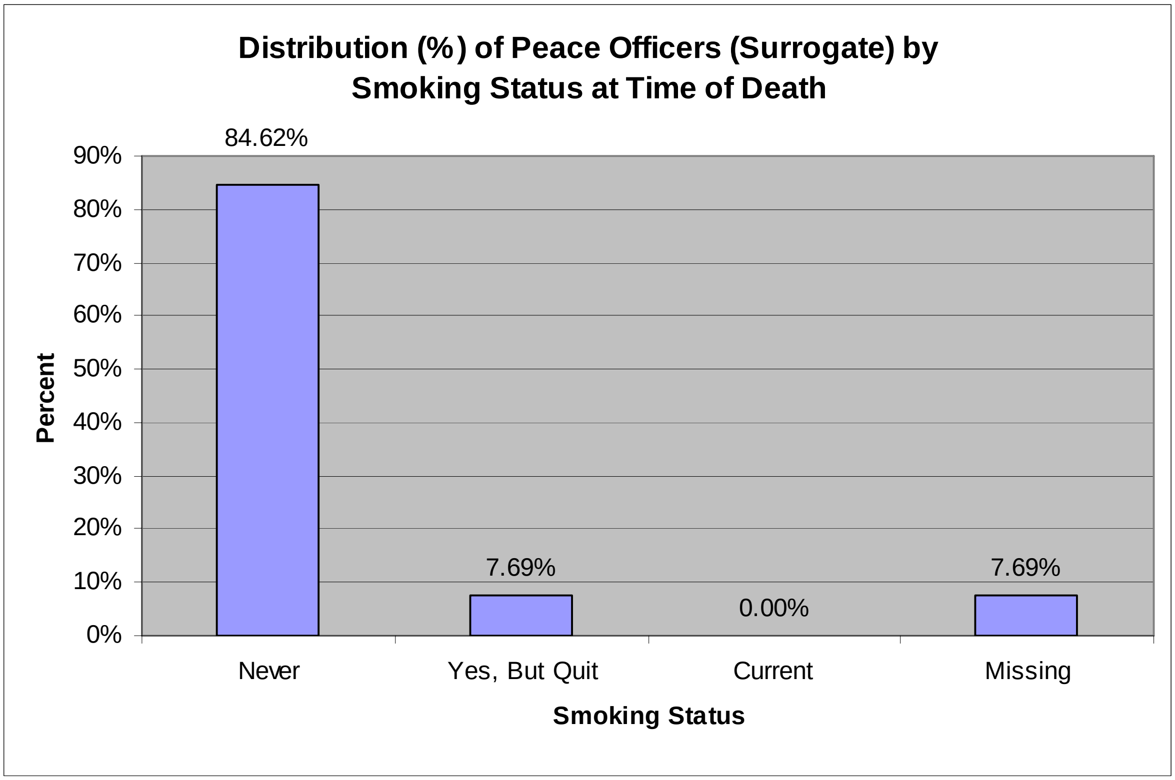
Graph 24. Percent Distribution of BMI for Police Officers (Surrogate)



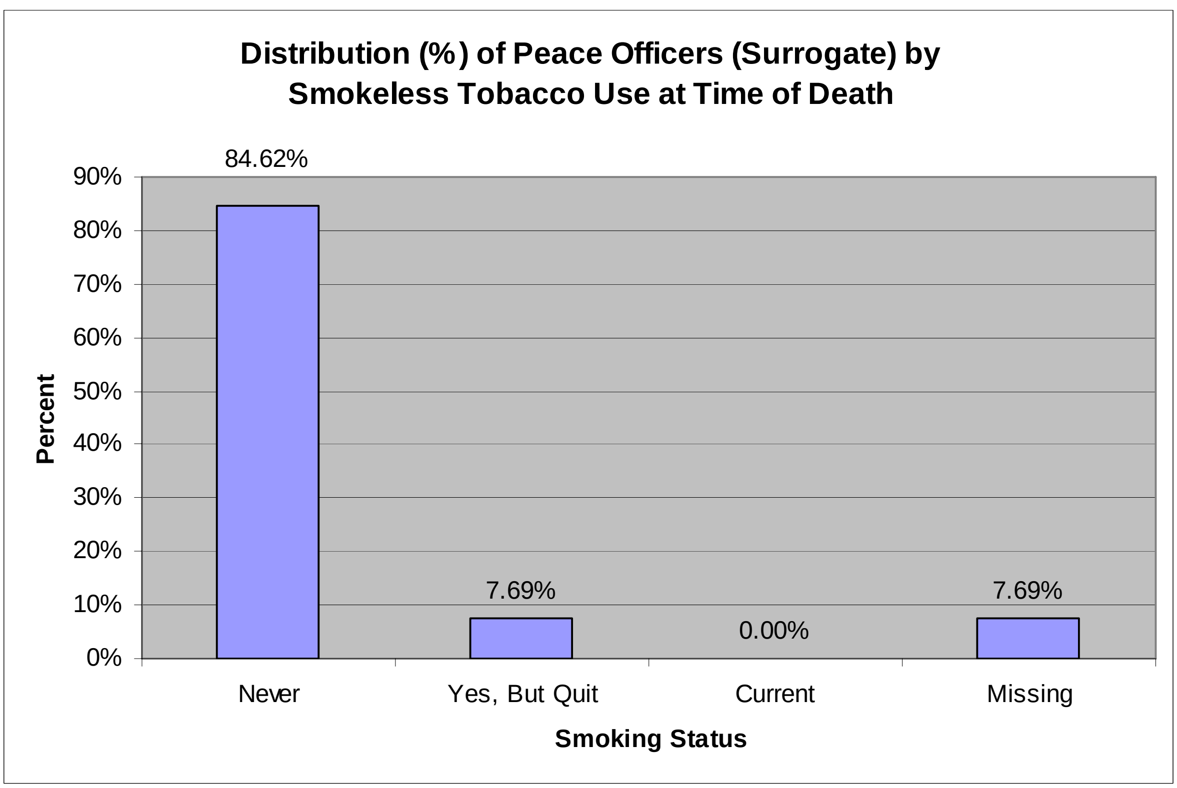
Graph 25. Percent Distribution by Race / Ethnicity for Police Officers (Surrogate)



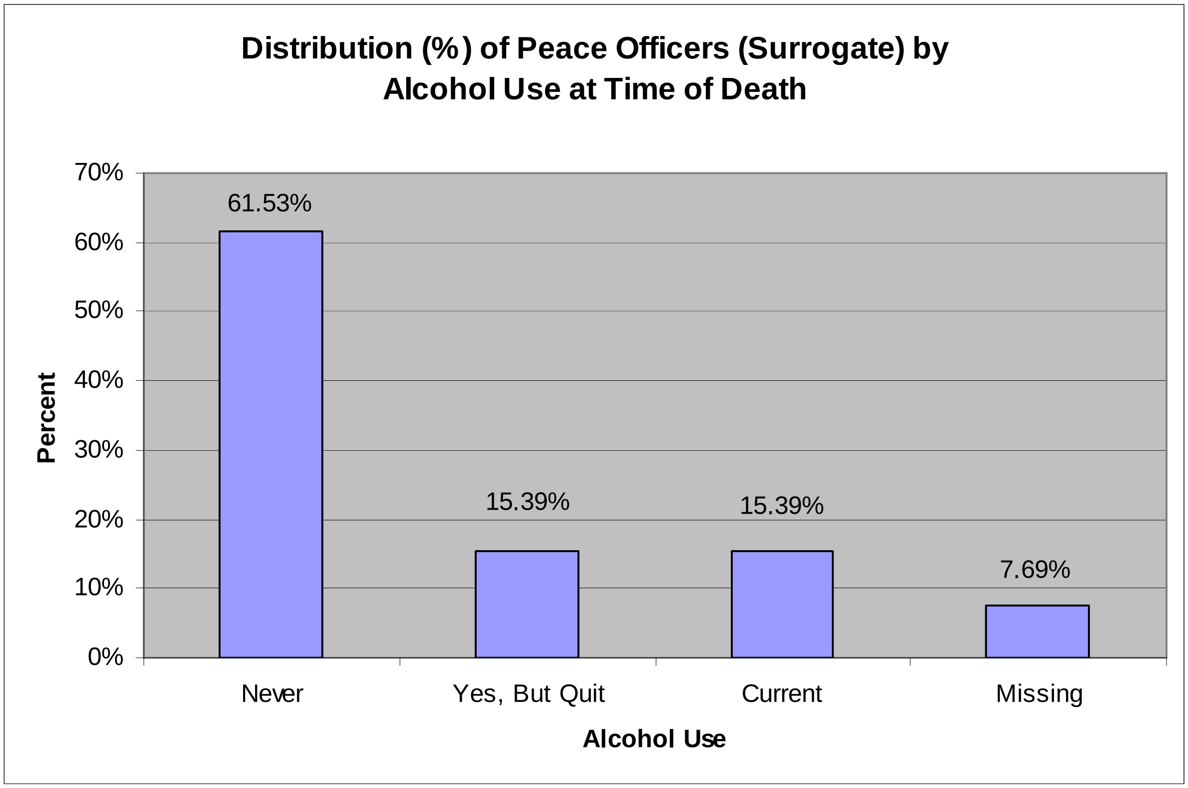
Graph 26. Percent Distribution by Level of Education for Police Officers (Surrogate)



