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Abstract

Recent research on health and wellness has suggested that firefighters are at increased risk for health concerns (e.g., cancer, heart disease). Limited information is available about the prevalence and role of modifiable risk factors such as health behaviors related to tobacco use, physical activity, and nutrition in this population. The current study reports findings of a cross-sectional survey of firefighters that investigated issues such as health status, health practices related to substance use, and lifestyle factors.

Introduction & Literature Review

The firefighter's role in the broad emergency response network of the United States includes more than just fire alarms; they are charged as first responders to a wide range of emergency and disaster calls. This unique set of responsibilities places on the firefighter a high burden of stress and other work-related health hazards. According to a report by the Centers for Disease Control and Prevention (2006), on-duty fatalities for firefighters in the United States numbered 948 between 1994 and 2004. Considering the dangers firefighters routinely face, this number is a testament to the training and protocol in place to prevent such casualties. However, what is the most surprising are the causes behind the number of fatalities. Of the 948 fatalities reported, nearly half were cardiac-related events. Of these deaths, 97 percent of career and 98 percent of volunteer firefighter cardiac deaths were attributed to stress or overexertion.

Findings related to the relative risk of cardiac deaths in the fire service have been somewhat mixed. Upon examining death certificates, Calvert, Merling and Burnett (1999) reported that firefighters have among the highest proportionate mortality ratio for ischemic heart disease. Several studies conducted in the 1980s and 1990s also reported positive and significant relationships between cardiovascular disease and fire fighting (e.g., Aronson, Tomlinson, & Smith, 1994; Bates, 1987; Feuer & Rosenman, 1986; Grimes, Hirsch, & Borgeson, 1991; Sardinias, Miller, & Hansen, 1986). However, other studies conducted at this time reported non-significant relationships (e.g., Burnett, Halpern, Lalach, & Sestito, 1994; Deschamps, Mosmas, & Festy, 1995; Eliopoulos, Armstrong, Spickett, & Heyworth, 1984; Guidotti, 1993). The reasons behind the discrepancy are unclear. However, one hypothesis is that the discrepancy may be attributable to what has been termed the "healthy

worker effect" (Choi, 2000). The selection process for new firefighters favors those who have above-average stamina and strength, making a comparison to standard population control groups prone to error. In fact, passing a strenuous physical test is required prior to admission into many fire training academies. Therefore, Choi (2000) explains, the expected risk of cardiovascular disease, given the relative health of firefighters at selection and hiring, should actually be lower than the general population. He reassessed the literature available at the time and found that several of the studies actually produced significant and positive results when adjusted for the "healthy worker effect" even when they initially presented non-significant differences in risk (e.g., Burnett et al., 1994; Deschamps, Mosmas, & Festy, 1995; Eliopoulos et al., 1984).

The very nature of fire fighting likely lends itself to increased cardiovascular risk. To explain the increased prevalence of cardiovascular disease found, researchers have hypothesized a number of contributing factors. Barnard and Duncan (1975) studied firefighter's cardiovascular response to an alarm call. In their study of 35 firefighters responding to 189 alarms, an average increase of 47 beats per minute was observed (range 12-117 beats per minute increase) after hearing the alarm and high levels of arousal also were maintained after the initial alarm. Increased levels of psychological and physical arousal have been related to increased incidence of cardiovascular problems (Rozanski, Blumenthal, & Kaplan, 1999). Encounters with carbon monoxide may be another contributing factor. The National Fire Protection Agency recommends use of the self-contained breathing apparatus (SCBA) for all firefighters (NFPA®, 2002). Barnard and Weber (1979) found that dangerous levels of carbon monoxide remain at alarm sites even after visible smoke and fumes cleared,

when firefighters were less likely to use such protection. Another factor may be the night and day shift schedules required of firefighters. Knutsson et al. (1986) found that shift work was correlated to ischemic heart disease, even when smoking status and age were considered.

Risk factors such as elevated levels of arousal and shift work schedules are not easily modifiable. However, a number of modifiable cardiovascular risk factors have been identified among fire service personnel. In one study of the Omaha Fire Department, Chief Mancuso (2003) found that 73 percent (N = 647) of fire service professionals in his fire department were either overweight or obese. In another instance, the National Volunteer Fire Council (NVFC, 2005) provided free health screenings at local and regional fire conferences. Of the screenings conducted, the average body mass index (BMI) scores were in the overweight category ranging from 27.4 to 29.8. An average of the four screenings performed found that only 28.5 percent (N = 3089) of participants were in the normal range (i.e. BMI 18.5-24.9). The survey methodology used in obtaining this data (participant self selection, possibility of family member inclusion) limits conclusions that may be drawn, but indicates strongly the need for more in-depth and controlled studies.

