Approximately 800,000 firefighters in the United States are volunteer firefighters and 300,000 are career firefighters. Volunteer firefighters primarily serve communities with fewer than 25,000 inhabitants, whereas most career firefighters serve communities of more than 25,000 persons. To characterize fatalities among volunteer and career firefighters, CDC analyzed data from the U.S. Fire Administration (USFA). This report summarizes the results of that analysis and, to illustrate the most common types of volunteer and career firefighter fatalities, describes two cases investigated by the National Institute for Occupational Safety and Health (NIOSH) Firefighter Fatality Investigation and Prevention Program. Fifty-three percent (610 of 1,141) of U.S. firefighters who died while on duty during 1994-2004 were volunteers, and 32% (368) were career firefighters. The remaining 15% (163) of deaths were among other firefighters (e.g., wildland, paid on-call, and part-time paid firefighters). Among volunteer firefighters, sudden cardiac death (e.g., from myocardial infarction or arrhythmia) and motor vehicle (MV) crashes during emergency response were the leading causes of fatality. Among career firefighters, sudden cardiac death and asphyxiation were leading causes of death. Adoption and enforcement of existing fire-service recommendations regarding fitness standards, mandatory medical evaluations with appropriate work restrictions, and emergency vehicle response protocols are needed to prevent these fatalities among firefighters.


Fire fighters are regularly exposed to chemical and non-chemical agents that have known or suspected adverse effects on reproductive health. Although chemical agents have received some attention, non-chemical hazards such as heat, noise, and physical exertion have only recently been examined for their reproductive effects. There is evidence that heat, noise, and physical exertion may affect various endpoints of reproductive health, including fertility, fetal loss, and growth parameters of the offspring. In particular, hyperthermia, a major fire fighting hazard, has been shown to impair male fertility and may also be teratogenic. Further study of the potential reproductive effects of this and other common non-chemical agents in the fire environment is needed to ensure the reproductive health of male and female fire fighters.


A population-based case-control study of cancer and occupation was carried out in Montreal, Canada. Between 1979 and 1986, 449 pathologically confirmed cases of prostate cancer were interviewed, as well as 1,550 cancer controls and 533 population controls. Job histories were evaluated by a team of chemist/hygienists using a checklist of 294 workplace chemicals. After preliminary evaluation, 17 occupations, 11 industries, and 27 substances were selected for multivariate logistic regression analyses to estimate the odds ratio between each occupational circumstance and prostate cancer with control for potential confounders. There was moderate support for risk due to the following occupations: electrical power workers, water transport workers, aircraft fabricators, metal product fabricators, structural metal erectors, and railway transport workers. The following substances exhibited moderately strong associations: metallic dust, liquid fuel combustion products, lubricating oils and greases, and polyaromatic hydrocarbons from coal. While the population attributable risk, estimated at between 12% and 21% for these occupational exposures, may be an overestimate due to our method of analysis, even if the true attributable fraction were in the range of 5-10%, this represents an important public health issue.


BACKGROUND: Previous studies have found significant associations between firefighting and cancer. METHODS: Fires, vehicle movement, and firefighter job assignment were determined, and storage and distribution of self-contained-breathing-apparatus (SCBAs) were tracked for 12 months. Time spent at
fires and use of SCBAs were calculated. RESULTS: Only 66% of fire department personnel were 1st-line combat firefighters. Number of runs was an unreliable surrogate for time spent at fires. Eight firefighter exposure groups were identified (based on job title, firehall assignment, and time spent at fires), ranging from no exposures to 3,244 min/year/firefighter. SCBAs appear to have been used for approximately 50% of the time at structural fires but for only 6% of the time at all fires. CONCLUSIONS: Failure of previous studies to identify homogeneous exposure groups may have resulted in misclassification and underestimates of health risks. The approach used in this study may be used in epidemiological studies to identify exposure/response relationships.


The objective of this study was to characterize volatile organic compounds (VOCs) found at municipal structural fires in order to identify sources of long-term health risks to firefighters, which may be contributing factors in heart disease and cancer. Firefighters collected air into evacuated Summa canisters inside burning buildings at nine municipal structural fires under conditions where they judged that at least some firefighters might remove their self-contained breathing apparatus masks. Volatile organic compounds were identified and quantified for 144 target compounds using cryogenic preconcentration and gas chromatography/mass spectral detection (GC/MSD) methodology operating in selected ion monitoring mode. Samples were also analyzed in SCAN mode and examined for the appearance of substances that were not present in the instrument standard calibration mixture. The spectra of municipal structural fires were surprisingly similar and remarkable for their simplicity, which was largely due to the dominating presence of benzene along with toluene and naphthalene. Propene and 1,3-butadiene were found in all of the fires, and styrene and other alkyl-substituted benzene compounds were frequently identified. Similar "fingerprints" of the same 14 substances (propene, benzene, xylenes, 1-butene/2-methylpropene, toluene, propane, 1,2-butadiene, 2-methylbutane, ethylbenzene, naphthalene, styrene, cyclopentene, 1-methylcyclopentene, isopropylbenzene) previously identified at experimental fires burning various solid combustible materials were also found at municipal structural fires, accounting for 76.8% of the total VOCs measured. Statistically significant positive correlations were found between increasing levels of benzene and levels of propene, the xylenes, toluene, 1-butene/2-methylpropene, 1,3-butadiene, and naphthalene. Given the toxicity/carcinogenicity of those VOCs that were found in the highest concentrations, particularly benzene, 1,3-butadiene, and styrene, further investigation of VOC exposures of firefighters is warranted. Benzene, or its metabolic product s-phenylmercapturic acid in urine, was identified as a suitable chemical marker for firefighter exposure to combustion products.


New York City Fire Department rescue workers experienced massive exposure to airborne particulates at the World Trade Center site. Aims of this longitudinal study were to (1) determine if bronchial hyperreactivity was present, persistent, and independently associated with exposure intensity, (2) identify objective measures shortly after the collapse that would predict persistent hyperreactivity and a diagnosis of reactive airways dysfunction 6 months post-collapse. A representative sample of 179 rescue workers stratified by exposure intensity (high, moderate, and control) without current smoking or prior respiratory disease was enrolled. Highly exposed workers arrived within 2 hours of collapse, moderately exposed workers arrived later on Days 1-2; control subjects were not exposed. Hyperreactivity at 1, 3, and 6 months post-collapse was associated with exposure intensity, independent of ex-smoking and airflow obstruction. Six months post-collapse, highly exposed workers were 6.8 times more likely than moderately exposed workers and control subjects to be hyperreactive (95% confidence interval, 1.8-25.2; \( p = 0.004 \)), and hyperreactivity persisted in 55% of those hyperreactive at 1 and/or 3 months. In highly exposed subjects, hyperreactivity 1 or 3 months post-collapse was the sole predictor for reactive airways dysfunction (\( p = 0.021 \)). In conclusion, development and persistence of hyperreactivity and reactive airways dysfunction were strongly and independently associated with exposure intensity. Hyperreactivity shortly post-collapse predicted reactive airways dysfunction at 6 months in highly exposed workers; this has important implications for disaster management.

BACKGROUND: Inhaled corticosteroids (ICS) are the most effective anti-inflammatory treatment for asthmatics. This trial evaluated the effects of prophylactic ICS in firefighters exposed to the World Trade Center disaster. METHODS: Inhaled budesonide via a dry powder inhaler (Pulmicort Turbuhaler, AstraZeneca, Wilmington, DE) was offered on-site to New York City firefighters between September 18 and 25, 2001. One to 2 years later, firefighters (n = 64) who completed 4 weeks of daily ICS treatment were evaluated and compared with an age- and exposure-matched comparison group (n = 72) who did not use ICS. RESULTS: When spirometry results at the final visit were compared with those from the weeks following the 9/11 disaster, the treatment group had a greater increase in forced vital capacity (P = .009) and possibly a slower decline in forced expiratory volume at 1 second (P = .11), as well as a greater improvement in perceived well-being as assessed by the St George's Respiratory Questionnaire (P < .01). There was no difference in airway hyperreactivity and no evidence of adverse effects from ICS. CONCLUSIONS: Because the potential for hazardous exposures is great at many disasters, disease prevention programs based on environmental controls and respiratory protection are warranted immediately. Our results suggest that, pending further study with a larger sample, prophylactic ICS should be considered, along with respiratory protection, to minimize possible lung insult.


Lifetime occupational histories as well as information on known and suspected breast cancer risk factors were collected by means of a self-administered questionnaire from 1018 women with incident breast cancer ascertained from the British Columbia Cancer Registry, and from 1020 population controls. A matched case-control study design was used. Conditional logistic regression for matched sets data and the likelihood ratio were used in a two-step procedure and were performed separately for pre-menopausal women, post-menopausal women, and for all cases combined. Excess risk was noted for several white-collar occupations. Significantly increased risk was observed: (1) among pre-menopausal women: in electronic data-processing operators; barbers and hairdressers; in sales and material processing occupations; and in the food, clothing, chemical and transportation industries; (2) among post-menopausal women: in schoolteaching; in medicine, health, and nursing occupations; in laundry and dry-cleaning occupations; and in the aircraft and automotive, including gasoline service station, industries. Several significant associations were also seen in the combined group of pre- and post-menopausal women, particularly in crop farmers and in the fruit and vegetable, publishing and printing, and motor vehicle repair industries. The results of this study suggest excess breast cancer risk in a number of occupations and industries, notably those that entail exposure to solvents and pesticides.


We have, as part of a program aimed at detecting occupational risk factors in British Columbia, collected lifetime occupational histories as well as information on lifetime cigarette smoking and alcohol consumption from 15,643 incident cancer cases, of whom 782 had a diagnosis of non-Hodgkin's lymphoma (NHL). Occupational risks for this cancer site are examined using a matched case-control study design, and the results are presented in this report for all cases and for histopathology subtypes. The results of our study indicate excess NHL risk, particularly for a number of occupations that involve exposures to electromagnetic fields, treated and fresh wood, metals, and solvents.

OBJECTIVE: We collected information on lifetime occupational histories, smoking, and alcohol consumption from 15,463 incident cancer cases. Occupational risk factors for bladder cancer are presented in this report. METHOD: A matched case-control design was used. All cases were diagnosed with bladder cancers, with controls being internal controls consisting of all other cancer sites, excluding lung and unknown primary. Data were analyzed using conditional logistic regression for matched sets data and the likelihood ratio test. RESULTS: Excess bladder cancer risks was observed in a number of occupation and industries, particularly those involving exposure to metals, including aluminum, paint and solvents, polycyclic aromatic hydrocarbons, diesel engine emissions, and textiles. CONCLUSIONS: The results of our study are in line with those from the literature and further suggest that exposure to silica and to electromagnetic fields may carry an increased risk of bladder cancer.


The study of Xuan Wei fuel use and lung cancer mortality and also the interim case-control study suggested an association between domestic smoky coal use and Xuan Wei lung cancer. The collaborative studies of physical characterization, chemical analysis, and toxicology further substantiated this linkage. The Xuan Wei residents who used smoky coal inhaled extremely high concentrations of mostly submicron-sized particles, which can be inhaled and deposited effectively deep in the lung. These fine particles were composed mostly of organic compounds (72%), including mutagenic and carcinogenic organic compounds, especially in the aromatic and polar fractions. These residents were exposed to polycyclic aromatic compounds, such as benzo[a]pyrene, at comparable or higher levels than those measured in coke oven plants and other occupational environments (International Agency for Research on Cancer 1984). In comparison with wood and smokeless coal combustion emissions, the organic extracts of smoky coal emission particles showed much higher activity of genotoxicity and carcinogenicity. These results all point to a strong etiological link between the complex organic mixtures from smoky coal emissions and Xuan Wei lung cancer. This study and studies reported by other investigators (de Koning et al. 1984) suggested little association between indoor open-fire wood smoke and lung cancer. The less efficient lung deposition of the larger particles from wood combustion, as well as the lower concentrations of biologically active organic compounds, may contribute to the low rate of lung cancer in the wood-burning communes. As to the smokeless coal emissions, the lower particulate concentration and the lower organic content of the particles emitted may also contribute to the low lung cancer rate in the commune using this fuel. In conclusion, the complex organic mixtures from combustion emissions are genotoxic and carcinogenic in animal and in vitro assays. The magnitude of the cancer risks from the complex organic mixtures in man depends on the degree of the exposure, the types of the compounds contained in the mixtures, and the concentrations of these biologically active compounds present in the combustion emissions.


BACKGROUND: There is no consensus whether firefighters are at increased cancer risk for particular cancers. Previous studies have been small, mostly investigated cancer mortality, and suggested increased risks for brain, bladder, testicular, prostate, thyroid and colorectal cancers, leukemia, and melanoma. METHODS: Records of all male cancers registered in California during 1988-2003 were obtained. Firefighters were identified from occupation and industry text fields. Logistic regression analysis was used other cancers as controls. RESULTS: Of the 804,000 eligible records, 3,659 had firefighting as their occupation. Firefighting was associated with testicular cancer (odds ratio = 1.54, 95% confidence interval: 1.18-2.02), melanoma (1.50, 1.33-1.70), brain cancer (1.35, 1.06-1.72), esophageal cancer (1.48, 1.14-1.91), and prostate cancer (1.22, 1.12-1.33). CONCLUSIONS: 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.

INTRODUCTION/OBJECTIVE: This paper reports the results of an initial effort to develop and test a measure of the various sources of job-related stress in firefighter and paramedic emergency service workers. METHODS: A 57-item paper and pencil measure of occupational stressors in firefighter/Emergency Medical Technicians (EMTs) and firefighter/paramedics was developed and administered by anonymous mail survey. RESULTS: More than 2,000 (50% rate of return) emergency service workers completed and returned the surveys. The responses of 1,730 firefighter/EMTs and 253 firefighter/paramedics were very similar in terms of the degree to which job stressors were bothersome. A factor analysis of replies yielded 14 statistically independent "Occupational Stressor" factors which together accounted for 66.3% of the instrument's variance. These Sources of Occupational Stress (SOOS) factor scale scores essentially did not correlate with a measure of the social desirability test-taking bias. Finally, SOOS factors were identified that correlated with job satisfaction and work-related morale of the respondents. Conflict with administration was the job stressor factor that most strongly correlated with reports of low job satisfaction and poor work morale in both study groups. CONCLUSION: The findings suggest that firefighter and paramedic job stress is very complicated and multi-faceted. Based on this preliminary investigation, the SOOS instrument appears to have adequate reliability and concurrent validity.


To test the hypothesis that firefighter exposures may increase cancer risk, mortality rates were calculated for 3,066 San Francisco Fire Department firefighters employed between 1940 and 1970. Vital status was ascertained through 1982, and observed and expected rates, rate ratios (RR), and 95% confidence intervals (CI) were computed using United States death rates for comparison. The total number deceased (1,186) was less than expected and there were fewer cancer deaths than expected. However, there were significant excess numbers of deaths from esophageal cancer (12 observed, 6 expected), cirrhosis and other liver diseases (59 observed, 26 expected), and accidental falls (21 observed, 11 expected). There were 24 line-of-duty deaths, which were primarily due to vehicular injury, falls, and asphyxiation. Heart disease and respiratory disease deaths occurred significantly less often than expected. It was concluded that the increased risks of death from esophageal cancer and cirrhosis and other liver diseases may have been due to firefighter exposures, alcohol consumption, or interaction between alcohol and exposures. Because this was an older cohort and firefighter exposures have changed due to the increasing use of synthetic materials, it is recommended that the effects of modern-day exposures be further studied.


This study evaluated effects on respiratory health of forest firefighters exposed to high concentrations of smoke during their work shift. This is the first study of cross-shift respiratory effects in forest firefighters conducted on the job. Spirometric measurements and self-administered questionnaire data were collected before and after the 1992 firefighting season. Seventy-six (76) subjects were studied for cross-shift and 53 for cross-season analysis. On average, the cross-season data were collected 77.7 days after the last occupational smoke exposure. The cross-shift analysis identified significant mean individual declines in FVC, FEV1, and FEF25 75. The preshift to midshift decreases were 0.089 L, 0.190 L, and 0.439 l/sec. respectively, with preshift to postshift declines of 0.065 L, 0.150 L, and 0.496 L/sec. Mean individual declines for FVC, FEV1 and FEF25 75 of 0.033 L, 0.104 L, and 0.275 l/sec, respectively, also were noted in the cross-season analysis. The FEV1 changed significantly (p < 0.05). The use of wood for indoor heat also was associated with the declines in FEV1. Although annual lung function changes for a small subset (n = 10) indicated reversibility of effect, this study suggests a concern for potential adverse respiratory effects in forest firefighters.

OBJECTIVE: Firefighters and emergency medical services (EMS) personnel have the potential for occupational exposures to blood, which increases their risk for occupational blood-borne infection. To address this concern, the authors conducted a literature review of occupational blood exposures, the seroprevalence of blood-borne pathogens among these workers, and the seroprevalence of blood-borne pathogens among the patients they serve. METHODS: A MEDLINE search was conducted, and all identified articles that described surveys of exposures to blood or surveillance of blood-borne infections among firefighters and/or emergency medical technicians (EMTs) in the United States were reviewed. For hepatitis B, only seroprevalence surveys conducted after the 1992 requirement by the Bloodborne Pathogens Standard to offer vaccination to potentially exposed employees were included. RESULTS: From these data, the expected number of annual occupational hepatitis C virus seroconversions was estimated to be between 5.8 and 118.9 per 100,000 employee-years for EMT-paramedics, between 3.4 and 33.7 per 100,000 for firefighter-EMTs, and up to 3.6 per 100,000 for firefighters (non-EMT). CONCLUSIONS: This review suggests there are a limited number of studies addressing this issue, and these studies have numerous limitations. Despite the expected occupational seroconversions and recognizing the limitations in drawing conclusions from these studies, it appears that firefighters and EMS personnel do not have an elevated seroprevalence of hepatitis C virus compared with the general population. Improved exposure surveillance programs would clarify exposure risks and identify potential interventions for firefighters and EMS personnel.