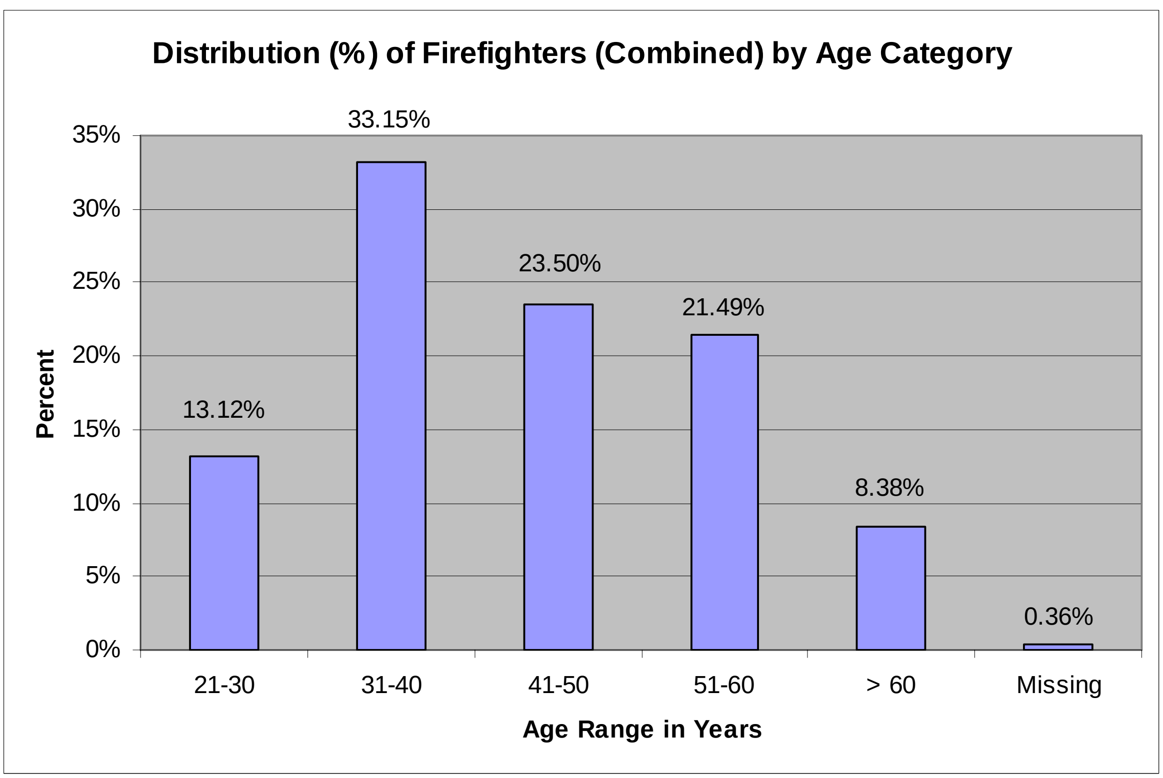
Graph 27. Percent Distribution by Smoking Status for Police Officers (Surrogate)



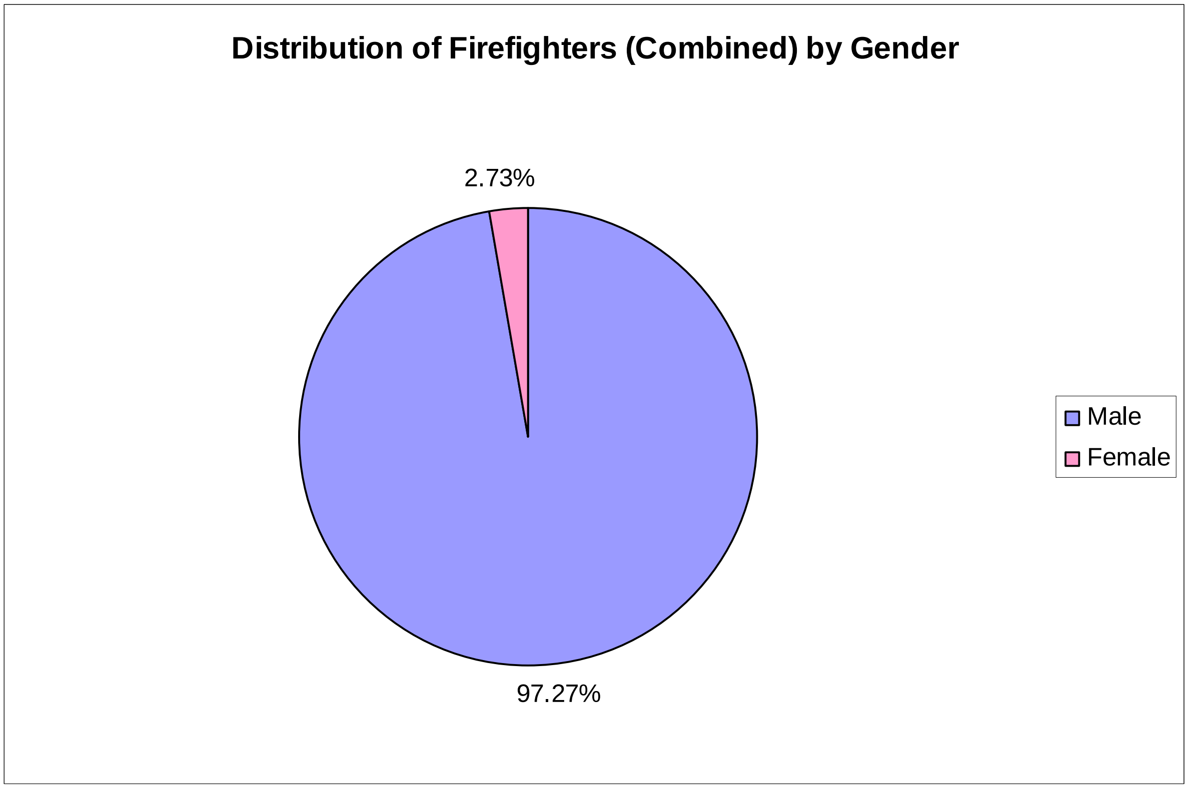
Graph 28. Percent Distribution by Use of Smokeless Tobacco for Police Officers (Surrogate)



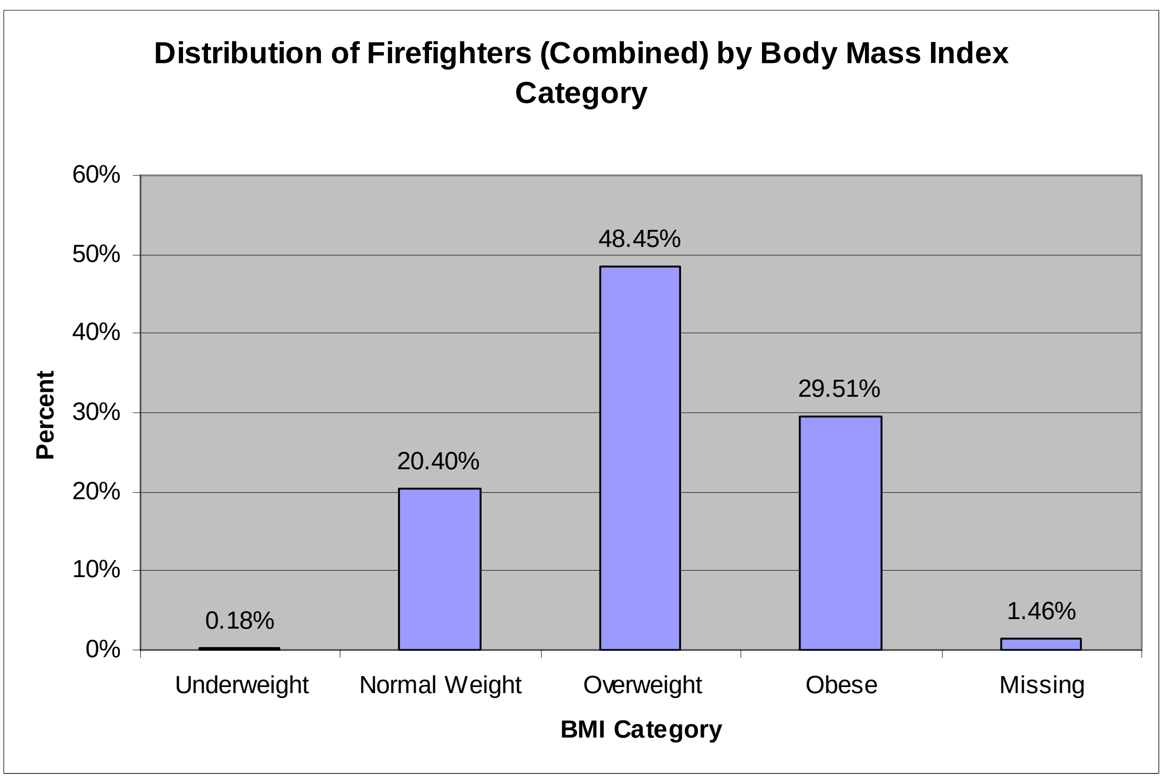
Graph 29. Percent Distribution by Use of Alcohol for Police Officers (Surrogate)



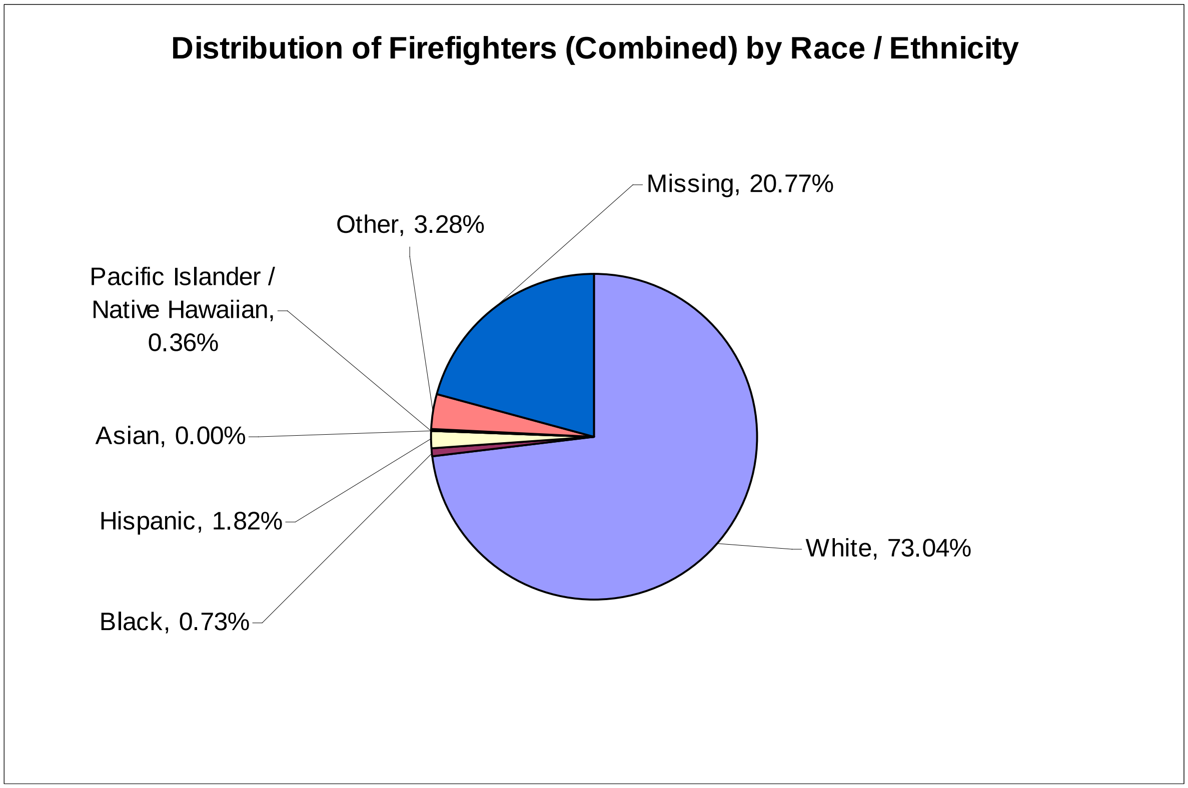
Graph 30. Distribution of Age for Firefighters (Combined)



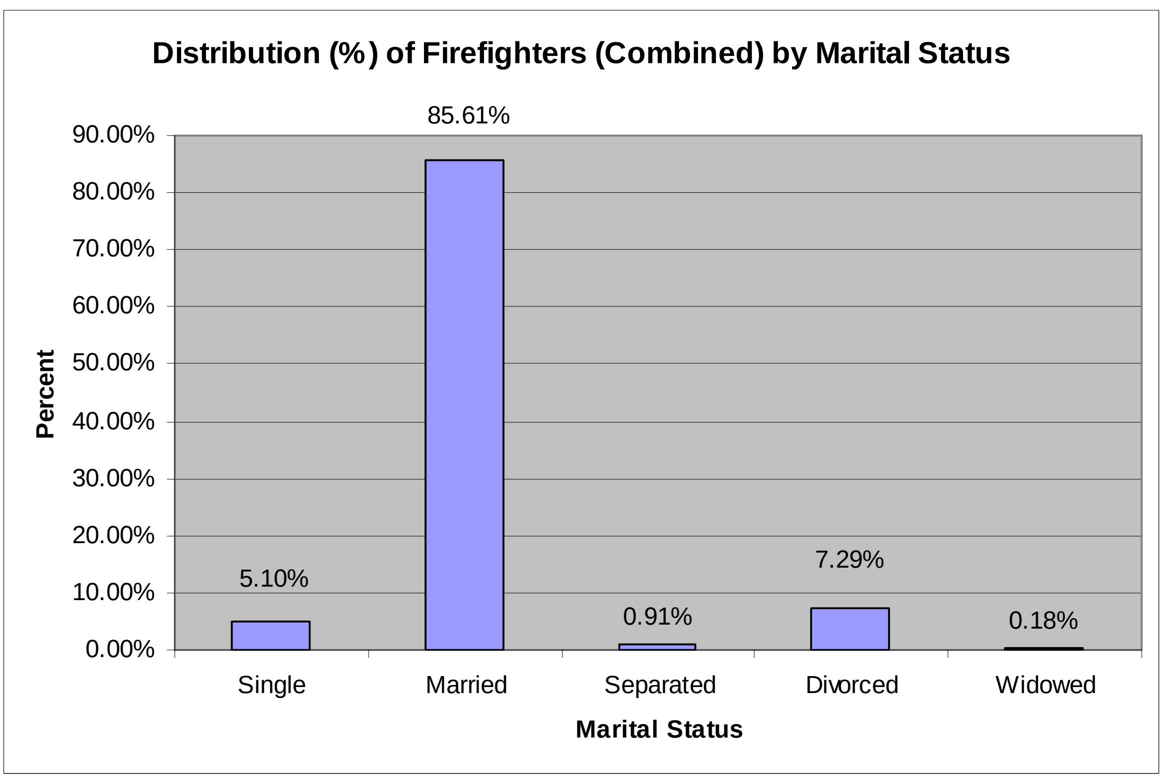
Graph 31. Percent Distribution of Firefighters (Combined) by Gender