Previous studies have characterized firefighter exposures during fire suppression. However, minimal information is available regarding firefighter exposures during overhaul, when firefighters look for hidden fire inside attics, ceilings, and walls, often without respiratory protection. A comprehensive air monitoring study was conducted to characterize City of Phoenix firefighter exposures during the overhaul phase of 25 structure fires. Personal samples were collected for aldehydes; benzene; toluene; ethyl benzene; xylene; hydrochloric acid; polynuclear aromatic hydrocarbons (PNA); respirable dust; and hydrogen cyanide (HCN). Gas analyzers were employed to continuously monitor carbon monoxide (CO), HCN, nitrogen dioxide (NO2), and sulfur dioxide (SO2). Area samples were collected for asbestos, metals (Cd, Cr, Pb), and total dust. During overhaul the following exceeded published ceiling values: acrolein (American Conference of Governmental Industrial Hygienists [ACGIH] 0.1 ppm) at 1 fire; CO (National Institute for Occupational Safety and Health [NIOSH] 200 ppm) at 5 fires; formaldehyde (NIOSH 0.1 ppm) at 22 fires; and glutaraldehyde (ACGIH 0.05 ppm) at 5 fires. In addition, the following exceeded published short-term exposure limit values: benzene (NIOSH 1 ppm) at two fires, NO2 (NIOSH 1 ppm) at two fires, and SO2 (ACGIH 5 ppm) at five fires. On an additive effects basis, PNA concentrations exceeded the NIOSH recommended exposure limits (0.1 mg/M3) for coal tar pitch volatiles at two fires. Maximum concentrations of other sampled substances were below their respective permissible exposure limits. Initial 10-min average CO concentrations did not predict concentrations of other contaminants found in this atmosphere.


A screening health risk assessment was performed to assess the upper-bound risks of cancer and noncancer adverse health effects among wildland firefighters performing wildfire suppression and prescribed burn management. Of the hundreds of chemicals in wildland fire smoke, we identified 15 substances of potential concern from the standpoints of concentration and toxicology; these included aldehydes, polycyclic aromatic hydrocarbons, carbon monoxide, benzene, and respirable particulate matter. Data defining daily exposures to smoke at prescribed burns and wildfires, potential days of exposure in a year, and career lengths were used to estimate average and reasonable maximum career inhalation exposures to these substances. Of the 15 substances in smoke that were evaluated, only benzene and formaldehyde posed a cancer risk greater than 1 per million, while only acrolein and respirable particulate matter exposures resulted in hazard indices greater than 1.0. The estimated upper-
bound cancer risks ranged from 1.4 to 220 excess cancers per million, and noncancer hazard indices ranged from 9 to 360, depending on the exposure group. These values only indicate the likelihood of adverse health effects, not whether they will or will not occur. The risk assessment process narrows the field of substances that deserve further assessment, and the hazards identified by risk assessment generally agree with those identified as a concern in occupational exposure assessments.


As part of an environmental monitoring and medical surveillance programme to evaluate potential health hazards from firefighting, complete baseline medical examinations were performed on a cohort of 77 firefighters. During a ten day study period, 37 follow up medical examinations were performed after exposure to fire to monitor any significant differences in pre-fire and post-fire physiological indices, including pulmonary function and blood counts and chemistries. For the group as a whole, no significant differences were found. For individuals not wearing respiratory protective equipment, however, statistically significant post-fire decrements in FEV1 and FVC were noted. These decrements were consistent with previously shown levels of exposure to pulmonary toxicants in this cohort. These results support the need for more extensive use of respiratory protective equipment by firefighters.


When fit-testing firefighters who may be required to wear an SCBA unit in the positive pressure mode for IDLH or structural firefighting applications, use these guidelines. 1. The firefighter shall be allowed to pick the most acceptable respirator from a sufficient number of respirator models and sizes so the respirator is acceptable to, and correctly fits, the firefighter. 2. Before a firefighter may be required to use the SCBA, the respirator must be fit-tested with the same make, model, style, and size of respirator that will be used. If different makes, models, styles, and sizes of facepieces are used, the firefighter must be fit-tested for each. 3. Based on current interpretations and guidance, OSHA requires firefighters to be quantitatively fit-tested while in the negative pressure mode. 4. Quantitative fit-testing of these respirators shall be accomplished by modifying the facepiece to allow sampling inside the facepiece and breathing zone of the user, midway between the nose and mouth. This requirement shall be accomplished by installing a permanent sampling probe onto a surrogate facepiece or by using a sampling adapter designed to temporarily provide a means of sampling air from inside the facepiece. 5. Qualitative fit-testing can be accomplished by converting the user's actual facepiece into a negative pressure respirator with appropriate filters or by using an identical negative pressure air-purifying respirator facepiece with the same sealing surfaces as a surrogate for the SCBA facepiece. 6. If after passing the fit-test the firefighter subsequently determines the fit of the respirator is unacceptable, he/she shall be given a reasonable opportunity to select a different respirator facepiece and be retested. 7. The new standard requires initial and at least annual fit-testing using quantitative or qualitative fit-testing protocols. 8. Additional fit-testing may be required whenever physical changes to the employee occur that may affect respirator fit, such as facial scarring, dental changes, cosmetic surgery, or an obvious change in body weight.


Seattle firefighters participate in a voluntary annual medical surveillance program including measurements of ventilatory capacity (FVC and FEV1) and single-breath diffusing capacity of carbon monoxide (DLCO). From 1989 to 1996, average % predicted DLCO (Crapo) for all participating firefighters declined from 94.4% (95% confidence interval [CI]: 93.4% to 95.5%) to 87.3% (95% CI: 86.2% to 88.3%), with no significant change in average FVC or FEV1. A random-effects regression model based on data from 812 firefighters with at least two annual sets of DLCO measurements showed the expected
associations between DLCO and age, height, gender, race, ventilatory capacity, and smoking. In addition, two important temporal changes were observed, including, for an average firefighter, a large mean decline in DLCO of -1.02 ml/min/mm Hg associated with year of measurement, and a relatively smaller decline of -0.006 ml/min/mm Hg associated with number of fires fought. Although the stability of ventilatory capacity over time is reassuring, the marked temporal decline in diffusing capacity among this population of firefighters raises issues of concern. Interpretation of the observed decline poses a dilemma in terms of the reliability and efficacy of diffusing capacity as a screening tool, in whether DLCO is subject to unacceptably technical variability or whether it might provide more sensitive detection of early adverse respiratory effects of smoke inhalation.


Overhaul is the stage in which firefighters search for and extinguish possible sources of reignition. It is common practice not to wear respiratory protection during overhaul. Fifty-one firefighters in two groups, 25 without respiratory protection and 26 wearing cartridge respirators, were monitored for exposure to products of combustion and changes in spirometric measurements and lung permeability following overhaul of a structural fire. Testing at baseline and 1 hour after overhaul included forced vital capacity (FVC), forced expiratory volume in one second (FEV1), serum Clara cell protein (CC16), and serum surfactant-associated protein A (SP-A). Overhaul increased CC16 in both groups, indicating increased alveolocapillary membrane permeability. Contrary to expectations, SP-A increased and FVC and FEV1 decreased in the firefighters wearing cartridge respirators. Changes in FEV1, CC16, and SP-A were associated with concentrations of specific products of combustion or carboxyhemoglobin levels. Firefighter exposures during overhaul have the potential to cause changes in spirometric measurements and lung permeability, and self-contained breathing apparatus should be worn during overhaul to prevent lung injury.


BACKGROUND: Serum pneumoproteins provide a measure of the permeability of the lower respiratory tract, and have shown promise as a biomarker of acute and chronic exposure to respiratory toxicants. METHODS: To evaluate the effects of chronic occupational smoke exposure, 105 firefighters were compared with 44 police controls in a cross-sectional study using spirometry, diffusing capacity of the lung, serum Clara cell protein (CC16), and serum surfactant-associated protein A (SP-A) measurements. RESULTS: There were no significant differences in age, gender, height, spirometry (FVC and FEV(1)), and diffusing capacity between the two groups. Serum SP-A was lower in firefighters (260.1 +/- 121.2 microg/L) than police (316.0 +/- 151.4 microg/L, P = 0.019). Serum CC16 was also lower in firefighters (8.39 +/- 3.11 microg/L) than police (10.56 +/- 4.20 microg/L, P < 0.001), although this difference lost statistical significance when adjusted for confounders. CONCLUSIONS: Firefighters have lower serum concentrations of SP-A than do police. Although the clinical significance of this finding is presently unknown, SP-A deserves further study as a biomarker of toxic exposure to the lower respiratory tract.


Carbon monoxide and oxygen concentrations were measured in seventy-two structural fires using a personal air sampler carried by working firefighters. In a total sampling time of 1329 minutes the carbon monoxide concentration exceeded 500 ppm approximately 29 percent of the time. The maximum carbon monoxide concentration was 27,000 ppm and in 1 percent of the fires, the maximum concentration exceeded 5500 ppm. Only six runs indicated oxygen concentrations less than 18 percent. On the basis of these exposure data, a minimum protection factor of 100 is proposed for breathing apparatus for structural firefighting.

The effect of the self-contained breathing apparatus (SCBA) with compressed air (BA-A) on ventilatory mechanics, work of breathing (WOB), pulmonary function, and respiratory muscle fatigue, was compared with that of a low resistance breathing valve (LRV). Further, the effect of unloading the respiratory muscles with heliox with the SCBA (BA-H) was compared with BA-A and LRV. Twelve men completed three randomized exercise trials on separate days, each consisting of three 10 min bouts of stepping exercise (Bouts 1, 2, and 3) separated by a 5 min recovery. Subjects wore firefighter protective equipment including the SCBA. At rest, FEV(1) and peak expiratory flow rates were lower with BA-A than with LRV, but were higher with BA-H than either with BA-A or LRV. After Bout 3, expiratory reserve volume, expiratory resistive WOB, and inspiratory elastic WOB were increased in BA-A compared to LRV but these were lower with BA-H compared to BA-A. After Bout 3, maximal inspiratory and expiratory pressures were reduced with BA-A, but not with LRV or BA-H. In summary, we found that the SCBA reduced resting pulmonary function, and increased expiratory reserve volume, work of breathing, and respiratory muscle fatigue during stepping exercise, and these changes can be reduced with the use of heliox.


In accomplishing their duties, firefighters are potentially exposed to a vast array of toxic combustion and pyrolysis products such as benzene, carbon monoxide, acrolein, nitrogen dioxide, and polycyclic aromatic hydrocarbons. Exposure to PAH and benzene was assessed by means of urinary measurements of 1-hydroxypyrene and t,t-muconic acid, respectively. All urine samples were collected from 43 firefighters during a period extending for 20 h following the end of exposure during a fire. A control sample was also obtained from each participant after at least four days without involvement in fire fighting activities. Only one control 1-hydroxypyrene measurement exceeded the value of 0.32 micromol/mol creatinine considered as the 95th percentile of a normal reference population in this study. Following exposure, 38 percent of the maximum values of all samples collected from each firefighter exceeded this reference value. The highest single value observed in this study was 3.6 micromol/mol creatinine. None of the control samples had a t,t-muconic acid concentration above the limit of detection. A large number (81%) of post-fire samples also had nonquantifiable concentrations of this metabolite. Among 43 firefighters in this study, 17 had measurable excretion of this metabolite in any of the urine samples after fire fighting and, of the latter group, only 6 had t,t-muconic acid concentrations exceeding 1.1 mmol/mol creatinine, a value considered to correspond to a benzene-air concentration of approximately 1 ppm according to the literature. There is clear evidence that fire fighting activities are associated with exposure to PAH above environmental background, as assessed by 1-hydroxypyrene measurements, despite the use of protective equipment. However, in comparison with observations made in other cohorts of industrial workers with known polycyclic aromatic hydrocarbons exposure, firefighters’ exposure in this study was low. Similarly, based on t,t-muconic acid determinations, exposure to benzene was rather low in this study. For both contaminants, observation of low exposure could be due to either low concentrations of the contaminant during fire fighting or to the efficiency of protective equipment worn.


Ventilatory function and airway reactivity of 20 firefighters were studied one hour before and one hour after exposure in a smoke chamber. None showed an increase in airway reactivity to inhaled histamine before exposure. Eight (80%) of the regular firefighters, however, had an increase in airway reactivity after exposure in the smoke chamber. After six hours, three of the firefighters still had increased airway reactivity. All were non-reactive after 24 hours but the ventilatory function of the three firefighters who were reactive after six hours did not return to baseline values. The duration of service as a firefighter is the major contributing factor to the change in airway reactivity. This increase in airway responsiveness among regular firefighters suggests that some form of chronic epithelial injury is needed before an increase in airway responsiveness is seen.

A Select Annotated Bibliography Used for Firefighter Cancer Research


The risk of cancer of the central nervous system (CNS) by industry and occupation was investigated with a case-control analysis of the death certificates of 28,416 cases and 113,664 controls, selected from over 4.5 million deaths in 24 U.S. states between 1984 and 1992. Industries showing consistent increases in risk by gender and race included textile mills, paper mills, printing and publishing industries, petroleum refining, motor vehicles manufacturing, telephone and electric utilities, department stores, health care services, elementary and secondary schools, and colleges and universities. CNS cancer risk was increased for administrators in education and related fields, secondary school teachers, and other education- and health-related occupations. The application of job-exposure matrices to the industry/occupation combinations revealed a modest increase in risk for potential contact with the public at work and exposure to solvents. Occupational exposure to electromagnetic fields (EMF) was not associated with CNS cancer, although an association was observed with a few EMF-related occupations and industries. Agricultural exposures were associated with significant risk increases among white women and white men. Further work is required to investigate in more detail specific occupational exposures or possible confounders responsible for the observed associations.


**BACKGROUND:** In a recent report, we found an elevated risk of cancer of the central nervous system (CNS) in several occupations and industries, and a modest association with exposure to solvents and to contact with the public. **METHODS:** To further explore the occupational risk of CNS cancer among women, we extended the analysis of the previous death certificate-based case-control study, including 12,980 female cases (ICD-9 codes 191 and 192) in 24 US states in 1984-1992 and 51,920 female controls who died from diseases other than malignancies and neurological disorders. We applied newly designed job-exposure matrices for 11 occupational hazards, previously reported as brain cancer risk factors, to the occupation and industry codes in the death certificates. We also conducted a separate analysis of 161 meningioma cases (ICD-9 codes 192.1 and 192.3), a tumor more frequent among women, particularly in the postmenopausal age group. **RESULTS:** Overall, CNS cancer risk showed a 20-30% increase among women exposed to electromagnetic fields (EMF), methylene chloride, insecticides and fungicides, and contact with the public. Risk for meningioma was elevated among women exposed to lead (OR = 1.9; 95% CI 1.0, 3.9). CNS cancer did not show a clear pattern of risk increase by probability and intensity of exposure to any of the explored risk factors. Cross-classification by probability and intensity of exposure did not reveal any significant trend. Cases were too few to explore trends of meningioma by probability and intensity of exposure to lead. **CONCLUSIONS:** We did not find evidence of a strong contribution of 11 occupational hazards to the etiology of CNS cancer. However, limitations of the occupational information might have reduced our ability to detect clear patterns of risk.


We evaluated the risk of gastric cardia cancer by occupation and industry in a case-control study using information from death certificates for 24 US states in 1984-1992. One thousand fifty-six cases of gastric cardia cancer were identified among men aged 20 years or more, including 1,023 whites and 33 blacks. Controls were 5,280 subjects who died of nonmalignant diseases, 5:1 matched to cases by geographic region, race, gender, and 5-year age group. Among white men, occupations with elevated risk included financial managers (odds ratio [OR] = 6.1; 95% confidence interval [CI], 1.3-28.8), janitors and cleaners (OR = 1.7; 95% CI, 1.0-2.9), production inspectors (OR = 3.2; 95% CI, 1.5-6.9), and truck drivers (OR = 1.5; 95% CI, 1.0-2.2). Industries with elevated risk included pulp and paper mills (OR = 2.0; 95% CI, 1.0-37), newspaper publishing and printing (OR = 2.6; 95% CI, 1.0-6.3), industrial and miscellaneous chemicals (OR = 2.0; 95% CI, 1.0-3.9), water supply and irrigation (OR = 5.6; 95% CI, 1.6-19.9). Among black men, risks were nonsignificantly increased for subjects employed in railroads (3 cases, 2 controls) and for carpenters (3 cases, 0 controls). We created job-exposure matrices for asbestos, inorganic dust, metal dust, lead, polycyclic aromatic hydrocarbons, nitrogen oxides, nitrosamines, sulfuric acid, fertilizers,
herbicides, other pesticides, and wood dust. Among white men, a consistent pattern of risk increase by level and probability of exposure was observed only for sulfuric acid mists, with a twofold excess (95% CI, 0.6-7.3) associated with high probability of high intensity exposure. A significant 30% increase in risk was observed for those subjects with a high probability of exposure (all levels combined) to lead, and a 60% increase was observed for subjects with high-level exposure to lead (all probabilities combined). However, crosstabulation of gastric cardia cancer risk by probability and level of exposure to lead did not show consistent trends. Asbestos exposure also showed an overall 50% increase but no consistent trends among white men. None of the 12 occupational hazards showed an association with risk for black men.