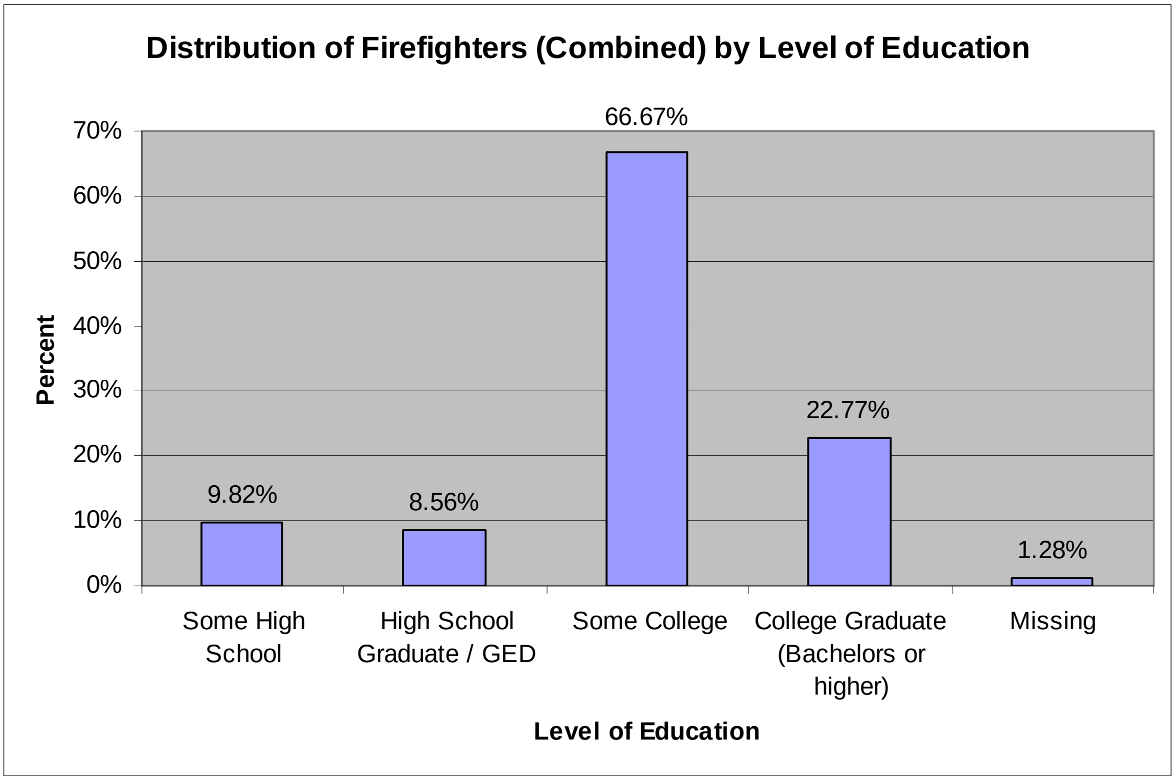
Graph 32. Percent Distribution of Firefighters (Combined) by BMI Category



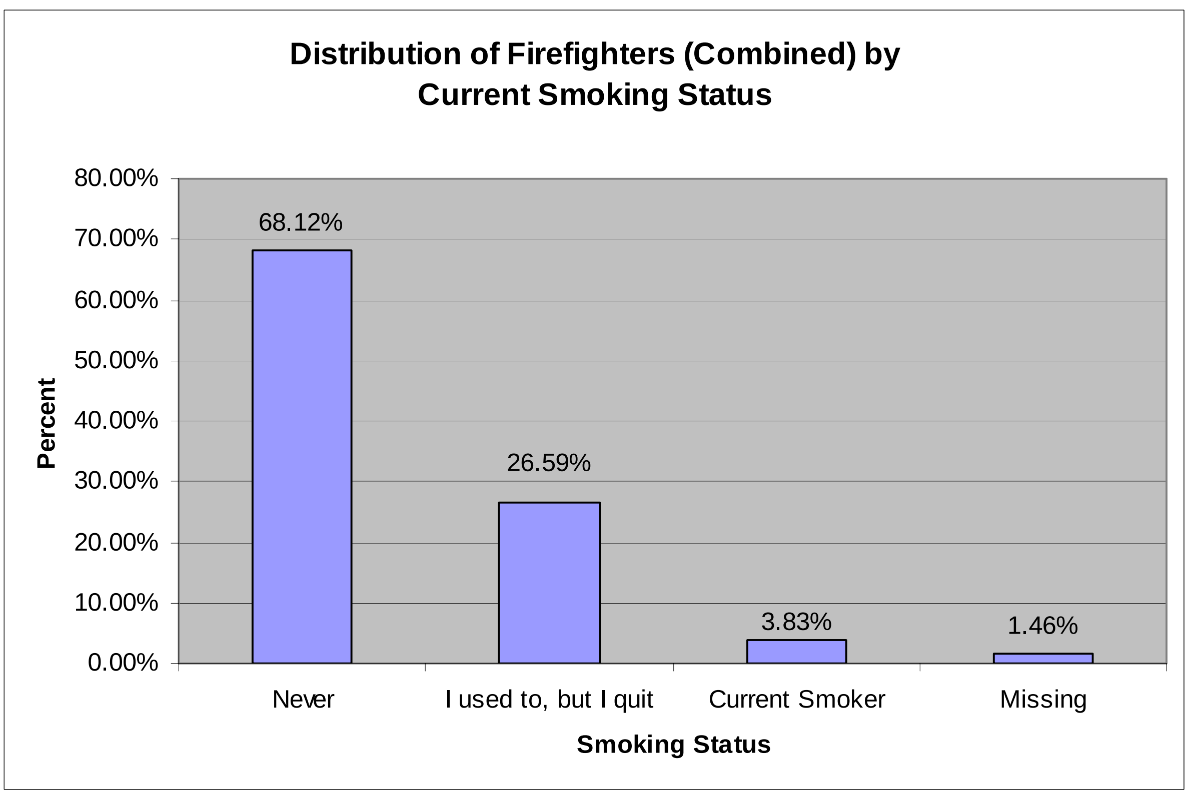
Graph 33. Percent Distribution by Race/Ethnicity for Firefighters (Combined)