INTRODUCTION: Firefighters are taught that heat, oxygen deprivation, and carbon monoxide (CO) are the primary threats to life in residential structure fires, and they are taught to search for victims on the fire floor first, and then floors above. The objective of this study was to gather data regarding oxygen, CO, and heat conditions inside a realistic house fire, to examine the validity of these teachings. METHODS: During six live-burn training evolutions in a two-story wood-frame house, metering for oxygen levels, CO levels, and temperature was conducted. Except where noted, all readings were taken 24 inches off the floor, to simulate the location of a crawling victim or firefighter. Readings were hand-recorded on a convenience basis by firefighters stationed outside the building, near the meters. RESULTS: Of the 35 oxygen levels recorded, the lowest was 18.2%, with only 12 readings below 20%. Three of 16 first-floor readings were below 20%, whereas nine of 19 second-floor readings were below 20% (p=0.07). First- and second-floor readings were comparable (mean 20.3% vs. 19.9%, p=0.11). Except for one reading of 1,870 ppm, all CO readings at the ceiling exceeded the 2,000-ppm limit of the meters. Of the 34 CO levels recorded 24 inches off the floor, 29 (76%) exceeded the permissible exposure limit of 50 ppm, with the highest reading being 1,424 ppm, well above the "immediately dangerous to life and health" level of 1,200 ppm. None of the 20 CO levels recorded on the first floor exceeded the 30-minute exposure limit of 800 ppm, whereas seven of 14 second-floor readings exceeded this limit (p<0.001). While ceiling temperatures frequently exceeded the 1,000 degrees F limit of the meters, none of 16 readings taken 24 inches off the floor exceeded 137 degrees F. First- and second-floor temperatures were comparable (mean 88.5 degrees F vs. 90.1 degrees F, p=0.9). CONCLUSIONS: In residential structure fires, CO poses a greater threat to victims and firefighters than does oxygen deprivation or heat. Emergency medical services personnel should consider CO toxicity in all fire victims. Conditions on the floor above a fire are at least as adverse as those on the fire floor.


BACKGROUND: Bushfire fighters are potentially subject to risks from bushfire smoke. Although many different protective masks and filters are available, it is not clear which is the most effective from a health and safety perspective. The effect of protective filters on the respiratory health of Western Australian urban career fire fighters under controlled simulated conditions is investigated. METHODS: Sixty-four healthy Fire and Emergency Services Authority of Western Australia (FESA) urban career fire fighters were subjected to controlled simulated bushfire smoke in an open smoke chamber for 15 min. The fire fighters were allocated one of the three types of protective filters: particulate only (P), particulate/organic vapor (POV), and a particulate/organic vapor/formaldehyde (POVF) filter using a double-blind randomized procedure. Personal air sampling inside the fire fighters' masks, spirometry, oximetry, and self-reported symptom data were collected at baseline and at two time intervals after the smoke exposure. RESULTS: A significant decline in oxygen saturation was seen immediately after exposure, however, the decline was small and no significant relationships could be established between this and the type of filter used. A significantly higher number of participants in the P and POV filter groups self-reported an increase in coughing, wheezing, and shortness of breath compared to the POVF group. Air sampling demonstrated a significantly higher level of formaldehyde and acrolein inside the masks fitted with P filters compared to POV and POVF filters. CONCLUSIONS: Testing the effectiveness of P, POV, and POVF filters under
controlled conditions has demonstrated that the POVF filter provides statistically significant better protection for the fire fighters' airways in a simulated bushfire exposure chamber.


BACKGROUND: Bushfire smoke contains a range of air toxics. To prevent inhalation of these toxics, fire fighters use respiratory equipment. Yet, little is known about the effectiveness of the equipment on the fire ground. Experimental trials in a smoke chamber demonstrated that, the particulate/organic vapor/formaldehyde (POVF) filter performed best under simulated conditions. This article reports on the field validation trials during prescribed burns in Western Australia. METHODS: Sixty-seven career fire fighters from the Fire and Emergency Services Authority of Western Australia were allocated one of the three types of filters. Spirometry, oximetry, self-reported symptom, and personal air sampling data were collected before, during and after exposure to bushfire smoke from prescribed burns. RESULTS: Declines in FEV(1) and SaO(2) were demonstrated after 60 and 120 min exposure. A significant higher number of participants in the P filter group reported increases in respiratory symptoms after the exposure. Air sampling inside the respirators demonstrated formaldehyde levels significantly higher in the P filter group compared to the POV and the POVF filter group. CONCLUSIONS: The field validation trials during prescribed burns supported the findings from the controlled exposure trials in the smoke chamber. Testing the effectiveness of three types of different filters under bushfire smoke conditions in the field for up to 2 hr demonstrated that the P filter is ineffective in filtering out respiratory irritants. The performance of the POV and the POVF filter appears to be equally effective after 2 hr bushfire smoke exposure in the field.


In order to determine if exposure to carcinogens in fire smoke increases the risk of cancer, we examined the incidence of cancer in a cohort of 2,447 male firefighters in Seattle and Tacoma, (Washington, USA). The study population was followed for 16 years (1974-89) and the incidence of cancer, ascertained using a population-based tumor registry, was compared with local rates and with the incidence among 1,878 policemen from the same cities. The risk of cancer among firefighters was found to be similar to both the police and the general male population for most common sites. An elevated risk of prostate cancer was observed relative to the general population (standardized incidence ratio [SIR] = 1.4, 95 percent confidence interval [CI] = 1.1-1.7) but was less elevated compared with rates in policemen (incidence density ratio [IDR] = 1.1, CI = 0.7-1.8) and was not related to duration of exposure. The risk of colon cancer, although only slightly elevated relative to the general population (SIR = 1.1, CI = 0.7-1.6) and the police (IDR = 1.3, CI = 0.6-3.0), appeared to increase with duration of employment. Although the relationship between firefighting and colon cancer is consistent with some previous studies, it is based on small numbers and may be due to chance. While this study did not find strong evidence for an excess risk of cancer, the presence of carcinogens in the firefighting environment warrants periodic re-evaluation of cancer incidence in this population and the continued use of protective equipment.


This study is designed to evaluate the efficacy of colorectal cancer screening in a high risk population of pattern and model makers. The cohort of 1,641 white male automotive pattern and model makers was identified in 1981, and offered colorectal cancer screening. The program involved periodic 60 cm flexible sigmoid examination, stool occult blood testing, and digital rectal examination. Screening was offered in 1981, 1982, 1985, 1988, and 1991. Approximately 60% of those eligible participated in at least one screening examination. Nonparticipants showed a relative risk for incident colorectal cancer of over 10, compared to those who participated at least once in the screening. Cohort tracking has accumulated 10 years; results suggest a benefit to colorectal cancer screening in this population.

BACKGROUND: Prostate cancer mortality and incidence rates have been gradually increasing for decades in the United States, with an accelerated increase in incidence noted in the past several years. This study explores in detail the occurrence of prostate cancer in southeast Michigan from 1973 through 1991. METHODS: Data from the National Cancer Institute Surveillance, Epidemiology, and End Results program are analyzed with emphasis on time trends by race, age, stage, and treatment. RESULTS: Population-based rates for prostate cancer increased by 70% between 1988 and 1991. Increases are most pronounced for early stage disease and among whites compared with blacks. Corresponding increases in treatment with radical prostatectomy are also observed. CONCLUSION: Increased incidence of prostate cancer is likely a result of widespread use of prostate-specific antigen.


BACKGROUND: Organic solvents have been associated with renal cell cancer; however, the risk by gender and type of solvents is nuclear. METHODS: We evaluated the risk of renal cell carcinoma among men and women exposed to all organic solvents-combined, all chlorinated aliphatic hydrocarbons (CAHC)-combined, and nine individual CAHC using a priori job exposure matrices developed by NCI in a population-based case-control study in Minnesota, U.S. We interviewed 438 renal cancer cases (273 men and 165 women) and 687 controls (462 men and 225 women). RESULTS: Overall, 34% of male cases and 21% of female cases were exposed to organic solvents in general. The risk of renal cell carcinoma was significantly elevated among women exposed to all organic solvents combined (OR = 2.3; 95% CI = 1.3-4.2), to CAHC combined (OR = 2.1; 95% CI = 1.1-3.9), and to trichloroethylene (TCE) (OR = 2.0; 95% CI = 1.0-4.0). Among men, no significant excess risk was observed among men exposed to any of these nine individual CAHCs, all CAHCs-combined, or all organic solvents-combined. DISCUSSION: These observed gender differences in risk of renal cell carcinoma in relation to exposure to organic solvents may be explained by chance based on small numbers, or by the differences in body fat content, metabolic activity, the rate of elimination of xenobiotics from the body, or by differences in the level of exposure between men and women, even though they have the same job title.


The collapse of the World Trade Center (WTC) on 11 September 2001 exposed New York City firefighters to smoke and dust of unprecedented magnitude and duration. The chemicals and the concentrations produced from any fire are difficult to predict, but estimates of internal dose exposures can be assessed by the biological monitoring of blood and urine. We analyzed blood and urine specimens obtained from 321 firefighters responding to the WTC fires and collapse for 110 potentially fire-related chemicals. Controls consisted of 47 firefighters not present at the WTC. Sampling occurred 3 weeks after 11 September, while fires were still burning. When reference or background ranges were available, most chemical concentrations were found to be generally low and not outside these ranges. Compared with controls, the exposed firefighters showed significant differences in adjusted geometric means for six of the chemicals and significantly greater detection rates for an additional three. Arrival time was a significant predictor variable for four chemicals. Special Operations Command firefighters (n = 95), compared with other responding WTC firefighters (n = 226), had differences in concentrations or detection rate for 14 of the chemicals. Values for the Special Operations Command firefighters were also significantly different from the control group values for these same chemicals and for two additional chemicals. Generally, the chemical concentrations in the other firefighter group were not different from those of controls. Biomonitoring was used to characterize firefighter exposure at the WTC disaster. Although some of the chemicals analyzed showed statistically significant differences, these differences were generally small.

OBJECTIVE: PHLAME’s (Promoting Healthy Lifestyles: Alternative Models’ Effects) objective was to assess and compare two means to promote healthy lifestyles. METHODS: Prospective trial among 599 firefighters randomized by station to 1) team-centered curriculum, 2) one-on-one motivational interviewing (MI), and 3) controls. Assessment included dietary behavior, physical activity, weight, and general well-being at baseline and 12 months. Program effects were determined using an analysis of covariance (ANCOVA) based approach, and models for relationships were evaluated with path analysis. RESULTS: Both interventions were acceptable and delivered with high fidelity. The team and MI programs increased fruit and vegetable consumption (P < 0.01 and 0.05, respectively) and general well-being (P < 0.01). Significantly less weight gain occurred in both (P < 0.05). A cross-sectional model was consistent with mediation differing between interventions. CONCLUSIONS: Both a team-centered and individual-oriented intervention promoted healthy behaviors. The scripted team curriculum is innovative, exportable, and may enlist influences not accessed with individual formats.


Firefighting is a demanding occupation, laden with hazardous exposures which result in traumatic injuries. Little epidemiologic evidence exists quantifying these factors, however. We conducted an incident-level case-control study of National Fire Incident Reporting System data of the association between firefighter injury and incident characteristics. Risk factors included 5 or more alarms (OR = 3.85; 95% CI, 3.32-4.48), number of stories (> 3 vs. ground level OR = 2.49; 95% CI, 1.43 to 1.55), and at least one civilian injury (OR = 3.69; 95% CI, 3.55-3.84). Risk of injury was reduced for fires originating 49 feet and higher (OR = 0.57; 95% CI, 0.49-0.66). This analysis suggests that fireground-specific situations such as the number of stories or a civilian injury increase the risk of injury. Given the danger of firefighting, the identification of risk factors through epidemiologic methods is vital to developing safety measures.


CONTEXT: New York City firefighters responding to the World Trade Center (WTC) disaster on September 11, 2001, were exposed to numerous hazards. A medical screening program was conducted 3 weeks after the disaster on a sample of firefighters. OBJECTIVES: To determine whether arrival time at the WTC and other exposure variables (including respirator use) were associated with symptoms and changes in pulmonary function (after exposure - before exposure). DESIGN: A cross-sectional comparison of firefighters representing the following groups: (1) firefighters who arrived before/during the WTC collapse, (2) firefighters who arrived 1 to 2 days after the collapse, (3) firefighters who arrived 3 to 7 days after the collapse, and (4) unexposed firefighters. SETTING: Fire Department of New York City (FDNY) Bureau of Health Services on October 1 to 5, 2001. POPULATION: A stratified random sample of 362 of 398 recruited working firefighters (91%). Of these, 149 firefighters (41%) were present at the WTC collapse, 142 firefighters (39%) arrived after the collapse but within 48 h, 28 firefighters (8%) arrived 3 to 7 days after the collapse, and 43 firefighters (12%) were unexposed. MAIN OUTCOME MEASURES: New/worsening symptoms involving the eyes, skin, respiratory system, and nose and throat (NT), and changes in spirometry from before to after exposure. RESULTS: During the first 2 weeks at the WTC site, 19% of study firefighters reported not using a respirator; 50% reported using a respirator but only rarely. Prevalence ratios (PRs) for skin, eye, respiratory, and NT symptoms showed a dose-response pattern between exposure groups based on time of arrival at the WTC site, with PRs between 2.6 and 11.4 with 95% confidence intervals (CIs) excluding 1.0 for all but skin symptoms. For those spending > 7 days at the site, the PR for respiratory symptoms was 1.32 (95% CI, 1.13 to 1.55), compared with those who were exposed for < 7 days. Mean spirometry results before and after exposure were within normal limits. The change in spirometry findings (after exposure - before exposure) showed near-equal reductions for FVC and FEV(1). These reductions were greater than the annual reductions measured in a referent population of incumbent FDNY firefighters prior to September 11 (p <or= 0.05). There was a 60% increased risk of a
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decline of \( \geq 450 \text{ mL} \) in FEV\( (1) \) in those arriving during the first 48 h compared to the referent \( (p \leq 0.05) \). CONCLUSIONS: The symptoms and pulmonary function changes following exposure at the WTC demonstrate the need for improvements in respirators and their use, as well as long-term medical monitoring of rescue workers.


New York City Firefighters (FDNY-FFs) were exposed to particulate matter and combustion/pyrolysis products during and after the World Trade Center (WTC) collapse. Ten months after the collapse, induced sputum (IS) samples were obtained from 39 highly exposed FDNY-FFs (caught in the dust cloud during the collapse on 11 September 2001) and compared to controls to determine whether a unique pattern of inflammation and particulate matter deposition, compatible with WTC dust, was present. Control subjects were 12 Tel-Aviv, Israel, firefighters (TA-FFs) and 8 Israeli healthcare workers who were not exposed to WTC dust. All controls volunteered for this study, had never smoked, and did not have respiratory illness. IS was processed by conventional methods. Retrieved cells were differentially counted, and metalloproteinase-9 (MMP-9), particle size distribution (PSD), and mineral composition were measured. Differential cell counts of FDNY-FF IS differed from those of health care worker controls \( (p < 0.05) \) but not from those of TA-FFs. Percentages of neutrophils and eosinophils increased with greater intensity of WTC exposure \( (< 10 \text{ workdays or greater than or equal to } 10 \text{ workdays; neutrophils } p = 0.046; \text{ eosinophils } p = 0.038) \). MMP-9 levels positively correlated to neutrophil counts \( (p = 0.002; r = 0.449) \). Particles were larger and more irregularly shaped in FDNY-FFs \((1-50 \text{ microm; zinc, mercury, gold, tin, silver})\) than in TA-FFs \((1-10 \text{ microm; silica, clays})\). PSD was similar to that of WTC dust samples. In conclusion, IS from highly exposed FDNY-FFs demonstrated inflammation, PSD, and particle composition that was different from nonexposed controls and consistent with WTC dust exposure.


BACKGROUND: This study was carried out to identify male occupational groups with increased incidence of cancer for the period 1972-1984 in New Zealand. No data on cancer incidence by occupation have been reported previously for New Zealand. METHODS: Age (SIR1) and age and socioeconomic level (SIR2) standardized incidence ratios were calculated for males 15-64 years for all cancers combined and for site-specific cancers by occupational group. Directly age standardized rates were also calculated by socioeconomic level. RESULTS: In general, occupations in higher socioeconomic levels had lower all-cancer incidence ratios and lower socioeconomic levels had higher ratios. However, the highest socioeconomic level (level 1) had a higher all-cancer incidence rate than levels 2-6. After socioeconomic adjustment in increased incidence ratio for lung cancer was found for jewellery and precious metal workers \((\text{SIR2} = 241; \text{95\% confidence interval [CI]}: 116-146)\), and bricklayers and carpenters \((\text{SIR2} = 130; \text{95\% CI: 120-433})\), Woodworkers had increased ratios for stomach \((\text{SIR2} = 144; \text{95\% CI: 110-186})\) and rectal cancer \((\text{SIR2} = 146; \text{95\% CI: 116-181})\). Firefighters had an increase for laryngeal cancer \((\text{SIR2} = 1074; \text{95\% CI: 279-2776})\). CONCLUSIONS: Research appears to be warranted to further investigate associations of laryngeal cancer in firefighters, lung cancer in jewellery and precious metal workers and bricklayers and carpenters, and digestive cancers in woodworkers.