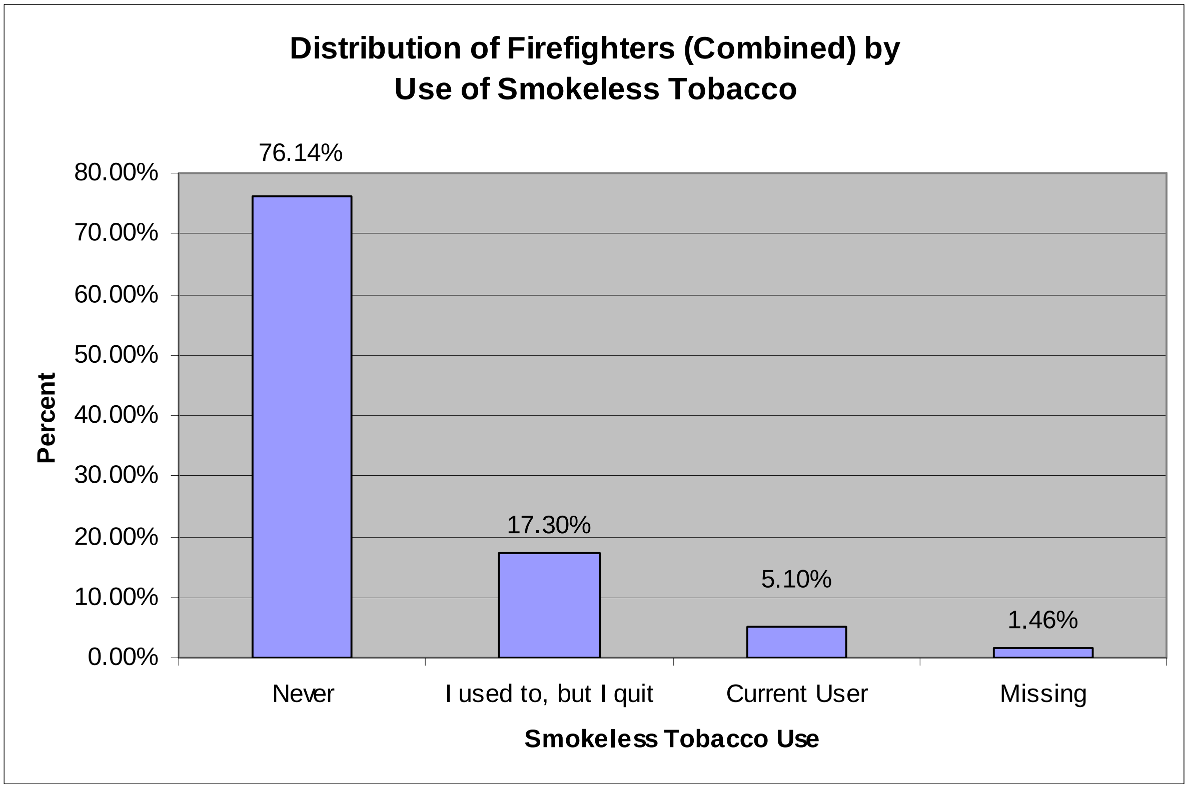
Graph 34. Percent Distribution by Marital Status for Firefighters (Combined)



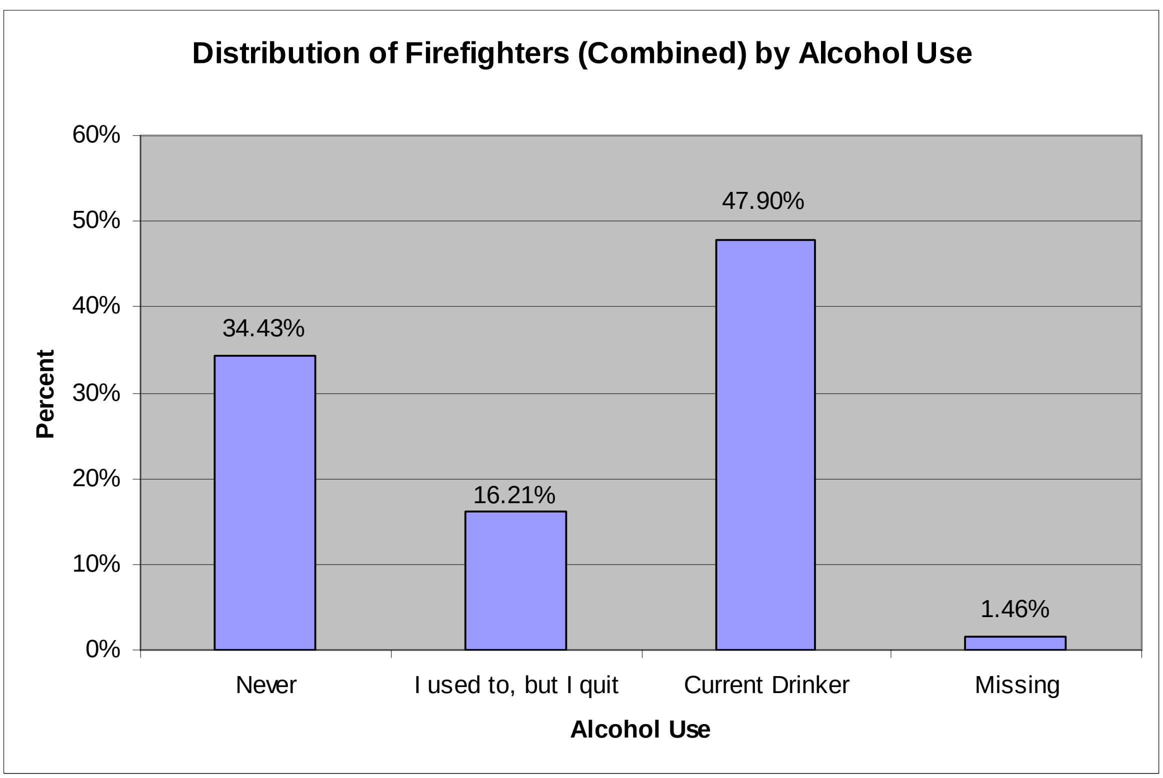
Graph 35. Percent Distribution by Level of Education for Firefighters (Combined)



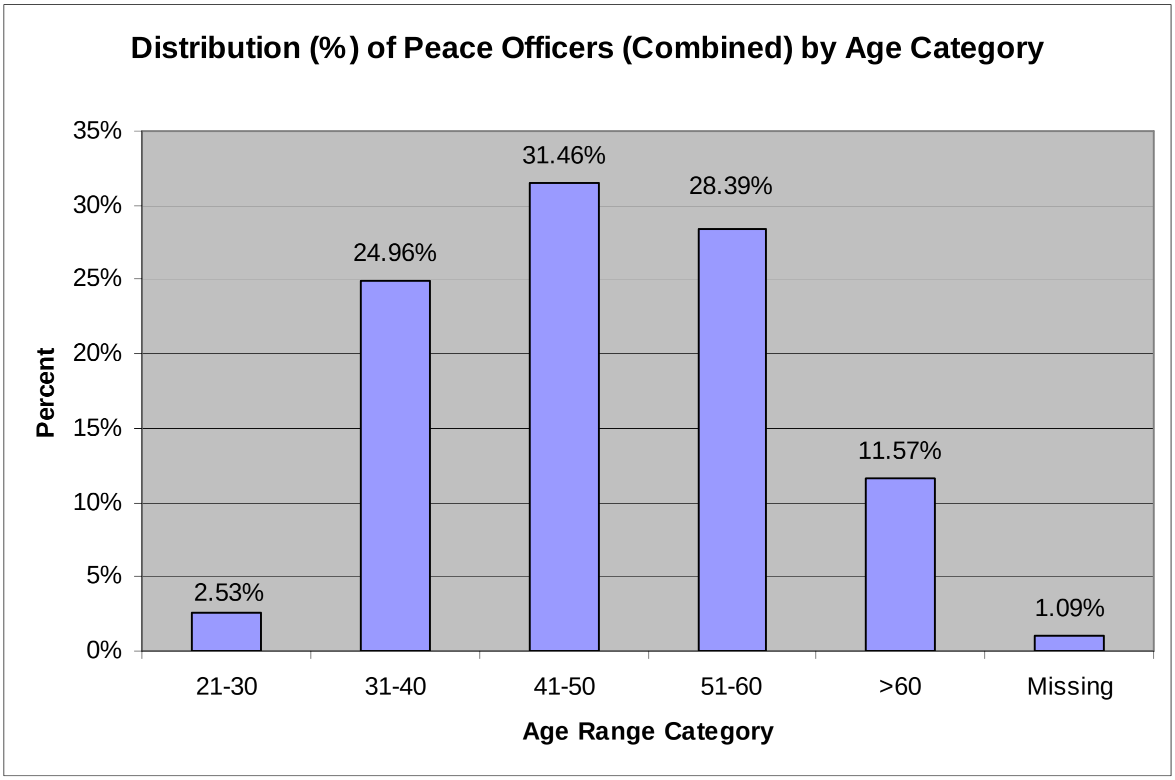
Graph 36. Percent Distribution by Current Smoking Status for Firefighters (Combined)



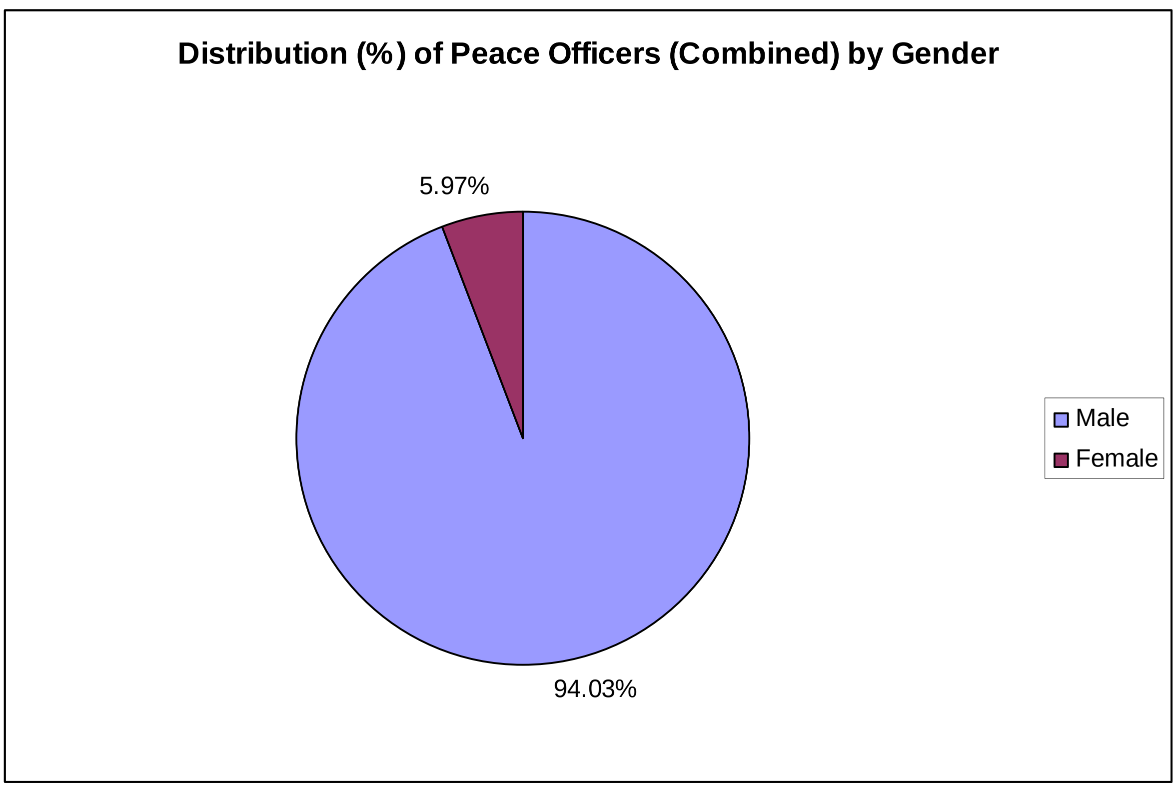
Graph 37. Percent Distribution by Use of Smokeless Tobacco for Firefighters (Combined)



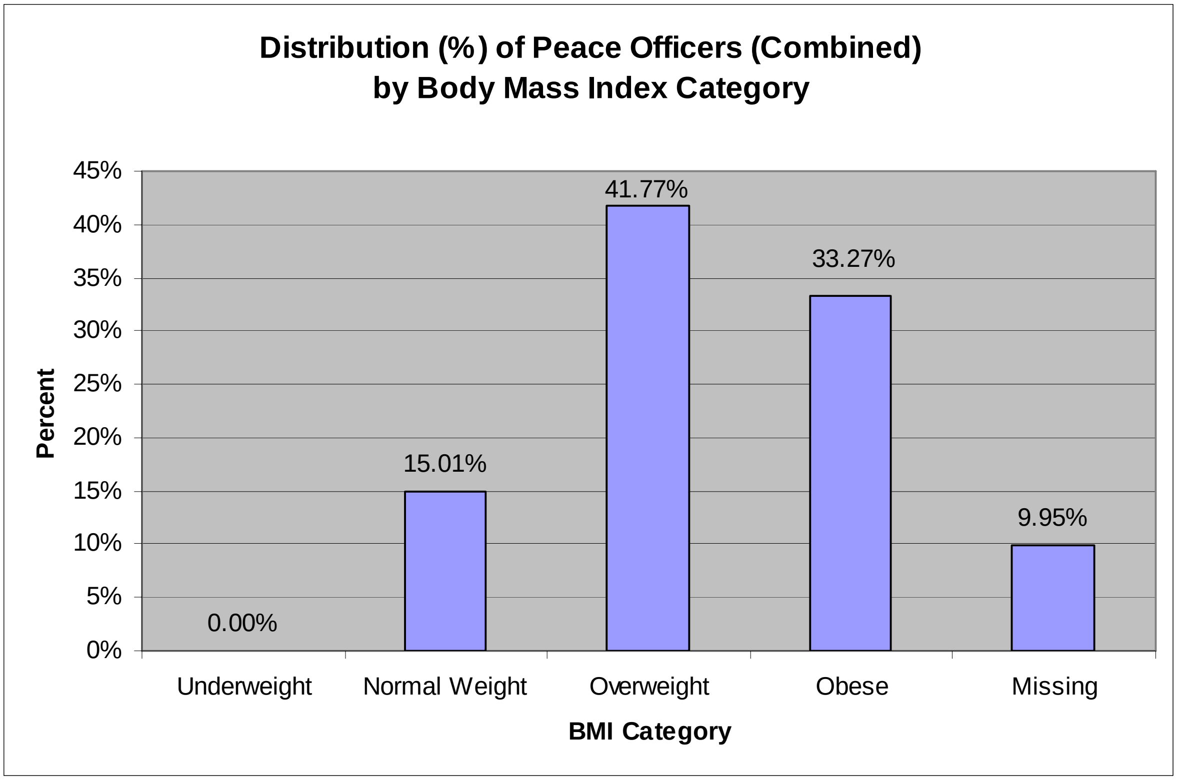
Graph 38. Percent Distribution by Use of Alcohol for Firefighters (Combined)



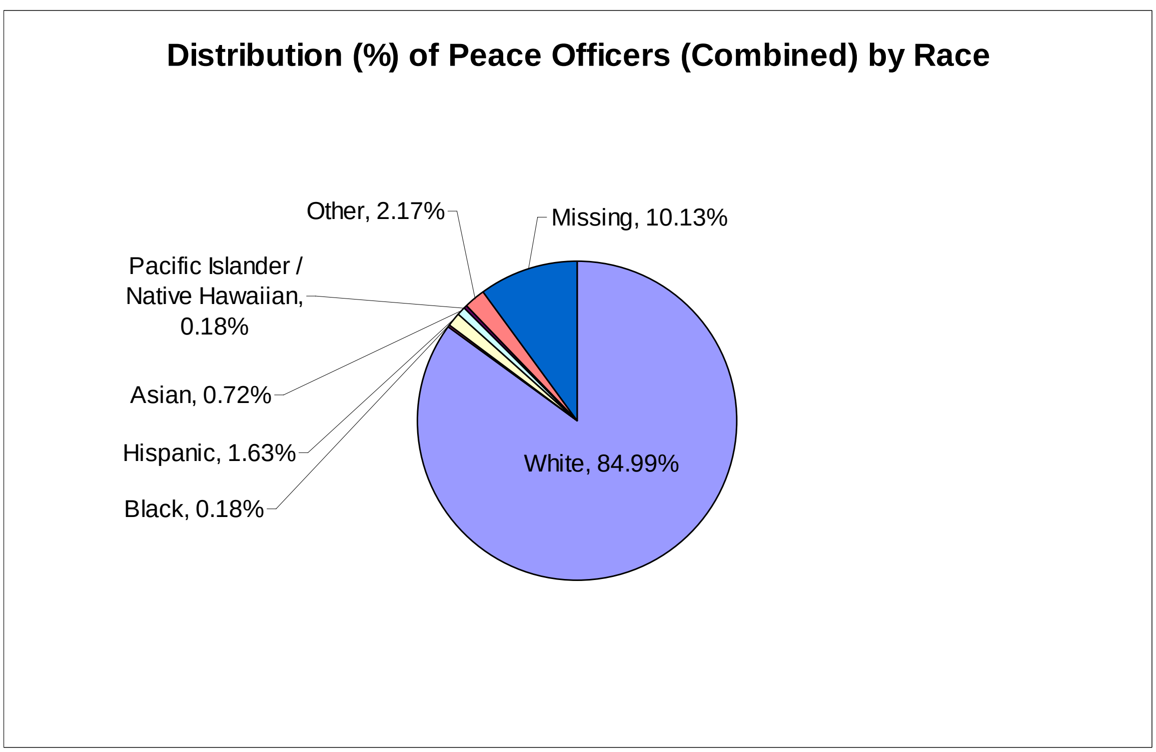
Graph 39. Distribution of Age for Police Officers (Combined)