AIM. To identify male occupational groups with increased risk of death from cancer in 1973-86. METHOD. Age and social class standardised mortality ratios were calculated for males 15-64 years for all cancers combined and for site specific cancers by occupational group. RESULTS. In general, higher socio-economic groups had a lower all cancer mortality and lower socio-economic groups a higher mortality. After standardisation for age and social class, mortality ratios were increased for lung cancer in bricklayers and carpenters \((\text{SMR} = 125; \text{95\% CI: 110-141})\), machine tool operators \((\text{SMR} = 218; \text{95\% CI: 131-342})\), and welders \((\text{SMR} = 140; \text{95\% CI: 120-161})\), with the first group also having an increased risk for pleural mesothelioma \((\text{SMR} = 222; \text{95\% CI: 70-522})\). Malignant melanoma risk was increased in
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clerical workers (SMR = 147; 95% CI: 106-199) and not in outdoor occupations. Colon cancer mortality risk was increased in managers (SMR = 125; 95% CI: 104-148), and woodworkers (SMR = 147; 95% CI: 115-186). Stomach cancer mortality risk was raised for machine tool operators (SMR = 357; 95% CI: 128-782). Painters had an increased ratio for multiple myeloma (SMR = 352; 95% CI: 140-729) and machine tool operators an increase for leukaemia (SMR = 172; 95% CI: 45-446). CONCLUSIONS. The use of routinely collected data to examine cancer mortality by occupation is a useful method to identify groups with increased risks and provide information for hypothesis generation. Further research may be warranted to investigate lung and digestive cancers in woodworkers and machine tool operators, and cancer of the haemopoietic and lymphatic systems in painters and machine tool operators.


Personal sampling techniques were used to evaluate firefighter exposure to particulates from diesel engine emissions. Selected fire stations in New York, Boston and Los Angeles were studied. Firefighter exposure to total particulates increased with the number of runs conducted during an 8-hr period. In New York and Boston where the response level ranged from 7 to 15 runs during an 8-hr shift, the resulting exposure levels of total airborne particulates from diesel exhaust were 170 to 480 micrograms/m3 (TWA). Methylene chloride extracts of the diesel particulates averaged 24% of the total. The authors' findings suggest that additional research is necessary to assess fire station concentrations of vehicle diesel exhaust that may have adverse health consequences to firefighters.


INTRODUCTION: In the summer of 1998, a series of wildfires swept across Florida. Firefighters and support personnel were imported and based in a central camp in Flagler County, Florida. Local residents were evacuated. Disaster medical assistance teams (DMATs) were deployed to provide medical support. Similar large-scale fire disasters occur frequently, but the illnesses and injuries seen have not been described. OBJECTIVES: To report the descriptive epidemiology of illnesses and injuries seen in firefighters and support personnel engaged in control and suppression of a series of wildfires. METHODS: Review of DMAT treatment records to determine the nature of illnesses and injuries seen during a 19-day deployment. RESULTS: Approximately 1,600 firefighters and support personnel were present in the camp. There were 3,404 patients seen with 3,841 complaints. An average of 179 patients was seen per day (range 47-414). A prominent bimodal pattern of presentations was noted during the course of each day. Reasons for seeking medical care included: preventive/hygiene and environmental, 33%; foot-related, 15%; rashes, 14%; ear, nose, and throat (ENT)/allergies, 9%; headache, 4%; eye irritation, 4%; gastrointestinal/abdominal complaints, 3%; cuts and penetrating injuries, 3%; strains/sprains, 2%; bites/stings, 2%; others, 1%. Eight patients (0.2%) were transferred to an emergency department for further care; 99.8% were treated on site. CONCLUSIONS: In this setting the majority of illnesses and injuries are minor. Visits related to preventive care and hygiene are common. This information can help in planning medical support operations in similar situations.


OBJECTIVES: To assess acute respiratory effects experienced by wildland firefighters. METHODS: We studied two Interagency Hotshot Crews with questionnaires, spirometry, and measurement of albumin, eosinophilic cationic protein (ECP), and myeloperoxidase (MPO) as indicators of inflammation in sputum and nasal lavage fluid. Assessments were made preseason, postfire, and postseason. RESULTS: Fifty-eight members of the two crews had at least two assessments. Mean upper and lower respiratory symptom scores were higher postfire compared to preseason (P < 0.001). The mean forced expiratory volume in 1 second was lower postfire compared to preseason (P < 0.001) and then recovered by postseason. Individual increases in sputum and nasal ECP and MPO from preseason to postfire were all significantly associated with postfire respiratory symptom scores. CONCLUSIONS: Wildland firefighting was associated with upper and lower respiratory symptoms and reduced forced expiratory volume in 1
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second. Within individuals, symptoms were associated with increased ECP and MPO in sputum and nasal lavage fluid. The long-term respiratory health impact of wildland firefighting, especially over multiple fire seasons, remains an important concern.


INTRODUCTION: The world's new social environment dictates the need for preparedness should a disaster occur. One caveat in the realm of disaster preparedness is the vertical evacuation of hospital patients. Little data regarding the evacuation of patients are available, and the consequences of not being prepared could be devastating. Therefore, if the vertical evacuation of critically ill patients was thrust upon a community hospital, the response of emergency services and ancillary staff is largely unknown.

METHODS: The vertical evacuation of 12 simulated critically ill patients from the fourth floor of a newly constructed and vacant critical care unit was undertaken by local fire fighters, on-staff nursing, residents, and ancillary staff, all under the direction of the hospital Emergency Management Committee. Four randomly selected groups of firefighters, two teams consisting of three personnel and two teams of four personnel, were timed and had vital signs assessed prior to ascending to the fourth floor to retrieve a patient and upon each subsequent decent. Each team, dressed in full turnout gear, retrieved three patients. Each simulated patient was fashioned with mock endotracheal tube, intravenous lines, monitor, and a Pleurovac was attached in three of the four patients. Vital signs were analyzed for significant changes or patterns due to exertion and or stress during the drill. Evaluations were distributed to all participants upon completion of the drill. RESULTS: Mean values for the vital signs of the members of each team showed minimal increases from baseline to completion with the exception of heart rate. A decrease in systolic blood pressure was present in both of the four member teams. Subjective evaluation by the firefighters, indicated a "minimal" increase in exertion. Mean extraction time was 14.7 minutes. Patient transfer and evacuation was completed without complication to the patients or staff. Only one firefighter requested a replacement. Completed evaluations indicated above average or outstanding performance on organization, commitment, security, and care. Comments included statements regarding equipment management during transport, better communication, stairwell width, difficulty with ventilating intubated patients, improvement of evacuation time, and organization as drill progressed; three member teams, spatially, worked better than four. CONCLUSION: This drill reflected an impressive level of preparedness by firefighters, nurses, and ancillary staff both physically and organizationally. Should a vertical evacuation of critically ill patients be necessary, a four firefighter extraction team and accompanying nurse and respiratory therapist would be able to evacuate one patient at a rate of 3.75 minutes per floor.


To characterize the physical demands associated with on-the-job use of current firefighting equipment and the performance of essential firefighting operations, an initial task analysis of all firefighting operations was followed by an in-depth physical and physiological characterization of those tasks deemed to be physically demanding. The most commonly encountered applications of strength and endurance were lifting and carrying objects (up to 80 lbs), pulling objects (up to 135 lbs), and working with objects in front of the body (up to 125 lbs). The most demanding firefighting operations required a mean VO2 of 41.5 ml/kg.min-1 with peak lactate concentrations of 6 to 13.2 mM. Ninety percent of the demanding firefighting operations that were studied required a mean VO2 of 23 ml/kg.min-1. These aerobic energy requirements corresponded to 85 and 50% VO2max, respectively. Therefore a minimum VO2max standard for firefighter applicants of 45 ml/kg.min-1 is recommended.


It is imperative that fitness screening protocols for firefighter applicants embody the specific physical requirements of fighting fires. Based on the physiological characterization of experienced firefighters performing essential tasks, a test battery was developed that includes both job related performance tests
and a combination of health-related and performance-related laboratory tests of physical fitness. Fifty-three firefighters with an average of 5.4 years of experience completed the battery and provided Likert scale comparisons of the tests with actual firefighting operations for criterion validation. "Acceptable" through "maximum" times were established for the job-related performance tests, and "minimum" through "optimum" standards were developed for the physical fitness tests. Guidelines for the medical screening of firefighter applicants are also described. In addition, an overall scoring procedure was formulated for the ranking of acceptable applicants.


There has been increasing interest in the newly identified condition of childhood traumatic grief (CTG) since the 2001 attack on the World Trade Center. The case presented here is one of an adolescent girl who was diagnosed with CTG following the death of her father, a firefighter killed in the line of duty on September 11, 2001. Literature on CTG, its treatment, and adolescent development will be discussed. The application of client-centered treatment to CTG will be highlighted by the case description and diagnostic findings prior to, during, and following treatment.


The firefighter's exposure to carbon monoxide represents a relatively constant occupational hazard. Unfortunately, attempts to predict the level of this exposure in work situations have failed to be of practical benefit. This study was designed to examine the several determinants of carbon monoxide uptake by firefighters in a controlled situation. Twenty firefighters were monitored for heart rate and carboxyhemoglobin (COHb) levels during a search-and-rescue drill in a smoke-filled building. Carbon monoxide levels were maintained at 200 to 1000 ppm. Heart rates increased to 90% of maximum for age within minutes, and COHb levels increased at more than 1% per minute. The use of breathing apparatus provided full protection from uptake of COHb but was associated with significantly increased heart rates. The results show that exertional levels and, therefore, ventilatory rates may be so great during firefighting that even in moderate or low levels of atmospheric carbon monoxide the COHb can rise to dangerous levels within minutes. These findings suggest that no firefighter should be allowed to work in a burning or smoke-filled structure without the protection of breathing apparatus.


The mortality experience of firefighters has been an active topic of investigation. Collateral toxicological evidence suggests that certain causes of death are likely to be associated with firefighting: lung cancer, heart disease, and obstructive pulmonary disease. To date there has not been a clear and consistent demonstration of excess risk due to occupational exposure for these outcomes, but certain other cancers, including genitourinary, colon and rectum, and leukemias, lymphomas, and myeloma, appear to be consistently elevated. A major unproven hypothesis is that risk increased following the introduction, in the 1950s of combustible plastic furnishings and building materials known to generate toxic combustion products. Mortality by cause of death was examined for two cohorts totalling 3,328 firefighters active from 1927 to 1987 in Edmonton and Calgary, the two major urban centers in the province of Alberta, Canada, examining associations with cohort (before and after the 1950s) and years of service weighted by exposure opportunity. The study attained 96% follow-up of vital status and over 64,983 person-years of observation, yielding 370 deaths. Mortality from all causes was close to the expected standardized mortality ratio (96; 95% confidence limits (CL) 87, 107) as was that for heart disease (110; 95% CL 92, 131), and neither was statistically significant at the p < 0.05 level (N.S.). Excesses were observed for all malignant neoplasms (127; 95% CL 102, 155, p < 0.05) and for cancer of lung (142; 95% CL 91, 211, N.S.), bladder (315; 95% CL 86, 808, N.S.), kidney and ureter (414; 95% CL 166, 853, p < 0.05), colon and rectum (161; 95% CL 88, 271, N.S.), pancreas (155; 95% CL 50, 362, N.S.) and leukemia, lymphoma, and myeloma (127; 95% CL 61, 233, N.S.); obstructive pulmonary diseases (157; 95% CL 79, 281, N.S.). Fire-related causes showed a marked excess (486; 95% CL 233, 895, p < 0.01), but external causes overall showed a significant deficit (66; 95% CL 49, 87, p < 0.05). The lung cancer excess was
confined to Edmonton; there was no consistent association with duration of employment, exposure opportunity, or cohort of entry (before or after the 1950s) except that the highest risk was observed among Edmonton firefighters with over 35 weighted years. The excess of cancers of the urinary tract was observed mostly among firefighters entering service after 1950, appeared to increase with length of service and exposure opportunity, and was observed in both cities. An occupational association with heart disease and chronic pulmonary disease is not supported in this study on this population. (ABSTRACT TRUNCATED AT 400 WORDS)


Because of their occupational exposure to a variety of toxic agents, fire fighters may be at risk for a number of exposure-related diseases. We reviewed the current literature on disease risk among fire fighters to compare findings and to infer magnitude of risk. A standard mortality ratio (SMR) of 200 is equal to an attributable risk of 100% of expected, sufficient to justify presumption in most workers’ compensation systems that accept this. We therefore concentrated on risks that approach or exceed an SMR of 200 or an equivalent risk estimate, bearing in mind that confidence intervals around these estimates are wide. Based on the criteria for presumption of occupational risk, we suggest the following conclusions with respect to general presumption of risk: (1) Lung cancer: There is evidence for an association but not of sufficient magnitude for a general presumption of risk. (2) Cardiovascular. There is no evidence for an increased risk of death overall from heart disease. Sudden death, myocardial infarction, or fatal arrhythmia occurring on or soon after near-maximal stress on the job are likely to be heart related, but such "heart attacks" occurring away from work cannot be presumed to be work related. (3) Aortic aneurysm: The evidence is incomplete for an association, but if an association does exist, it would probably be of a magnitude compatible with a general presumption of risk. (4) Cancers of the genitourinary tract, including kidney, ureter, and bladder: The evidence is strong for both an association and for a general presumption of risk. (5) Cancer of brain: Incomplete evidence strongly suggests a possible association at a magnitude consistent with a general presumption of risk. (6) Cancer of lymphatic and hematopoietic tissue: By group, there is some evidence for both an association and a general presumption or risk. However, the aggregation is medically meaningless. We therefore recommend a case-by-case approach. (7) Cancer of the colon and rectum: There is sufficient evidence to conclude that there is an association but not that there is a general presumption of risk. (8) Acute lung disease: Unusual exposures, such as exposure to the fumes of burning plastics, can cause severe lung toxicity and even permanent disability. This does not appear to result in an increased lifetime risk of dying from chronic lung disease.


BACKGROUND: The evaluation of causality in cancers associated with firefighting presents problems common to other applications of occupational epidemiology in adjudication of individual claims for workers' compensation. A trend in Canada to establish legislated presumptions for compensation of firefighters created an opportunity to re-evaluate the literature applying medicolegal standards of certainty. OBJECTIVE: To evaluate causality in selected cancer categories for firefighters using the criteria applied in tort litigation and workers’ compensation, which is based on the weight of evidence and which is required to take into account individual factors. METHODS: The epidemiological literature on cancer risk among firefighters was reviewed based on the weight of evidence rather than scientific certainty. Generalizable frameworks were formulated to define recurrent issues in assessing the evidence from epidemiological studies. The evidence for latency and for a threshold effect with duration of employment was also examined in order to provide practical guidelines. RESULTS: Presumption is justified for the following cancers: bladder, kidney, testicular and brain, and lung cancer among non-smokers. Non-Hodgkin lymphoma, leukaemia and myeloma (each as a class) not only present particular problems in assessment but also merit an assumption of presumption. Four analytical frameworks describe the problems in analysis encountered. DISCUSSION: The preponderance of evidence supports the presumption of causation for certain cancer, mostly rare. These frameworks are applicable to other problems of adjudication that rest on interpretation of epidemiological data. The named cancers, taking
into account the special assessment issues described by each framework, are supported by sufficient evidence to conclude that a presumption is warranted but not necessarily sufficient evidence to accept as proof by a scientific standard.


Firefighter mortality studies that used standardized mortality ratio (SMR) as a summary measure are reviewed and an overview of time-dependent mortality effects for all causes, CAD, cancer, and respiratory deaths is provided. Of 17 studies reporting SMRs for firefighters, three overlapped with larger studies and six did not contain time-dependent data, leaving eight for inclusion. The time effects showed no increased mortality with increasing time employed and time since first employment (latency) for all-cause mortality or any specific cause. There were many causes of death for which firefighters' SMRs were below one through all durations of employment and latency. There was no convincing evidence that employment as a firefighter is associated with increased all-cause, CAD, cancer, or respiratory disease mortality.


Problem/Condition: A review of existing reporting systems indicated that not enough information was being collected to determine the public health consequences of emergency events involving hazardous substances. Reporting Period Covered: January 1990 through December 1992. Description of System: State health departments in selected states collect and each quarter transmit information about the events, substances released, and the public health consequences of hazardous substance releases (i.e., morbidity, mortality, and evacuations) to the Agency for Toxic Substances and Disease Registry (ATSDR). Five state health departments (Colorado, Iowa, Michigan, New Hampshire, and Wisconsin) began data collection on January 1, 1990. On January 1, 1992, the reporting state health departments included those from Colorado, Iowa, New Hampshire, New York, North Carolina, Oregon, Rhode Island, Washington, and Wisconsin. Results and Interpretation: During 1990-1992, 3,125 events were reported from participating states to ATSDR's Hazardous Substances Emergency Events Surveillance (HSEES) system. Of these events, 2,391 (77%) were fixed-facility events (i.e., occurred at stationary facilities), and 723 (23%) were transportation related. In 88% of events, a single chemical was released. The most frequently released hazardous substances were volatile organic compounds (18% of the total 4,034 substances released), herbicides (15%), acids (14%), and ammonias (11%). In 467 events (15% of all events), 1,446 persons were injured; 11 persons died as a result of these injuries. Respiratory irritation (37%) and eye irritation (23%) were the most frequently reported health effects. A total of 457 (15%) events resulted in evacuations; of these, 400 (88%) were ordered by an official (e.g., a police officer or firefighter).(ABSTRACT TRUNCATED AT 250 WORDS)


This study was set up to investigate the effect of exposure to combustion effluents on the chronic health of firefighters. A cohort of firefighters was followed up through 10 years with regard to cause specific mortality. Comparisons were made with another cohort of civil servants and salaried employees in physically demanding jobs. After a latency of five years, an excess mortality from cancer was seen for persons aged 30 to 74 (standardised mortality ratio (SMR) 173, 95% confidence interval (95% CI) 104-270). A significant increase in lung cancer was seen in the group aged 60 to 74 (SMR 317, 95% CI 117-691), whereas non-pulmonary cancer was significantly increased in the group aged 30 to 49 (SMR 575, 95% CI 187-1341). It is concluded that inhalation of carcinogenic and toxic compounds during firefighting may constitute an occupational cancer risk. An extended use of respiratory protective equipment is advocated.
Specialised protective clothing, such as that worn by firefighters, is usually tested only to standards which give requirements for the materials used (e.g. EN469). However, this testing often neglects the effect the manufacturing process of the garment has on the material properties, the effects of clothing design, sizing and fit, as well as the interaction of the clothing with other components of the standard gear for the profession. Such effects can only be tested by looking at the protective gear as a whole. This paper deals with methods to do additional testing on protective garments with firefighter clothing as example. In other words, methods which go beyond EN469. Human subject tests for physiological load, heat protection, ergonomic design, loss of performance, rain/moisture protection and conspicuity/visibility of the clothing are described and proposed for evaluation of protective clothing in general and for further development of standards on firefighters' clothing.