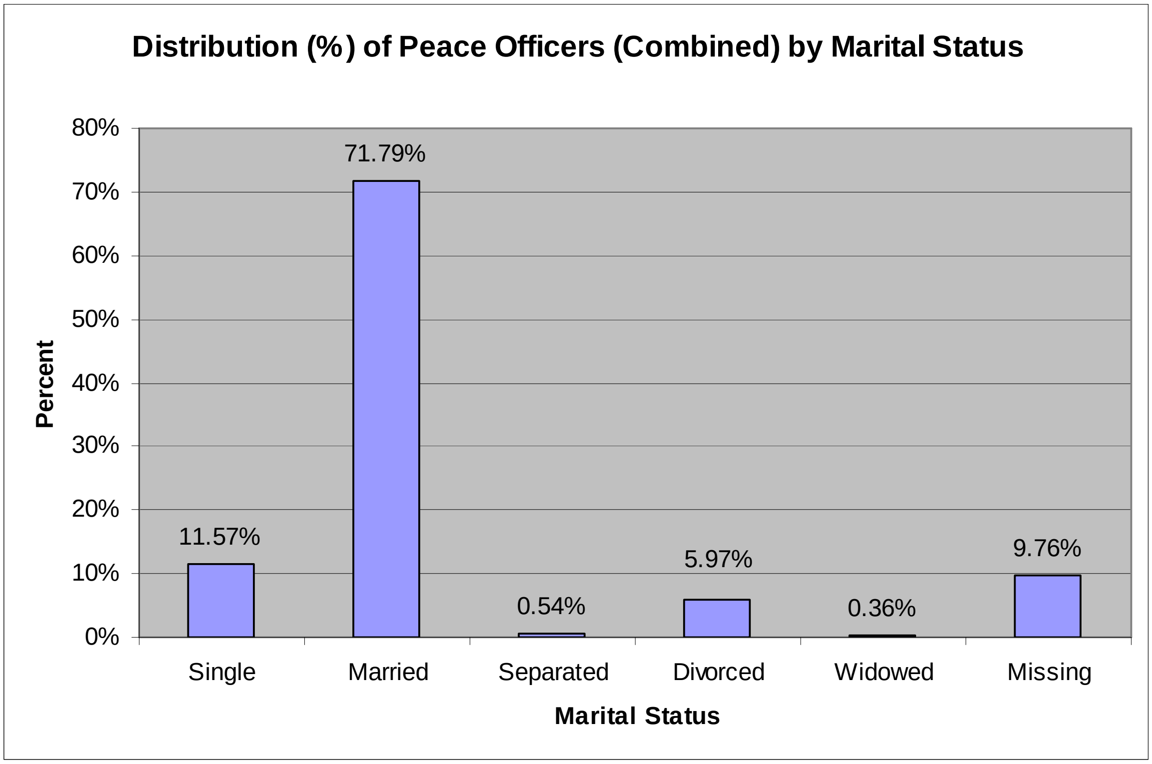
Graph 40. Percent Distribution of Police Officers (Combined) by Gender



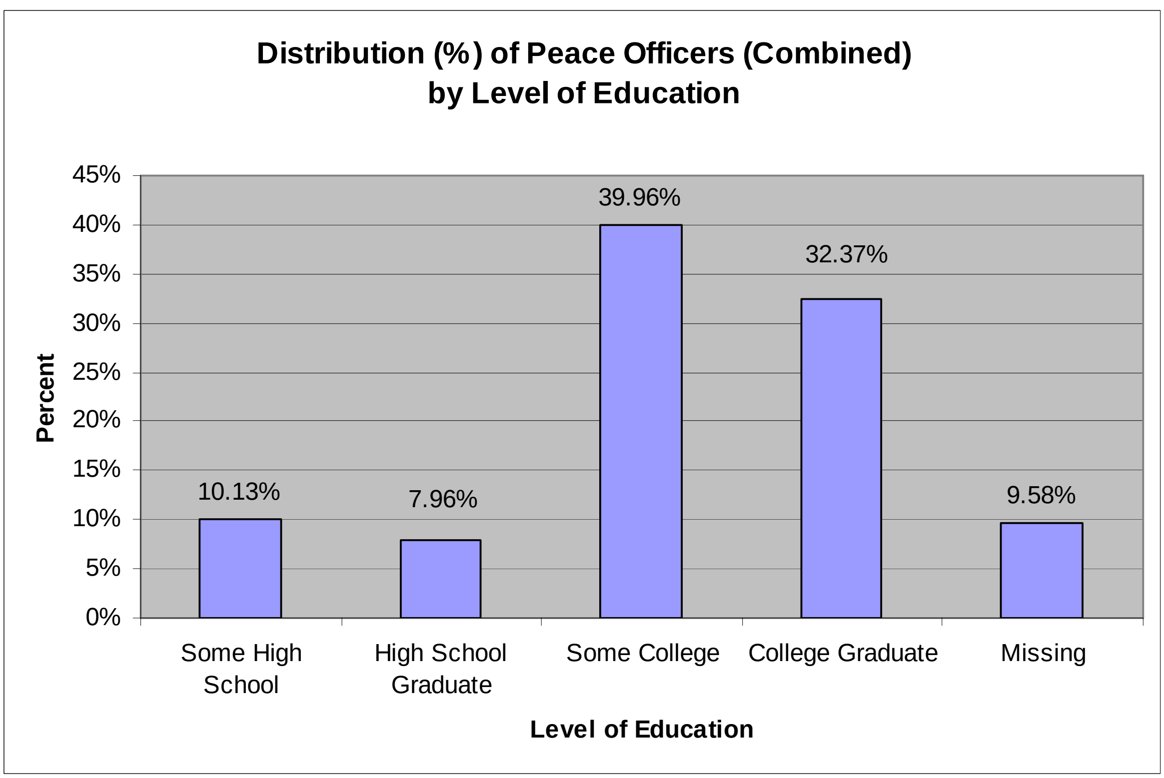
Graph 41. Percent Distribution of Police Officers (Combined) by BMI Category



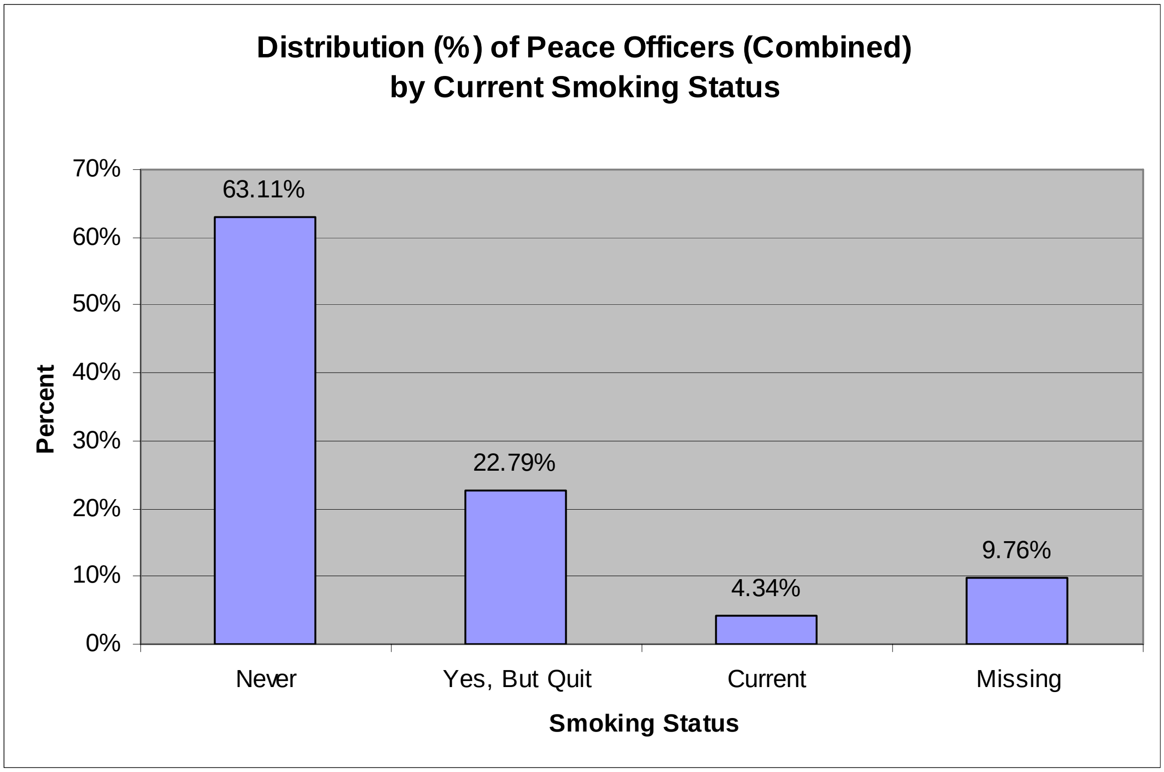
Graph 42. Percent Distribution by Race/Ethnicity for Police Officers (Combined)



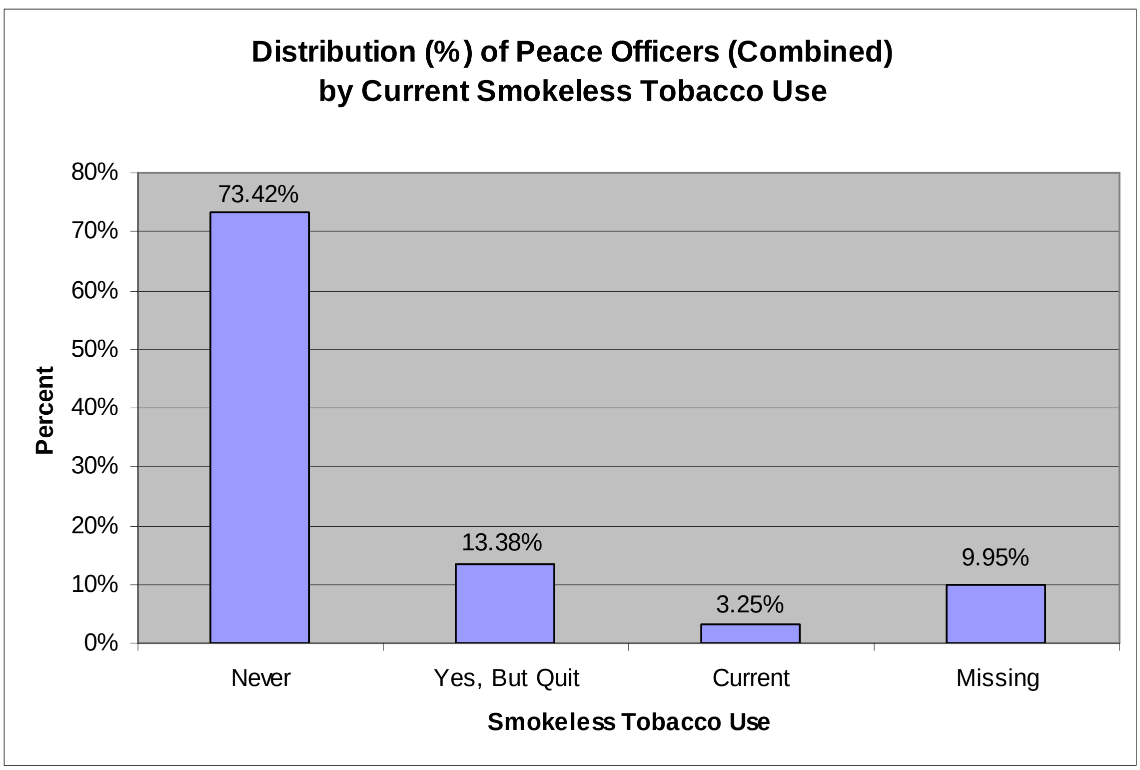
Graph 43. Percent Distribution by Marital Status for Police Officers (Combined)



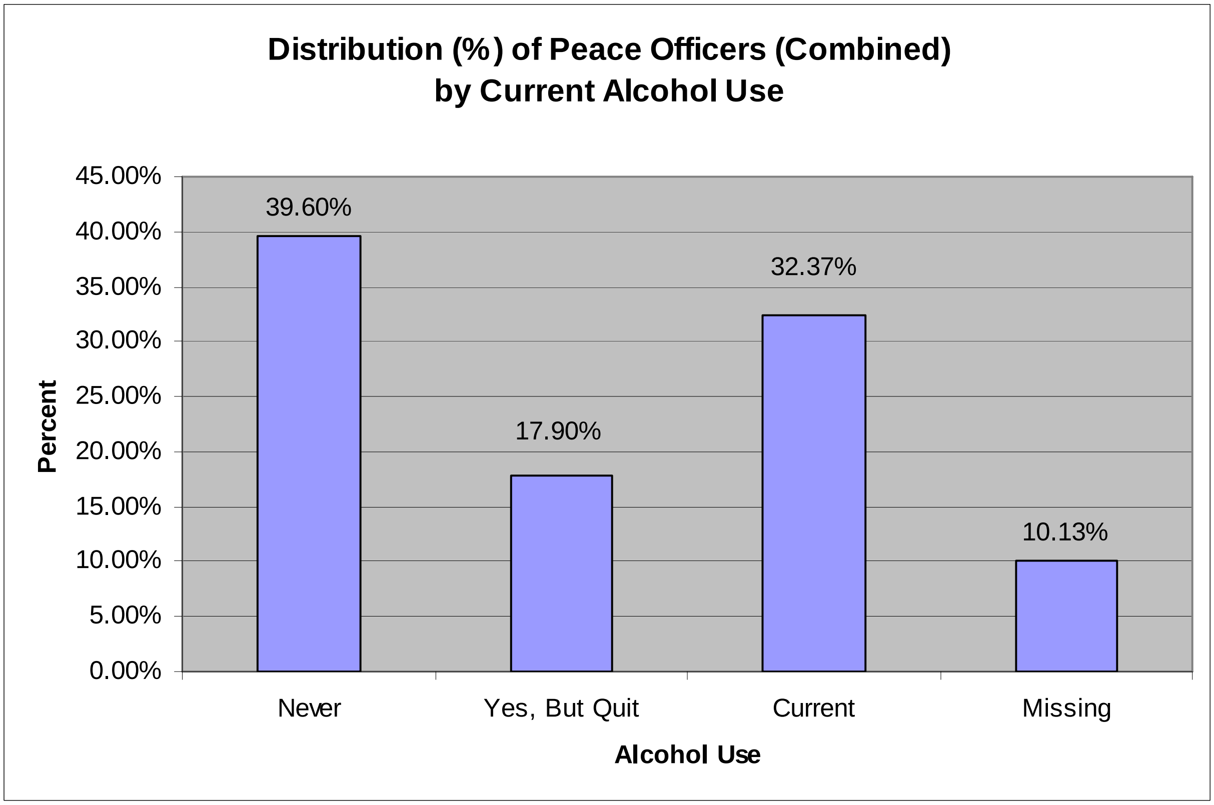
Graph 44. Percent Distribution by Level of Education for Police Officers (Combined)



Graph 45. Percent Distribution by Current Smoking Status for Police Officers (Combined)



Graph 46. Percent Distribution by Use of Smokeless Tobacco for Police Officers (Combined)



Graph 47. Percent Distribution by Use of Alcohol for Police Officers (Combined)