Chlorinated aliphatic hydrocarbons (CAHs) were evaluated as potential risk factors for astrocytic brain tumors. Job-exposure matrices for six individual CAHs and for the general class of organic solvents were applied to data from a case-control study of brain cancer among white men. The matrices indicated whether the CAHs were likely to have been used in each industry and occupation by decade (1920-1980), and provided estimates of probability and intensity of exposure for "exposed" industries and occupations. Cumulative exposure indices were calculated for each subject. Associations of astrocytic brain cancer were observed with likely exposure to carbon tetrachloride, methylene chloride, tetrachloroethylene, and trichloroethylene, but were strongest for methylene chloride. Exposure to chloroform or methyl chloroform showed little indication of an association with brain cancer. Risk of astrocytic brain tumors increased with probability and average intensity of exposure, and with duration of employment in jobs considered exposed to methylene chloride, but not with a cumulative exposure score. These trends could not be explained by exposures to the other solvents.

The present study of 469 municipal firefighters examined the effect of flexibility training on the incidence and severity of joint injuries. Both flexibility measures and costs (lost time and medical care costs) were investigated in this study. Significant differences were found in flexibility scores of the experimental and control subjects with overall flexibility increased in the experimental group. Although incidence of injury was not significantly different for the experimental and control groups, injuries sustained by the experimental group resulted in significantly less lost time costs. Findings indicate that the flexibility training program had a beneficial effect on reducing the severity and costs of joint injuries in this firefighter population.

OBJECTIVE: "Heart Presumption" legislation is common throughout North America. We sought to study Massachusetts firefighters retiring with heart disability awards. METHODS: The authors conducted a retrospective review of Massachusetts firefighters: 362 receiving Heart Presumption pensions (1997-2004) and a comparison group of 310 professionally active firefighters. RESULTS: Of retirements, 77% were due to coronary heart disease and 23% for other cardiovascular conditions. Only 42% of the retirements were related to discrete on-duty events. Fire suppression (odds ratio = 51, 95% confidence interval = 12-223) and alarm response (odds ratio = 6.4, 95% confidence interval = 2.5-17) were associated with markedly higher risks of duty-related heart retirement events than nonemergency activities. Cardiovascular risk factor prevalence was high among all retiree subgroups and significantly greater than among control firefighters in almost all cases. CONCLUSIONS: Our study supports calls for improved cardiovascular prevention and risk reduction strategies among firefighters.

Five students of a rescue training school cycled at 50 W for 20 min at 20 degrees C before walking at 5 km/hr up to 30 min in a climatic chamber at 55 degrees C and 30% relative humidity. 4 different types of clothing ensembles differing in terms of thickness and thermal insulation value were tested on separate days. All subjects completed 28-30 min in light clothing, but quit after 20-27 min in 3 firefighter ensembles due to a rectal temperature of 39.0 degrees C or subjective fatigue. No difference in the evolution of mean skin or rectal temperature was seen for the 3 turnout ensembles. Sweat production amounted to about 1000 g in the turnout gears of which less than 20% evaporated. It was concluded that the small differences between the turnout gears in terms of design, thickness and insulation value had no effect on the resulting heat physiological strain for the given experimental conditions.


In the decade beginning 1 January 1985, 916 individuals (including five females) were medically examined with a view to joining the full-time service of Strathclyde Fire Brigade (SFB). One hundred and nine (11.9%), including two females, were rejected. The five main causes of failure were: ocular (n = 46, 42.2%); lack of stamina (n = 21, 19.2%); ‘others’ (n = 12, 11.0%); cardiovascular (n = 9, 8.3%) and orthopaedic (n = 6, 5.5%). Thirty-two had chest X-rays. One abnormality was found -an azygous lobe-but it played no part in the decision to decline the applicant. There was little life- or health-threatening pathology found. The most serious cases were murmurs consistent with mitral stenosis and regurgitation (one each), one case of ocular melanoma, four cases of hypertension and two cases of haematuria/proteinuria (++). This study shows that potentially serious findings can occasionally be detected in a population of 18-30 year olds who might be expected to be of better than average fitness, and that routine chest X-rays are not helpful in the selection process.


During the decade beginning 1 January 1985, 887 full-time firefighters, all male, left the service of Strathclyde Fire Brigade (SFB). There were 17 deaths--compared to 64.4 expected in the Scottish male population aged 15-54 years--giving a standardized mortality ratio (SMR) of 26, and 488 ill-health retirements (IHR). None of the deaths was attributable to service, the major causes being: myocardial infarction--five, (expected = 17.3; SMR = 29); cancers--three (colon, kidney and lung) (expected = 13.6; SMR = 22); road traffic accidents--two (expected = 4.17; SMR = 48) and suicide--two (expected = 4.9; SMR = 41). Amalgamating the deaths and IHRs showed that the six most common reasons for IHR were musculoskeletal (n = 202, 40%), ocular (n = 61, 12.1%), ‘others’ (n = 58, 11.5%), injuries (n = 50, 9.9%), heart disease (n = 48, 9.5%) and mental disorders (n = 45, 8.9%). Over 300 IHRs (over 60%) occurred after 20 or more years service. When the IHRs were subdivided into two quinquennia, there were 203 and 302 in each period. Mean length of service during each quinquennium was 19.4 vs. 21.3 years (p = 0.003) and median length was 21 years in both periods; interquartile range was 12-26 years in the first and 17-27 years in the second period (p = 0.002), but when further broken down into diagnostic categories, the differences were not statistically significant, with the exception of means of IHRs attributed to mental disorders (14.5 vs. 19 years, p = 0.03).

A Select Annotated Bibliography Used for Firefighter Cancer Research

The final routine medical examinations (RME) of 526 full-time firefighters, all male, retiring from Strathclyde Fire Brigade in the decade beginning 1 January 1985 were studied to determine differences between the results of the 328 taking ill-health retirement (IHR) and the 198 completing maximum service (MS). Mean ages at IHR and MS were 48 and 54 years/respectively. This was statistically significant ($P = 0.0000$), so the results of the third RMEs, performed after the subjects’ 46th birthdays, were also analysed. The findings were also reduced into quinquennia. Since the RMEs were weighted towards cardiovascular disorders, the outcomes of the 37 IHRs from arterial disease were sought and compared to the final results of those with MS. In both final and third RMEs, those completing MS were more likely to be non-smokers (60.9 vs 41.4%; 51.6 vs 42.6%; $P = 0.01$ and 0.015). In the final RME, subjects with MS generally had normal lung function (abnormal results 4.8 vs 10.4%; $P = 0.002$), abnormal chest X-rays and near vision (22.4 vs 7.6%; 91.1 vs 51.6%; $P = 0.000$ for both). In the third RME, firefighters with IHR were more likely to have hypertriglyceridaemia (39.6 vs 22.4%; $P = 0.004$), and reduced distance vision (32.2 vs 21.2%; $P = 0.03$). Where IHR resulted from arterial disease, sufferers had raised mean cholesterol (6.76 vs 6.20 mmol/l; $P = 0.049$), raised median triglycerides (2.1 vs 1.55 mmol/l; $P = 0.0236$), hypertriglyceridaemia (44.4 vs 21.2%; $P = 0.008$) and less likely to be non-smokers (32.4 vs 60.9%; $P = 0.001$). Differences between body mass index, systolic and diastolic blood pressure, fasting and HDL cholesterol, electrocardiogram abnormalities, urinary abnormalities and total numbers of risk factors did not reach statistical significance, apart from isolated quinquennial episodes. These results suggest that, except for highlighting known health hazards, current RMEs are ineffective in identifying those at risk of ill-health retirement in this group.


This job-related experiment investigated physiological strain in subjects wearing impermeable chemical protective suit systems (CPSSs) weighing about 28 kg. Two types of CPSSs were studied: the self-contained breathing apparatus was carried either inside or outside the suit. Eight healthy and physically fit male firefighter instructors aged 32 to 45 years volunteered for the study. The test drill, performed at a dry, windless ta of 40 degrees C, was divided into 2 consecutive work sessions of 14.5 min (a 20-min rest between) including typical operational work tasks. Considerable thermal and maximal cardiovascular strain and intense subjective discomfort measured in the firefighters emphasize the need to limit working time in hot conditions to only 10-12 min while wearing CPSSs. The present results indicate that the exceptionally heavy physical load and psychological stress during operations in chemical emergencies must be considered in the assessment of the cardiovascular capacity of ageing firefighters using CPSSs.


A study of firefighter exposures was undertaken at the request of the U.S. Fire Administration. This work was part of a larger study which included field evaluation of the performance of the self-contained breathing apparatus (SCBA) worn by firefighters during structural firefighting. Measurements were made for a variety of contaminants including CO, CO2, benzene, HCN, HCl, H2SO4, HF, acrolein, CH4, formaldehyde and PNAs. Many of the analyses were performed by collection of bag samples followed by Fourier transform infrared spectroscopy using a field mobile spectrometer. Measurements were also made using solid sorbent tubes and direct-reading meters. Sampling was done both during the knockdown and during overhaul phases of structural firefighting. Also, in order to estimate exposures including those when the SCBAs were worn, measurements were made both inside and outside the SCBA facepiece. Carbon monoxide was the most common contaminant found during knockdown, and about 10% of the samples were greater than 1500 ppm. Formaldehyde, acrolein, hydrogen chloride, hydrogen cyanide, sulphuric acid and hydrogen fluoride all exceeded their respective short-term exposure limits (STEL) on some occasions. Approximately 50% of the knockdown samples for acrolein exceeded the STEL. During overhaul, when masks were usually not worn, many of the contaminants found during knockdown were detected, but typically at much lower concentrations. Inside-mask sampling data
suggest that exposure to low concentrations of a variety of compounds is occurring but this is believed to be principally the result of early mask removal or of non-use during knockdown rather than of leakage. The three basic sampling approaches (bag sampling, sorbent tubes and direct-reading meters) proved in this study to be complementary and served to maximize our ability to detect and quantify a wide range of combustion products.


BACKGROUND AND METHODS: From a statewide medical examination program, we identified firefighters who were deemed unfit for duty by attending physicians (ATTENDING FAIL, n=9) and those who would have been disqualified by the application of selected numerical criteria from the 1997 National Fire Protection Association (NFPA) guidelines (NFPA FAIL, n=27) and criteria from a Medical Workshop (WORK FAIL, n=16). The subjects who were unfit for duty or failed numerical criteria were compared with those who were fit for duty and passed all objective criteria (FIT group, n=302). All subjects were given an overall morbidity rating by a board certified internist. Comparisons on two surrogate measures of fitness, VO(2) max predicted and predicted coronary heart disease (CHD) risk, were also performed. RESULTS: We found a significant tendency towards worse results (e.g. higher blood pressure or lower spirometric function) among the three FAIL groups compared with the FIT group. The FAIL groups shared only a small overlap, however, with the firefighters with the highest morbidity ratings, lowest predicted VO(2) max, and highest CHD risks. Increasing morbidity was associated with higher age, lower spirometric function, lower predicted VO(2) max, increasing cholesterol, greater BMI, and higher predicted 10 year CHD risk. CONCLUSIONS: Although the presence of a single serious or poorly controlled condition may render an individual unfit for safe performance as a firefighter, examination of our cohort suggests that multiple risk factor models or overall clinical assessments are superior means of identifying firefighters with poor health status and increased CHD risk.


BACKGROUND: Firefighters are known to be exposed to recognized or probable carcinogens. Previous studies have found elevated risks of several types of cancers in firefighters. METHODS: Standardized morbidity odds ratio (SMORs) were used to evaluate the cancer risk in white, male firefighters compared to police and all other occupations in the Massachusetts Cancer Registry from 1986 to 2003. Firefighters and police were identified by text search of the usual occupation field. All other occupations included cases with identifiable usual occupations not police or firefighter. Control cancers were those not associated with firefighters in previous studies. RESULTS: Risks were moderately elevated among firefighters for colon cancer (SMOR = 1.36, 95% CI: 1.04-1.79), and brain cancer (SMOR = 1.90, 95% CI: 1.10-3.26). Weaker evidence of increased risk was observed for bladder cancer (SMOR = 1.22, 95% CI: 0.89-1.69), kidney cancer (SMOR = 1.34, 95% CI: 0.90-2.01), and Hodgkin's lymphoma (SMOR = 1.81, 95% CI: 0.72-4.53). CONCLUSIONS: These findings are compatible with previous reports, adding to the evidence that firefighters are at increased risk of a number of types of cancer.


To investigate the association between occupational exposure to polycyclic aromatic hydrocarbons, aromatic amines and diesel and bladder cancer risk and the modification by smoking and metabolic polymorphisms, have we recruited 200 cases and 385 population controls. The adjusted OR of bladder cancer was 5.75 (95%CI 2.09-15.83) comparing the highest tertile of the cumulative probability of occupational exposure to aromatic amines with no occupational exposure. A possible interaction between occupational exposures to aromatic amines and smoking was found. The increased ORs of GSTM1, GSTT1, NAT2 and SULT1A1 among those ever occupational exposed was explored by estimating the false-positive report probability. We confirm that occupational exposure to aromatic amines is associated with an increase in bladder cancer risk.

Following an electrical transformer fire in Staten Island, New York, a health surveillance program was established for 60 New York City firefighters and emergency medical technicians exposed to polychlorinated biphenyls (PCBs) and polychlorinated dibenzofurans (PCDFs). Exposure potential was documented after high levels of PCBs and PCDFs were found on transformer and firefighters' uniforms. Personnel received comprehensive medical examinations, and the results were compared with preexposure values. Serum was analyzed for PCBs, PCDFs, and polychlorinated dibenzo-p-dioxins (PCDDs). Follow-up was conducted 9 mo later. Thirty-two of 58 (55%) firefighters reported initial symptoms, and 3 firefighters required brief medical leave. Pulmonary functions, exercise performance, serum liver functions, and serum lipid profiles were normal or unchanged from preexposure baselines. Serum PCBs averaged 2.92 +/- 1.96 ppb (range = 1.9-11.0 ppb). Five (8%) had serum PCBs that were greater than or equal to 6 ppb. Eight (73%) had a significant decrease (p = .05) in serum PCB level at the time of follow-up. Serum toxic equivalency (TEQ [1998 World Health Organization]) for total PCDDs and PCDFs averaged 39.0 +/- 21.5 (n = 48). Eight (73%) had a significant decrease (p = .05) in serum TEQ level at the time of follow-up. Serum total PCBs averaged 2.92 +/- 1.96 ppb (range = 1.9-11.0 ppb). Five (8%) had serum PCBs that were greater than or equal to 6 ppb. Eight (73%) had a significant decrease (p = .05) in serum PCB level at the time of follow-up. Serum toxic equivalency (TEQ [1998 World Health Organization]) for total PCDDs and PCDFs averaged 39.0 +/- 21.5 (n = 48). Eight (73%) had a significant decrease (p = .05) in serum TEQ level at the time of follow-up. Serum total PCBs averaged 2.92 +/- 1.96 ppb (range = 1.9-11.0 ppb). Five (8%) had serum PCBs that were greater than or equal to 6 ppb. Eight (73%) had a significant decrease (p = .05) in serum PCB level at the time of follow-up. Serum toxic equivalency (TEQ [1998 World Health Organization]) for total PCDDs and PCDFs averaged 39.0 +/- 21.5 (n = 48). Eight (73%) had a significant decrease (p = .05) in serum TEQ level at the time of follow-up. Serum total PCBs averaged 2.92 +/- 1.96 ppb (range = 1.9-11.0 ppb). Five (8%) had serum PCBs that were greater than or equal to 6 ppb. Eight (73%) had a significant decrease (p = .05) in serum PCB level at the time of follow-up. Serum toxic equivalency (TEQ [1998 World Health Organization]) for total PCDDs and PCDFs averaged 39.0 +/- 21.5 (n = 48). Eight (73%) had a significant decrease (p = .05) in serum TEQ level at the time of follow-up.


A unique cluster of three cases of sarcoidosis developed recently among 10 white firefighters who trained together as apprentices in 1979. This led us to hypothesize that firefighters are at increased risk of this condition because of the combined effect of smoke exposure and infection with a communicable agent, such as Chlamydia pneumoniae, a recently proposed cause of sarcoidosis. We conducted a case-finding questionnaire survey of 1,282 active and retired male Providence firefighters and police officers and then evaluated both the index apprenticeship class and two control cohorts by chest radiography, seromarkers of T lymphocyte activation (neopterin and sIL-2R), and chlamydial serology. One additional case of sarcoidosis was identified among the 990 (77%) survey respondents. No new cases were detected in the subsequent laboratory investigation of 46 (87%) firefighters from the index 1979 apprenticeship class, 53 (75%) firefighter controls from the 1974 and 1980 classes, or 50 (30%) police officer controls from 1973-1981 classes. The cohorts did not differ with regard to either C. pneumoniae antibody titers or sIL-2R levels, but serum neopterin was elevated (> 9.0 nmol/L) in 20% (eight of 41) of the index cohort, 22% (11 of 51) of firefighter controls, and 4% (two of 48) of police officers. Logistic regression found firefighting to be the only significant predictor of neopterin elevation (odds ratio 5.8; 95% CI, 1.3 to 26.9). Our results suggest that firefighters may be at risk of T lymphocyte activation. Determining whether this reflects an enhanced risk of lymphocytic alveolitis and whether firefighters are more likely to develop sarcoidosis requires further study.


The author examines a wide variety of substances, from smoke, to synthetic products, and even the products that are used to fight fires. Measurements of exposure are discussed for carbon dioxide, carbon
monoxide, hydrogen chloride, hydrogen cyanide, formaldehyde, acetaldehyde, benzene, and other chemicals.


Approximately 1500 occupational styrene exposure values from 28 reinforced-plastic manufacturers were collected retrospectively from companies and state and federal agencies. This report describes the major types of manufacturing processes within the reinforced-plastics industry and reports on the availability, collection and analysis of historical exposure information. Average exposure to styrene in most open-mold companies (24-82 ppm) was generally 2-3 times the exposure in press-mold companies (11-26 ppm). Manufacturers of smaller boats had mean styrene exposures of 82 ppm as compared to 37 ppm for yacht companies. There was considerable overlap in styrene exposure among job titles classified as directly exposed within open- and press-mold processing.


Studies of occupational exposure and spontaneous abortion may use pregnancies during which the mother was unemployed as part or all of the unexposed comparison group. Any type of maternal employment, however, may be a risk factor for spontaneous abortion, and potential confounder in occupational reproductive studies. This study evaluates the effect of employment in a cohort of pregnancies of 1535 women. Employed pregnancies had a significantly higher rate of spontaneous abortion (14.5%) than unemployed pregnancies (11.7%) (RR = 1.23, 95% CI = 1.02, 1.49). Gravidity acted as an effect modifier, as the employment effect was seen only in multigravid pregnancies (RR = 1.38, 95% CI = 1.11, 1.72) and not primigravid pregnancies (RR = 0.96). The effect persisted when an independent sample of one randomly selected pregnancy per woman was used for the analysis (RR = 1.27, 95% CI = 0.90, 1.79). The data were examined for confounding by other factors which could explain the excess in spontaneous abortion among employed pregnancies. The employment effect persisted with adjustment for other risk factors including maternal age, education, income, maternal diabetes, race, alcohol usage and smoking, and prior pregnancy ending in induced abortion. Stratifying by prior pregnancy loss eliminated the employment effect among those with prior loss (RR = 1.03) but enhanced the effect among those multigravid without the risk factor (RR = 1.50, 95% CI = 1.15, 1.97). Selection bias, also, was explored as a possible explanation of this employment effect, but could not be substantiated. Assessment of a true exposure effect requires consideration of a potential employment effect either in the design or analysis.


Firefighting, along with construction, mining and agriculture, ranks among the most dangerous occupations. In addition, the work environment of firefighters is unlike that of any other occupation, not only because of the obvious physical hazards but also due to the respiratory and systemic health hazards of smoke inhalation resulting from combustion. A significant amount of research has been devoted to studying municipal firefighters; however, these studies may not be useful in wildland firefighter exposures, because the two work environments are so different. Not only are wildland firefighters exposed to different combustion products, but their exposure profiles are different. The combustion products wildland firefighters are exposed to can vary greatly in characteristics due to the type and amount of material being burned, soil conditions, temperature and exposure time. Smoke inhalation is one of the greatest concerns for firefighter health and it has been shown that the smoke consists of a large number of particles. These smoke particles contain intermediates of hydrogen, carbon and oxygen free radicals, which may pose a potential health risk. Our investigation looked into the involvement of free radicals in smoke toxicity and
the relationship between particle size and radical generation. Samples were collected in discrete aerodynamic particle sizes from a wildfire in Alaska, preserved and then shipped to our laboratory for analysis. Electron spin resonance was used to measure carbon-centered as well as hydroxyl radicals produced by a Fenton-like reaction with wildfire smoke. Further study of reactive oxygen species was conducted using analysis of cellular H(2)O(2) generation, lipid peroxidation of cellular membranes and DNA damage. Results demonstrate that coarse size-range particles contained more carbon radicals per unit mass than the ultrafine particles; however, the ultrafine particles generated more *OH radicals in the acellular Fenton-like reaction. The ultrafine particles also caused significant increases in H(2)O(2) production by monocytes and lipid peroxidation. All particle sizes showed the ability to cause DNA damage. These results indicate that the radical generation and the damage caused by them is not only a function of surface area but is also influenced by changing chemical and other characteristics due to particle size.


OBJECTIVE: To identify barriers to first-responder automated external defibrillator (AED) use by determining firefighter attitudes, opinions, and concerns about their AED program. METHODS: An anonymous survey was mailed to all firefighters in a municipal department that had had first-responder defibrillation for more than two years. A follow-up survey was mailed to all nonrespondents. The survey requested firefighter demographics, comfort and experience with AED, definition of DOA (dead on arrival), and opinion of the program. RESULTS: Of 749 firefighters surveyed, 686 responded (92%). The respondents had an average of 12 +/- 8 years of experience; 66% felt very comfortable using the AED and 3% felt very uncomfortable. The respondents had applied an AED to a patient a median of 2 times (range 0-30); 24% had never applied an AED. Eighty-three percent reported they had been on the scene of an out-of-hospital cardiac arrest when their AED was not used for at least one patient. Predominant reasons for not applying an AED included the ambulance arrived "soon enough" (72%), the ambulance arrived first (63%), the patient was DOA (61%), and the patient had a do-not-resuscitate (DNR) order (32%). Eighty-one percent of the respondents correctly listed at least one clinical finding that defines DOA. Ninety-nine percent felt they should continue the AED program. The respondents gave numerous suggestions for improving the program, including being able to visualize the rhythm, increasing their level of care, and improved AED training. CONCLUSIONS: Municipal first response firefighters view their AED program favorably despite infrequently applying an AED. The appropriateness of withholding defibrillation because a secondary response unit will arrive "soon enough" should be reviewed. The definition of DOA should be reviewed to ensure that viable patients are not denied defibrillation.


The decision of the Virginia Supreme Court in Fairfax County Fire & Rescue Department v. Mottram (2002) has important implications for Workers' Compensation claims for posttraumatic stress disorder, particularly those involving emergency services personnel. A firefighter/paramedic who developed chronic, disabling PTSD after responding to a fatal fire was denied benefits because he had previously reported symptoms of the disorder, whereas the statute recognized a single traumatic incident only. The court held that PTSD resulting from multiple traumatic stressors may be considered a compensable occupational disease analogous to dermatitis developed by a flower shop employee with chronic exposure to irritating stimuli. The decision, which constitutes legal recognition of work-related cumulative PTSD in rescue workers, provides benefits for treatment and encourages earlier treatment of traumatic stress in this group.


Carotid artery dissections (CAD) are uncommon, but not rare, and are increasingly recognized as a cause of morbidity. A case of CAD following minimal sustained postural trauma is described. The causes and outcomes of CAD are discussed, with particular reference to risks that might be found in the workplace.
While wearing a self-contained breathing apparatus and fire-protective clothing, 35 healthy firefighting students aged 19-27 years performed smoke-diving (entry into a smoke-filled room) during a simulated shipboard fire. The mean (+/- SD) ambient temperature inside the simulator was 119 +/- 12 degrees C, and the task lasted 17 +/- 4 min. All subjects were fit according to their maximal oxygen consumption, which was 52.4 +/- 5.2 mL/min/kg (4.08 +/- 0.45 l/min). During the smoke-diving the average heart rate was 150 +/- 13 beats/min (79 +/- 6% of maximal heart rate attained in a cycle-ergometer test), and the peak heart rate was 180 +/- 13 beats/min (95 +/- 6% of maximal heart rate). The estimated oxygen consumption was 2.4 +/- 0.5 L/min (60 +/- 12% of maximal oxygen consumption). Neither ability to tolerate stress (as determined by the instructors) nor previous experience in smoke-diving tasks seemed to influence the heart rate or estimated oxygen consumption during experiment. Smoke-diving was physically very demanding even for the young and fit subjects, showing the importance of regular evaluation of the health and physical fitness of every firefighter who has to carry out smoke-diving tasks.


BACKGROUND: Exposure to occupational hazards among firefighters may lead to increased mortality from cancer, lung, or heart disease. METHODS: Age- and gender-adjusted mortality rates of 34,796 male and 2,017 female Florida professional firefighters between 1972 and 1999 were compared with the Florida general population. RESULTS: One thousand four hundred eleven male and 38 female firefighter deaths with known causes were identified. In male firefighters, mortality due to all causes and most non-malignant diseases was significantly less than expected. There was no excess overall mortality from cancer, but excesses existed for male breast cancer [standardized mortality ratio (SMR = 7.41; 95% confidence interval (CI): 1.99-18.96) and thyroid cancer (SMR = 4.82; 95% CI: 1.30-12.34)]. Mortality from bladder cancer was increased and approached statistical significance (SMR = 1.79; 95% CI: 0.98-3.00). Firefighters certified between 1972 and 1976 had excess mortality from bladder cancer (SMR = 1.95; 95% CI: 1.04-3.33). Female firefighters had similar mortality patterns to Florida women except for atherosclerotic heart disease (SMR = 3.85; 95% CI: 1.66-7.58). CONCLUSIONS: 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.


A mortality odds ratio (MOR) study of race-specific cancer risk among firefighters was conducted using 1984-1993 death certificate data from 24 states. The Bureau of the Census Index of Industries and Occupations was used to code occupation on death certificates. The overall cancer mortality was slightly elevated among white firefighters (MOR = 1.1; 95% confidence interval [CI] = 1.1-1.2), but the increase in
overall cancer mortality among black firefighters was not significant (MOR = 1.2; 95% CI = 0.9-1.5). Only prostate cancer risk was elevated in both groups (whites: MOR = 1.2; 95% CI = 1.0-1.3; blacks: MOR = 1.9; 95% CI = 1.2-3.2). Among white firefighters, elevated site-specific cancer mortality risks were found for the following cancer sites: lip (MOR = 5.9; 95% CI = 1.9-18.3), pancreas (MOR = 1.2; 95% CI = 1.0-1.5), soft tissue sarcoma (MOR = 1.6; 95% CI = 1.0-2.7), melanoma (MOR = 1.4; 95% CI = 1.0-1.9), kidney and renal pelvis (MOR = 1.3; 95% CI = 1.0-1.7), non-Hodgkin's lymphoma (MOR = 1.4; 95% CI = 1.1-1.7), and Hodgkin's disease (MOR = 2.4; 95% CI = 1.4-4.1). We also observed a slightly elevated risk for bronchus and lung cancer (MOR = 1.1; 95% CI = 1.0-1.2). Among black firefighters, excess risks were found for cancers of the brain and central nervous system (MOR = 6.9; 95% CI = 3.0-16.0), colon (MOR = 2.1; 95% CI = 1.1-4.0), and nasopharynx (MOR = 7.6; 95% CI = 1.3-46.4). Future studies are needed to confirm the existence of differential cancer mortality risks among firefighters of different race/ethnic subpopulations.


BACKGROUND: Few studies have investigated occupational lung cancer risk in relation to specific histopathological subtypes. METHODS: A case-control study was conducted to evaluate the relationship between lung cancer and occupation/industry of employment by histopathological subtype. A total of 2,998 male cases and 10,223 cancer controls, diagnosed between 1983 and 1990, were identified through the British Columbia Cancer Registry. Matched on age and year of diagnosis, conditional logistic regression analyses were performed for two different estimates of exposure with adjustment for potentially important confounding variables, including tobacco smoking, alcohol consumption, marital status, educational attainment, and questionnaire respondent. RESULTS: For all lung cancers, an excess risk was observed for workers in the primary metal (OR = 1.31, 95% CI, 1.01-1.71), mining (OR = 1.53, 95% CI, 1.20-1.96), machining (OR = 1.33, 95% CI, 1.09-1.63), transport (OR = 1.50, 95% CI, 1.08-2.07), utility (OR = 1.60, 95% CI, 1.22-2.09), and protective services (OR = 1.27, 95% CI, 1.05-1.55) industries. Associations with histopathological subtypes included an increased risk of squamous cell carcinoma in construction trades (OR = 1.25, 95% CI, 1.06-1.48), adenocarcinoma for professional workers in medicine and health (OR = 1.73, 95% CI, 1.18-2.53), small cell carcinoma in railway (OR = 1.62, 95% CI, 1.06-2.49), and truck transport industries (OR = 1.51, 95% CI, 1.00-2.28), and large cell carcinoma for employment in the primary metal industry (OR = 2.35, 95% CI, 1.11-4.96). CONCLUSIONS: Our results point to excess lung cancer risk for occupations involving exposure to metals, polyaromatic hydrocarbons and asbestos, as well as several new histopathologic-specific associations that merit further investigation.


A recent paper by Rees (Occup. Med. 1994; 44: 253-256) has proposed a study to evaluate the performance of both clinical and trade tests on firefighter recruits. The paper suggests that a new trade test using painted gas cylinders and/or the BOC cylinder identification chart may be appropriate in the selection of firefighter recruits. Evaluation of pass/fail standards on these tests would be achieved by comparing the results with those obtained from the Ishihara test, the City University test and the Holmes-Wright lantern test. In this paper, we argue that the proposed battery of tests does not allow an accurate evaluation of the new trade tests. Indeed, the new trade tests are likely to result in a false sense of obvious fairness that ultimately be an unsound means of assessing the colour vision requirements of firefighter recruits.


Long-term psychological effects of exposure to a dangerous chemical were evaluated in a sample of firefighters who fought a large polyvinyl chloride (PVC) fire. When compared with nonexposed firefighter controls (n = 22), the exposed firefighters (n = 64) had significantly higher levels of demoralization and specific emotional distress 22 months after the incident. Longitudinal analyses of a subsample of exposed
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Firefighter subjects (n = 55) surveyed 5 to 6 weeks after the fire and again 22 months later revealed that there was no reduction in symptomatology over time. Some psychological distress scores actually rose significantly between time points. Distress scores were also significantly correlated between time points. These results have a number of intervention and public health implications.


Firefighters exposed to burning polyvinyl chloride (PVC) were studied to assess respiratory effects at 5-6 wk post-incident and again 22 mo following the fire. Exposed subjects reported significantly more frequent and severe respiratory symptoms at both time points than did firefighter controls. In longitudinal analyses, a number of symptoms persisted over time, and acute symptom scores were significantly correlated with chronic scores. At Time 2, approximately 18% of exposed firefighters, compared with none of the controls, reported that since the time of the PVC exposure, a physician had told them that they had either asthma and/or bronchitis.


Samples of firefighter subjects (n = 80) and a comparison group (n = 15) were contrasted on a number of postincident psychological distress measures in the aftermath of a polyvinyl chloride (PVC) fire. Using a structured, self-administered questionnaire, firefighter subjects were found to be more psychologically distressed on demoralization, specific emotional distress, and perceived threat to physical health. After controlling for baseline characteristics on which subjects and the comparison group differed, these between-group effects remained significant. The three outcome scales, while correlated, measure different components of psychological distress.


Firefighters are frequently being called on to fight fires that are chemical in nature. In the aftermath of a chemical fire in Plainfield, New Jersey on March 20-21, 1985, the authors conducted a retrospective cohort study which surveyed 80 firefighters exposed to burning polyvinyl chloride (PVC) as well as 15 nonexposed firefighter subjects. By means of an 81-item symptom checklist, exposed firefighters reported more frequent and severe symptoms at 5-6 weeks post incident. This was true for a total symptomatology score as well as 19 individual items. Some of the items with an elevated risk were consistent with exposure to hydrogen chloride, the main pyrolysis product of polyvinyl chloride. Other items with an elevated risk appeared to be related to smoke inhalation while others seemed psychosocial in nature. Analyses conducted within the exposed firefighter group showed that fighting the fire the first day, being a truckman, and residence within 1 mile (1.6 km) of the firehouse were significant risk factors for high total symptom scores. These risk factors may have been associated with level or duration of exposure to the toxic substances produced during the fire.


Studies of the health of fire fighters have historically focused on non-malignant respiratory disease and cancer. More recently, concerns have surfaced about reproductive health effects in many areas of the workforce, including fire fighting. These concerns prompted this review of chemical exposures that may contribute to adverse reproductive health outcomes in male as well as female fire fighters. A review of the industrial hygiene literature was undertaken to identify agents commonly found in fire smoke. These agents were then examined for evidence of reproductive toxicity or mutagenicity/carcinogenicity. This
profile of chemical agents and their reproductive toxicities permits a qualitative determination that fire fighters are exposed to potential reproductive toxicants as a part of their normal fire fighting duties. Considerations for mitigating these risks are also discussed.


Firefighters may be exposed to carcinogenic agents in the smoke from fires, and there has been some concern regarding firefighters' risk of developing occupational-related cancer. Polycyclic aromatic hydrocarbons (PAHs) are present in most fires, posing a cancer risk. The objective of this study was to evaluate the PAH exposure among firefighters. Students (n = 9) and teachers (n = 4) at a firefighter training school delivered urine samples before and 6 to 7 hours after extinguishing burning diesel fuel. The urine samples were analyzed by high-performance liquid chromatography for 1-hydroxypyrene. A small but significant increase in 1-hydroxypyrene levels in the urine was found after the firefighting. This means that firefighting may cause exposure to PAHs. Although the exposure levels were low in this study, they may be different during other types of fires.


A group of 39 firefighters was examined during routine firefighting duty. Following smoke exposure the average decrease in one-second forced expiratory volume (FEV1.0) was 0.05 litre (137 observations). This decline in FEV1.0 was related to the severity of smoke exposure as estimated by the firefighter and to the measured particulate concentration of the smoke to which he was exposed. Decreases in FEV1.0 in excess of 0.10 litre were recorded in 30% of observations. Changes in FEV1.0 resulting from a second exposure to smoke on the same tour of duty were greater when smoke exposure at the previous fire was heavy. The repeated episodes of irritation of the bronchial tree that have been documented in this investigation may explain the origin of the previously observed chronic effect of firefighting on respiratory symptoms and pulmonary function.


In this study, smoke data were collected from two plots located on the Francis Marion National Forest in South Carolina during prescribed burns on 12 February 2003. One of the plots had been subjected to mechanical chipping, the other was not. This study is part of a larger investigation of fire behavior related to mechanical chipping, parts of which are presented elsewhere. The primary objective of the study reported herein was to measure PM(2.5) and CO exposures from prescribed burn smoke from a mechanically chipped vs. non-chipped site. Ground-level time-integrated PM(2.5) samplers (n=9/plot) were placed at a height of 1.5 m around the sampling plots on the downwind side separated by approximately 20 m. Elevated time-integrated PM(2.5) samplers (n=4/plot) were hung atop approximately 30 ft poles at positions within the interior of each of the plots. Real-time PM(2.5) and CO data were collected at downwind locations on the perimeter of each plot. Time-integrated perimeter 12-h PM(2.5) concentrations in the non-chipped plot (AVG 519.9 microg/m(3), SD 238.8 microg/m(3)) were significantly higher (1-tail P-value 0.01) than those at the chipped plot (AVG 198.1 microg/m(3), SD 71.6 microg/m(3)). Similarly, interior time-integrated 8-h PM(2.5) concentrations in the non-chipped plot (AVG 773.4 microg/m(3), SD 321.8 microg/m(3)) were moderately higher (1-tail P-value 0.06) than those at the chipped plot (AVG 460.3 microg/m(3), SD 147.3 microg/m(3)). Real-time PM(2.5) and CO data measured at a position in the chipped plot were uniformly lower than those observed at the same position in the non-chipped plot over the same time period. These results demonstrate that smoke exposures resulting from burned chipped plots are considerably lower than from burned non-chipped plots. These findings have potentially important implications for both firefighters working prescribed burnings at chipped vs. non-chipped sites, as well as nearby communities who may be impacted from smoke traveling downwind from these sights.


OBJECTIVES: To assess the six-month training retention for out-of-hospital providers donning and doffing Level C personal protective equipment (PPE). METHODS: In this prospective observational study, 36 out-of-hospital providers enrolled in a paramedic program were trained in Level C (chemical-resistant coverall, butyl gloves, and boots and an air-purifying respirator) PPE use. A standardized training module and checklist of critical actions developed by a hazardous materials (hazmat) technician were used to evaluate donning and doffing. Students were trained until they were able to correctly don and doff the Level C PPE. An investigator used the checklist accompanying the training module to assess proficiency and remediate mistakes. Six months after initial training, the subjects were reassessed using the same investigator and checklist. Errors were designated as either critical (resulted in major self-contamination of the airway, such as early removal of the respirator) or noncritical (potentially resulted in minor self-contamination not involving the airway). RESULTS: Only five subjects (14.3%) were able to don and doff PPE without committing a critical error. The most common critical errors were premature removal of the respirator (65.7%; n = 23) and actions allowing the contaminated suit to touch the body (54.3%; n = 19). The most common noncritical error was possible self-contamination due to the boots not being removed before exposing other body parts (37.1%; n = 13). Of the seven subjects (20%) with additional prior hazmat training, only two donned and doffed PPE without committing a critical error. CONCLUSIONS: Retention of proper donning and doffing techniques in paramedic students is poor at six months after initial training. Even in subjects with previous hazmat, firefighter, and emergency medical services training, critical errors were common, suggesting that current training may be inadequate to prevent harmful exposures in emergency medical services personnel working at a hazmat or weapons of mass destruction incident.


OBJECTIVE: The etiology of sarcoidosis is unknown, but epidemiology suggests that environmental agents are a factor. Because firefighters are exposed to numerous toxins, we questioned whether sarcoidosis was increased in this cohort. SETTING: The New York City Fire Department (FDNY), employing > 11,000 firefighters and nearly 3,000 emergency medical services (EMS) health-care workers (HCWs). DESIGN: In 1985, FDNY initiated a surveillance program to determine the incidence, prevalence, and severity of biopsy-proven sarcoidosis in firefighters. In 1995, EMS HCWs were added as control subjects. RESULTS: Between 1985 and 1998, 4 prior cases and 21 new cases of sarcoidosis were found in FDNY firefighters. Annual incidence proportions ranged from 0 to 43.6/100,000, and averaged 12.9/100,000. On July 1, 1998, the point prevalence was 222/100,000. For EMS HCWs, annual incidence proportions were zero. Radiographic stage 0 or stage 1 sarcoidosis was found in 19 firefighters (76%), and stage 3 was found in 1 firefighter (4%). Pulmonary function (FVC, FEV(1), and diffusing capacity for carbon monoxide) was normal in 17 firefighters (68%), and reduced to </= 65% predicted in 2 firefighters (8%). Maximum oxygen consumption (MVO(2)) was normal in 10 of 17 firefighters (59%), and reduced to 65% predicted in 3 firefighters (12%). Five of seven firefighters (71%) with abnormal MVO(2) had gas exchange abnormalities, and none had O(2) desaturation. All returned to fire fighting. CONCLUSIONS: Annual incidence proportions and point prevalence were increased in FDNY firefighters as compared to EMS HCWs and historical controls. Radiographs and physiologic measurements demonstrated only minimal impairment.


BACKGROUND: Workers from the Fire Department of New York City were exposed to a variety of inhaled materials during and after the collapse of the World Trade Center. We evaluated clinical features in a series of 332 firefighters in whom severe cough developed after exposure and the prevalence and severity of bronchial hyperreactivity in firefighters without severe cough classified according to the level of
exposure. METHODS: "World Trade Center cough" was defined as a persistent cough that developed after exposure to the site and was accompanied by respiratory symptoms severe enough to require medical leave for at least four weeks. Evaluation of exposed firefighters included completion of a standard questionnaire, spirometry, airway-responsiveness testing, and chest imaging. RESULTS: In the first six months after September 11, 2001, World Trade Center cough occurred in 128 of 1636 firefighters with a high level of exposure (8 percent), 187 of 6958 with a moderate level of exposure (3 percent), and 17 of 1320 with a low level of exposure (1 percent). In addition, 95 percent had symptoms of dyspnea, 87 percent had gastroesophageal reflux disease, and 54 percent had nasal congestion. Of those tested before treatment of World Trade Center cough, 63 percent of firefighters (149 of 237) had a response to a bronchodilator and 24 percent (9 of 37) had bronchial hyperreactivity. Chest radiographs were unchanged from precollapse findings in 319 of the 332 with World Trade Center cough. Among the cohort without severe cough, bronchial hyperreactivity was present in 77 firefighters with a high level of exposure (23 percent) and 26 with a moderate level of exposure (8 percent). CONCLUSIONS: Intense, short-term exposure to materials generated during the collapse of the World Trade Center was associated with bronchial responsiveness and the development of cough. Clinical and physiological severity was related to the intensity of exposure.


Bushfire fighting is a hazardous occupation and control strategies are generally in place to minimize the hazards. However, little is known regarding firefighters' exposure to bushfire smoke, which is a complex mixture of toxic gases and particles. In Australia, during the prescribed burning season, firefighters are likely to be exposed on a regular basis to bushfire smoke, but whether these exposures affect health has yet to be determined. There are a number of factors that govern whether exposure to smoke will result in short-term and/or long-term health problems, including the concentrations of air pollutants within the breathing zone of the firefighter, the exposure duration, and health susceptibility of the individual, especially for pre-existing lung or heart disease. This paper presents measurements of firefighters' personal exposure to bushfire smoke, the first step within a risk management framework. It provides crucial information on the magnitude, extent and frequency of personal exposure to bushfire smoke for a range of typical scenarios. It is found that the primary air toxics of concern are carbon monoxide (CO), respirable particles and formaldehyde. Also, work activity is a major factor influencing exposure with exposure standards (both average and short-term limits) likely to be exceeded for activities such as suppression of spot fires, holding the fireline, and patrolling at the edge of a burn area in the urban-rural interface.


Hydrocarbons (HCs) found in fuels and solvents are ubiquitous in the environment, yet we know little about their effects on the endocrine system. The objective of this study was to assess the potential reproductive endocrine effects of low-dose HCs encountered by female U.S. Air Force personnel with fuel (primarily JP-8 jet fuel) and solvent exposures (n = 63). We estimated the internal dose of HCs in fuels and solvents by measuring their levels in exhaled breath, including the sum of aliphatic HCs (C6H14-C16H34) and the sum of aromatic HCs (benzene, ethylbenzene, toluene, and m,p,o-xylenes). Adverse outcome measures included urinary endocrine markers that have been associated with nonconceptive (vs. conceptive) menstrual cycles in ovulatory women: lower preovulatory luteinizing hormone (LH) and mid-luteal phase pregnanediol 3-glucuronide (Pd3G) and estrone 3-glucuronide, and higher follicle phase Pd3G. We also obtained reproductive and exposure information from baseline questionnaires and daily diaries. Toluene was the most frequently found analyte in the breath, with values up to 52.0 ppb, and benzene breath levels were up to 97.5 ppb. Regression analysis revealed that preovulatory LH levels were significantly lower (p = 0.007) among women whose total aliphatic HC levels were above the median. The relationship between elevated aliphatic HC exposure and lowered preovulatory LH levels in the present study suggests that compounds in fuels and some solvents may act as reproductive endocrine disruptors. Confirmation of these findings is needed, not only to determine if fuel and solvent
exposure may impact other LH-dependent physiologic functions but also to examine effects of fuels and solvents on conception.


The firefighters are at increased risk of respiratory disease as a result of exposure to smoke and dust. The aim of this study was to determine the prevalence and risk associated with respiratory symptoms among city firefighters in Sao Paulo, Brazil. METHODS: A cross-sectional study utilizing the European Community Respiratory Health Survey (ECRHS) questionnaire was administered to firefighters and police officers, in order to evaluate their respiratory symptoms. RESULTS: Complete respiratory data were obtained from 1,235 firefighters and 1,839 police officers. Among the firefighters, there were 55.5% never-smokers, 22.4% current smokers and 18.2% former smokers (P < 0.05). Among the police officers, there were 63.4%, 18.6%, and 9.6% who were never-smokers, current smokers and former smokers (P < 0.05), respectively. Compared to police, firefighters experienced an increase in wheezing [OR = 1.63 (95% CI: 1.43-1.87)], wheezing with breathlessness [OR = 1.34 (95% CI: 1.10-1.64)], wheezing without a cold [OR = 1.60 (95% CI: 1.32-1.95)], waking with tightness in the chest [OR = 1.20 (95% CI: 1.02-1.42)], and rhinitis [OR = 1.12 (95% CI: 1.03-1.22)]. The prevalence of adult-onset asthma in never-smokers was 9.3% and 6.7% for firefighters and police officers [OR = 1.23 (95% CI: 1.01-1.56)]. An independent association was observed between years employed, smoking, history of rhinitis, and work as a firefighter and respiratory and nasal symptoms. We observed a high prevalence of asthma-like symptoms in firefighters who presented respiratory symptoms beginning immediately after firefighting. CONCLUSION: These results suggest that the prevalence of respiratory symptoms and asthma in firefighters is higher than those in police officers. Work-as a firefighter, rhinitis and years employed were risk factors for respiratory symptoms of asthma.


This article presents a case report of a 41-year-old male firefighter with cholecystitis and a history of mildly elevated alanine aminotransferase. Liver biopsy showed periodic acid Schiff-positive, diastase-resistant periportal globules. Retrospective review of clinical data revealed progressive lung function decline despite absent pulmonary symptoms and normal pulmonary function testing. The following disorders should be considered in any patient with elevated transaminases without an apparent etiology: viral hepatitides, medication toxicity, autoimmune hepatitis, alcohol-induced hepatic injury, and alpha-1-antitrypsin deficiency.


Rather than trying to write a second-hand description of the response to the April 19 bombing of the Federal Building in Oklahoma City, we thought we'd let some of the people who were there caring for patients and searching for victims share their experiences in their own words. Marion Angell Garza, JEMS editorial/news coordinator, spoke at length with six responders, including paramedics, the triage and treatment officer, a firefighter/EMT-1 and an emergency physician. The following excerpts are from those interviews.


Wildland firefighters are exposed to particulate matter and gases containing polycyclic aromatic hydrocarbons (PAHs), many of which are known carcinogens. Our objective was to evaluate the extent of firefighter exposure to particulate and PAHs during prescribed pile burns of mainly ponderosa pine slash and determine whether these exposures were correlated with changes in urinary 1-hydroxypyrene (1-HP), a PAH metabolite. Personal and area sampling for particulate and PAH exposures were conducted on the
We studied cross-seasonal changes in pulmonary function and respiratory symptoms in 52 wildland firefighters in Northern California. The mean cross-seasonal change in forced expiratory volume in 1 second (FEV1) was -1.2% (95% confidence interval [CI] -0.5%, -2.0%) with a corresponding mean change in forced expiratory volume (FVC) of -0.3% (95% CI 0.4%, -1.0%). Decreases in FEV1 and FVC were most strongly associated with hours of recent fire-fighting activity (P = .002 and .01, respectively). When the study group was divided into three categories based on recent fire-fighting activity, firefighters in the high activity category (mean +/- SE, 73 +/- 7 hours of fire-fighting in previous week) had a -2.9%
(130 mL) change in FEV1 and a -1.9% (102 mL) change in forced vital capacity (FVC). There was a significant cross-seasonal increase in most respiratory symptoms evaluated. Several symptoms (eye irritation, nose irritation, and wheezing) were associated with recent fire-fighting. These findings suggest that wildland firefighters experience a small cross-seasonal decline in pulmonary function and an increase in several respiratory symptoms. Research is under way to identify the fire conditions and specific components of exposure that produce pulmonary irritants, and to examine the potential reversibility of acute pulmonary change.


**PURPOSE:** The purpose of this investigation was to determine the total energy expenditure (TEE) by using the doubly labeled water (DLW) methodology during 5 d of wildfire suppression in Montana, California, Florida, Washington, and Idaho. **METHODS:** Seventeen wildland firefighters (from three Interagency Hot Shot crews, N = 8 men, height = 177 +/- 7 cm, weight = 74.6 +/- 6.4 kg, age = 24.5 +/- 1.8 yr; N = 9 women, height = 170 +/- 7 cm, weight = 65.2 +/- 8.0 kg, age = 25.0 +/- 1.3 yr) served as subjects. Before wildland fire suppression, each subject was given an oral dose of 2H2O and H218O (approximately 0.23 g 2H2O.kg estimated TBW-1 and 0.39 g H218O.kg estimated TBW-1). Urine samples were collected between 0400 and 0600 daily. TEE was calculated using the two-point method for days 1-3 and 1-5, with the TEE for days 4-5 calculated by extrapolation. Urine samples from other crew members not participating in the DLW protocol were collected at the same times and used to adjust calculations of isotopic elimination for background shifts. **RESULTS:** TEE was 17.4 +/- 3.7 and 17.5 +/- 6.9 MJ.d-1 during days 1-3 and 4-5, respectively. The energy expenditure associated with physical activity (EEA) was 8.8 +/- 3.0 and 8.9 +/- 6.1 MJ.d-1 for days 1-3 and 4-5, respectively. **CONCLUSION:** The current data demonstrate consistently high daily energy expenditure in the wildland firefighter. These data also demonstrate that the doubly labeled water methodology is an appropriate methodology for the measure of TEE during unpredictable field operations if adjustments are made for changes in background enrichment and elevated water turnover.


An important step in studies relating worker health to industrial exposure is the estimation of mean exposure levels. The investigator frequently has to rely on industrial hygiene measurements collected for other purposes. Samples may have been taken at several companies on different dates, and on each occasion multiple individual samplers may have been employed. Often it is not recognized that readings from such a hierarchical arrangement are correlated; for example, samples taken at the same time and location are more alike than samples taken on different days. This correlation invalidates the commonly used standard errors of sample means and the usual sample standard deviation. A component of variance analysis is suggested which quantifies within-day, between-day and between-company variation. Estimators of mean exposure are presented with correct standard errors. The techniques are illustrated by a small set of data and by a recent study of exposures to styrene in 36 companies manufacturing reinforced plastics.


We investigated the risk of prostate cancer in relation to a family history of prostate cancer in 58,279 men ages 55-69 years. We found 704 incident cases after 6.3 years of follow-up. Rate ratios and 95% confidence intervals for having an affected vs nonaffected father and brother were, respectively 1.44 (0.80-2.58) and 5.57 (1.61-19.26). We found no evidence for an increasing risk with an increasing percentage of affected family members. The associations we observed were stronger for cases...
A Select Annotated Bibliography Used for Firefighter Cancer Research

diagnosed before age 70 compared with cases diagnosed after age 70 and for advanced compared with localized tumors.


Recent experiences with severe acute respiratory syndrome and the US smallpox vaccination program have demonstrated the vulnerability of healthcare workers to occupationally acquired infectious diseases. However, despite acknowledgment of risk, the occupational death rate for healthcare workers is unknown. In contrast, the death rate for other professions with occupational risk, such as police officer or firefighter, has been well defined. With available information from federal sources and calculating the additional number of deaths from infection by using data on prevalence and natural history, we estimate the annual death rate for healthcare workers from occupational events, including infection, is 17-57 per 1 million workers. However, a much more accurate estimate of risk is needed. Such information could inform future interventions, as was seen with the introduction of safer needle products. This information would also heighten public awareness of this often minimized but essential aspect of patient care.


We undertook a study to determine the acute effects of routine firefighting on lung function and the relationship between these acute effects and nonspecific airway responsiveness. For 29 firefighters from a single fire station, we calculated the concentration of methacholine aerosol that caused a 100% increase in specific airway resistance (Pc100). Over an 8-week period we than measured FEV1 and FVC in each firefighter before and after each 24-hr workshift and after every fire. From 199 individual workshifts without fires, we calculated the mean +/- 2 SD across-workshift change in FEV1 and FVC for each firefighter. Eighteen of 76 measurements obtained within 2 hr after a fire (24%) showed a greater than 2 SD fall in FEV1 and/or FVC compared to two of 199 obtained after routine workshifts without fires (1%; p less than .001). On 13 of 18 occasions when spirometry decreased significantly, we obtained repeat spirometry (postshift) 3-18.5 hr after fires, and on four of these occasions FEV1 and/or FVC were still more than 2 SD below baseline. Decrements in spirometry occurred as often in firefighters with high Pc100s as in those with low Pc100s. In two firefighters in whom FEV1 and FVC fell by more than 10% after fires, we repeated measurements of methacholine sensitivity, and it was increased over the prestudy baseline. These findings suggest that routine firefighting is associated with a high incidence of acute decrements in lung function.(ABSTRACT TRUNCATED AT 250 WORDS)


OBJECTIVES: There are limited data on recent trends in subsite-specific colon cancer incidence and utilization of lower gastrointestinal endoscopy from Canada. The aim of our study was to determine the concomitant trends in right-sided colon cancer incidence and utilization of colonoscopy and flexible sigmoidoscopy (FS) in Manitoba. METHODS: Cases of colon cancer diagnosed from 1964 to 2004 were identified from the Manitoba Cancer Registry. Lower gastrointestinal endoscopies performed between 1984 and 2003 were identified from Manitoba Health's Physician Claims database. Trends of age-standardized incidence rates were determined using Joinpoint analyses. RESULTS: Rates of right-sided colon cancer showed a monotonic increase in both sexes (annual percent change [APC] in both sexes 1.04%, P < 0.001). The most rapid increase (200%) occurred in individuals of 70 yr of age and older. While rates of colonoscopies without polypectomies quadrupled between 1985 (257 per 100,000) and 2003 (1,083 per 100,000, APC 8.89%, P < 0.001), rates of colonoscopies with polypectomies quadrupled from 35 per 100,000 in 1985 to 140 per 100,000 in 2000, and then increased more rapidly in the subsequent 4 yr (233 per 100,000 in 2003, APC 20%, P < 0.001). Rates of FS declined between 1999 (342 per 100,000) and 2003 (257 per 100,000, APC -6.68%, P= 0.01). CONCLUSIONS: The rates of right-sided colon cancer are continuing to increase in Manitoba, with the most rapid increase occurring in older individuals. Reasons for the increasing incidence of right-sided colon cancer despite increasing
rates of colonoscopy need to be further explored, and may reflect increased detection of asymptomatic cancers or a real increase in right-sided colon cancer incidence.


Heart rate (HR) and oxygen consumption (VO2) responses during actual fire-suppression emergencies were monitored in 10 male firefighters. These firefighters worked at 157 +/- 8 beats per minute (bpm) for 15 +/- 7 minutes. This was 88 +/- 6% of their previously determined HR max. Based on treadmill testing, the HR x VO2 relationship was established for each firefighter. The predicted VO2 derived from HR monitoring in actual emergencies was 25.6 +/- 8.7 mL.kg-1.min-1 or 63 +/- 14% of VO2 max (40.0 +/- 6.5 mL.kg-1.min-1). These values on the cardiorespiratory response to actual emergencies are very similar to results derived from studies employing fire-suppression simulations. Recommendations for the VO2 max of firefighters ranging from 33.5 to 42.0 mL.kg-1.min-1 that have been generated from simulation testing appear appropriate given the cardiorespiratory responses to actual emergencies.


BACKGROUND: There is some evidence of an elevated risk for testicular cancer among firefighters. METHODS: We performed a population-based case-control study including 269 testicular cancer cases and 797 controls matching on age and region with a special focus on occupational exposures. Job tasks were coded according to the International Standard Classification of Occupations (ISCO 68). We used conditional logistic regression to calculate odds ratios (OR). RESULTS: Three controls (0.4%) and four cases (1.5%) ever worked as firefighters. Firefighters showed an increased odds of testicular cancer in the matched evaluation (OR = 4.3, 95% confidence interval (95% CI) 0.7-30.5). The adjustment for a history of cryptorchidism or family history of testicular cancer did not alter our results. CONCLUSION: Although 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.


The objective of this study was to identify major pathologies among firefighters, being the cause of leaving the job. The study was based on the analysis of temporary work disability and disability certificates, taking account of age and duration of employment in the capacity of a firefighter. The study was performed on a representative sample of 1503 firefighters, employed between 1994 and 1997 in 29 fire stations. During that period, 214 firefighters left their job (40% of them got retired and 38% of persons were given the right to receive disability pension). The analysis revealed the average annual frequency of leaving the job by firefighters that accounted for about 43/1000 persons (including 17 retired and 16 persons on disability pension per 1000 firefighters, respectively). Among firefighters, the frequency of leaving the job because of retirement or permanent disability was by 60% higher than among workers employed in different branches of the national economy. The analysis of the relationship between leaving the job and the duration of employment (adjusted for age) showed that the majority of those retired left job after 15 years and those on disability pension after 22 years. Sick absence among firefighters who left the job because of disability and retirement was respectively 13 and 4 times higher than that observed among firefighters in active service. Diseases of the musculoskeletal and circulatory systems and mental disorders were the most common causes of disability. Diseases of the circulatory system (26%), diseases of musculoskeletal system (25%) and mental disorders (16%) were the main causes of sick absence
among those disabled, whereas diseases of the musculoskeletal system (26%), nervous system and sense organs (24%) and digestive system (13%) among those getting retired. The study indicated an interchangeable nature of two main reasons why firefighters leave their job (retirement and disability), which results from the right to get retired after 15 years of employment, regardless of the age. The aforesaid pathologies, being the major causes of disability certification and temporary disability for work should be the basis for developing an enlarged program of compulsory preplacement medical examinations addressed to candidates for employment in a fire-brigade.


Objectives: In the present study, we modified a night shift system for an ambulance service so that ambulance paramedics were assured of taking a nap, and examined the effects of this new system on the fatigue and physiological function of ambulance paramedics. Methods: Ten ambulance paramedics at a fire station in the center of a large city in Japan voluntarily enrolled as subjects in this field study. They worked a 24-h shift system. There were two teams of 5 ambulance paramedics in the fire station. Three ambulance paramedics per shift usually provided the emergency services. In the traditional system, the ambulance paramedics had to deal with all emergency calls throughout a 24-h shift (T-shift). In the modified system, 2 ambulance paramedics were allotted time for naps in the 21:00-3:00 (C-shift) or 3:00-8:30 (B-shift) shift by the addition of another a firefighter (D-shift). Results: There were fewer emergency dispatches and nap time was longer in the B- and C-shifts than in the T-shift. Parasympathetic nerve activities during naps in B- and C-shifts were higher than in the T-shift. The results of critical flicker fusion frequency and 3-choice reaction time in the B-shift at 7:30 tended to be higher and shorter than that in T-shift. Conclusions: The results of this study suggest that the modified night shift which ensured time for ambulance paramedics to take long, restful power naps alleviated subjective fatigue, and improved physiological function which are often adversely affected by night workload.


This study investigated how 50 preschool children (25 girls, 25 boys) evaluated the appropriateness of excluding boys and girls from two types of activities (doll play, truck play) and two types of future roles (playing a teacher, playing a firefighter) across different exclusion contexts. Children judged straightforward exclusion from activities on the basis of gender as wrong, even if the child's gender was stereotypical of the activity. Furthermore, they justified these decisions on the basis of moral reasons, such as equality and unfairness. Children used a mixture of moral and social conventional reasoning (including stereotypes), however, to evaluate multifaceted situations that called for judgments about both inclusion and exclusion and that included information about the children's past experience with the activity.


The Iowa Gambling Task has been widely used in the assessment of neurological patients with ventro-mesial frontal lesions. The Iowa Group has claimed that the Gambling Task is too complex for participants to follow using cognition alone, so that participants must rely on emotion-based learning systems (somatic markers). The present study investigates whether similar tasks can be performed without direct somatic markers. In a 'Firefighter' task closely matched to the classic Gambling Task, participants evaluate the performance of others—so that they experience reward and punishment indirectly. In contrast to the gradual improvement in performance seen on the classic Iowa Gambling Task, participants on the Firefighter Task showed no learning effect, mirroring the performance of patients with ventro-mesial frontal lesions, and suggesting that the task is very difficult to perform without direct somatic marker information. The use of this task as empirical measure of 'empathy' are discussed.
Epidemiological studies provide the only direct means of measuring the risk of cancer in humans and for investigating effects directly avoiding interspecies extrapolation. Epidemiology is, however, too insensitive to detect small increases in risk. Furthermore, traditional epidemiology cannot be used prospectively to indicate future problems nor to explore the current exposure situation. Ideally, cancer hazards should be identified before humans are exposed. For the foreseeable future, therefore, identification of carcinogens will necessarily depend heavily on data derived from studies in experimental animals. Emerging molecular biological techniques, if used critically, hold great promise for resolving many contemporary puzzles in cancer risk prediction.


Several cases of a toxic shocklike syndrome have been reported in the United States during the past five years in association with Streptococcus pyogenes infection. We report a case of a firefighter exposed during attempted CPR to the secretions of an S pyogenes-infected child. The firefighter developed an infection of the hand and subsequent febrile illness with hypotension, erythematous rash, renal failure, and hypocalcemia. Bacterial isolates of blood and cerebrospinal fluid from the deceased child were identical in type and exotoxin production with isolates grown from the hand wound of the firefighter. This is the first reported case of documented transmission of S pyogenes, causing a toxic shocklike syndrome in an emergency medical technician.


In the afternoon of March 23, 2006 a Providence firefighter was diagnosed as having cyanide poisoning after working at a building fire. In the aftermath of three fires at commercial and residential sites that day, eight additional firefighters (out of 28 tested) were found to have elevated levels of cyanide. Numerous other members reported symptoms consistent with cyanide poisoning, including headaches, weakness and fatigue, nausea, and shortness of breath. The Providence Fire Department (PFD) established a joint union management committee to review the situation.


OBJECTIVE: This study investigated the prevalence of posttraumatic stress disorder (PTSD) and comorbid symptoms among professional firefighters in Germany and examined not only primary but also secondary traumatic stress disorder experienced by these firefighters who were exposed to the sufferings of others. METHOD: To estimate the prevalence of trauma-related disorders, a representative group of 402 professional firefighters from the State of Rheinland-Pfalz in Germany was surveyed through use of the General Health Questionnaire, a PTSD Symptom Scale, a stress coping questionnaire, and a self-rating scale to assess bodily complaints. RESULTS: The current prevalence rate of PTSD symptoms among professional firefighters was 18.2%. About 27% of the recruited subjects had a mental disorder according to the General Health Questionnaire. Predictors for the extent of traumatic stress were longer job experience and the number of distressing missions during the last month. Traumatic stress also predicted psychiatric impairment beyond PTSD, such as depressive mood, psychosomatic complaints, social dysfunction, and substance abuse. CONCLUSIONS: The high prevalence of PTSD and other psychiatric impairments in firefighters indicates that they often fail to cope with primary and particularly secondary stress in their daily work. This problem, together with the individual psychological consequences and expenses related to work absenteeism and early retirement, seems to be very specific for the profession of firefighters. The present findings provide a better understanding of the relationship between secondary traumatic stress and PTSD in professional helpers and high-risk populations such as firefighters, emergency workers, and the police.

BACKGROUND: Work-related injury rates in the fire service industry exceed those for most other industries, however little is known about the cost of injury to firefighters. METHODS: This is a preliminary investigation of detailed worker's compensation records of firefighter injuries, 1,343 claims in all, collected from 1992-1999. Summary statistics and regression analysis regarding the cause, nature, and cost of injury to firefighters are presented. RESULTS: Overexertion accounted for a significant portion (over 1/3) of injuries to firefighters, typically involved injuries to the back, and was associated with significantly higher costs than other types of injuries. The per-claim average worker's compensation cost of injury to firefighters was $5,168 and the average for injuries caused by overexertion was $9,715. CONCLUSIONS: Overexertion is a costly source of injury to firefighters that can likely be reduced through policy intervention.


A wide variety of occupations has been associated with prostate cancer in previous retrospective studies. Most attention has been paid to farming, metal working, and the rubber industry. Today, these results cannot be affirmed with confidence, because many associations could be influenced by recall bias, have been inconsistent, or have not been confirmed satisfactory in subsequent studies. This study was conducted to investigate and confirm these important associations in a large prospective cohort study. The authors conducted a prospective cohort study among 58,279 men. In September 1986, the cohort members (55-69 years) completed a self-administered questionnaire on potential cancer risk factors, including job history. Related job codes were clustered in professional groups. These predefined clusters were investigated in 3 time windows: 1) profession ever performed, 2) longest profession ever held, and 3) last profession held at baseline. Follow up for incident prostate cancer was established by linkage to cancer registries until December 1993. A case-cohort approach was used based on 830 cases and 1525 subcohort members. To minimize false-positive results, 99% confidence intervals (99% CI) were calculated. Although moderately decreased prostate cancer risks were found for electricians, farmers, firefighters, woodworkers, textile workers, butchers, salesmen, teachers, and clerical workers, none of the relative risks (RR) were found to be statistically significant. For road transporters, metal workers, and managers, no association with prostate cancer risk was found. Although the RR for railway workers, mechanics, welders, chemists, painters, and cooks was moderately increased, these estimates were not statistically significant. For men who reported to have ever worked in the rubber industry, we found a substantially increased prostate cancer risk, but not statistically significant (RR, 4.18; 99% CI = 0.22-80.45). For policemen, we found a substantial and marginally statistically significant increased prostate cancer risk, especially for those who reported working as a policeman for most of their occupational life (RR, 3.91; 99% CI = 1.14-13.42) or as the last profession held at baseline (RR, 4.00; 99% CI = 1.19-13.37). Most of the previously investigated associations between occupation and prostate cancer risk could not be confirmed with confidence in this prospective study. The lack of statistical significance for rubber workers could be caused by the scarcity of rubber workers in this cohort and subsequent lack of power. The results for policemen were substantial and statistically significant, although a conservative value for significance level was used.


OBJECTIVES: This study was conducted to estimate risk of bladder cancer associated with occupational exposures to paint components, polycyclic aromatic hydrocarbons (PAHs), diesel exhausts, and aromatic amines among the general population in The Netherlands. METHODS: A prospective cohort study was conducted among 58,279 men. In September 1986, the cohort members (55-69 years) completed a self administered questionnaire on risk factors for cancer including job history. Follow up for incident bladder cancer was established by linkage to cancer registries until December 1992. A case-cohort approach was
used based on 532 cases and 1630 subcohort members. A case by case expert assessment was carried out to assign to the cases and subcohort members a cumulative probability of occupational exposure for each carcinogenic exposure. RESULTS: Men in the highest tertiles of occupational exposure to paint components, PAHs, aromatic amines, and diesel exhaust had non-significantly higher age and smoking adjusted incident rate ratios (RRs) of bladder cancer than men with no exposure: 1.29 (95% confidence interval (95% CI) 0.71 to 2.33), 1.24 (95% CI 0.68 to 2.27), 1.32 (95% CI 0.41 to 4.23) and 1.21 (95% CI 0.78 to 1.88), respectively. The associations between paint components and PAHs and risk of bladder cancer were most pronounced for current smokers. Among former smokers it seemed that for cumulative probability of exposure to paint components and PAHs, men who had smoked more than 15 cigarettes a day had RRs below unity compared with men who had smoked less than 15 cigarettes a day, whereas among current smokers the opposite was found. Exposure to diesel exhaust was positively associated with risk of bladder cancer among current and former smokers who had smoked more than 15 cigarettes a day. CONCLUSIONS: This study provided only marginal evidence for an association between occupational exposure to paint components, PAHs, aromatic amines, and bladder cancer. Despite the small proportion of exposed subjects, an interaction with cigarette smoking was found, specifically for paint components, suggesting that the carcinogenic effect on the bladder might decrease after stopping smoking.


This analysis describes the frequency and type of injuries among responders to hazardous materials releases. Data were analyzed from states that participated in the Hazardous Substances Emergency Events Surveillance system maintained by the Agency for Toxic Substances and Disease Registry from 1996 through 1998. A total of 348 responders were injured in 126 (0.7%) of 16,986 reported events. Firefighters and police officers were most often injured. Respiratory irritation and nausea were the most commonly reported injuries, and no injuries resulted in death. Almost half of the responder victims wore firefighter turn-out gear, and about a third had received hazardous materials training. Chemicals frequently released during these events were in the category "other substances not otherwise specified" and "acids." Training, education, planning, and coordination are needed to effectively respond to hazardous substances emergency events.