The trend of increasing BMIs among the nation's firefighters may be related to the "firehouse culture," a natural consequence of the stressful situations, shift work, and downtime firefighters endure. Food plays a central role in the routine of those on duty, with the majority of crewmembers participating in meals. A firefighter interviewed in an article by Osborn (2005) states "The whole culture of the firehouse is based on food. One of the challenges between fire calls is, you get bored, and you want to eat, so you float to the refrigerator." In the same article, Osborn stated that the choice of one department to eat vegetarian meals in an attempt to reduce cholesterol was uncommon and "their choice still sends comrades at other fire stations into gales of laughter." In these situations, making individual choices for healthier eating is clearly difficult when a meal is shared among so many. Additionally, while many departments suggest physical activity as a part of daily duty activity, anecdotal evidence from firefighters indicates that structured physical activity often is not a priority. The combination of negative health choices and job-related risk factors makes management of modifiable risk factors even more imperative for firefighters. While efforts are being made and resources are being expended in the effort to decrease the rate of cardiovascular deaths in the fire service, the rate of line of duty deaths attributable to cardiovascular complications remains relatively constant (CDC, 2006).

Recent evidence demonstrates the importance of targeting firefighters in education and prevention efforts. Kales, et al. (2007) found that firefighters responding to an emergency were between 10 and 100 times more likely to die from coronary heart disease during emergency activities when compared to nonemergency

duties. The awareness level of leadership toward the importance of improving cardiovascular risk factors in firefighters has been increased and new prevention programs initiated (United States Fire Administration, 2005; NVFC, 2005), but the rate of line of duty deaths attributable to cardiovascular complications remains relatively constant (CDC, 2006). In order to adequately assess the obstacles, knowledge, attitudes, and practices of firefighters relating to cardiovascular health, a more comprehensive study is needed.

To date, information about the health of firefighters has been inconsistent. Programs such as the screenings by the NVFC and reports at the department level provide some insight into the plight of health status in the fire service; however, the findings are limited because the samples may be biased and not necessarily representative of the entire fire service. Currently, no regional or national standardized health surveillance system for firefighters exists. In order to accurately assess the risks to firefighter health, it is important to develop a comprehensive and consistent understanding of the current state of health for this population. This surveillance would in turn be used to understand risk profiles, particularly to understand who is most at risk, in order to target intervention and prevention efforts. Ultimately, a longitudinal assessment will be integral in comparing risk factors across time and gauging the changing health of the fire service as interventions are implemented. Without such an assessment, it is not possible to accurately gauge the impact of efforts to change firefighter health.

By developing a surveillance measure and obtaining preliminary information in select departments, the obstacles, knowledge, attitudes and practices most important to cardiovascular health can be identified and targeted in a larger, more comprehensive study. The purpose of the current survey was to pilot a data collection of the type of health surveillance measure proposed for the fire service.

Methods

Two Midwest fire departments participated in data collection. Surveys were distributed to every member of the department. Firefighters were provided with a gift card as appreciation for considering participation. Upon completing the survey, participants sealed them in an envelope and returned them to the designated department contact. The overall response rate was 72 percent (N = 132). The project received approval from the Institutional Review Board at the Kansas City University of Medicine & Biosciences.

Instrumentation

The survey for the current project was developed based on previously published surveys.

Overall Physical Health: BMI was calculated by using self-reported height and weight. BMI is calculated as kilograms divided by height in meters squared.

Participants were categorized as underweight (<18.5kg/m²), healthy weight (range, 18.5–24.9 kg/m²), overweight (range, 25.0–29.9 kg/m²), or obese (>30.0 kg/m²), in accordance with the World Health Organization (2003) guidelines. A single item question: “Would you say your overall physical health is” with response options of poor, fair, good, very good or excellent was used to measure overall self-rated health. This type of question is one of the most widely used measures of health status (Krause & Jay, 1994). For questions about medical co-morbidities, participants were presented with a list of common health concerns and asked, “Have you ever been told by a doctor, nurse or other health professional you have, or are you currently taking medications for each of the following conditions” with response options of “yes,” “no,” or “I don’t know.”

The Self-Report of Physical Activity (SRPA) Questionnaire: The SRPA questionnaire provides a global self-rating of physical activity patterns. Indicators of the questionnaire’s validity in adult populations (significant correlation between SRPA ratings and measured maximal oxygen consumption) have been published elsewhere (Jackson et al., 1990). For this study, students were instructed to select a value from the questionnaire that best described their physical activity pattern during the past 30 days (Jackson & Ross, 1997). Values ranged from zero (no regular physical activity) to seven (regular, heavy physical activity such as running over 10 miles per week). Students were categorized as either sedentary (0 and 1 - no regular physical activity) or active (2 through 7 - regular participation in moderate or heavy physical activity). The headings “sedentary” and “active” will be used to denote categorization based on the physical activity questionnaire.

Stage of Change for Exercise: A single question was used to assess each student’s current stage of change for exercise behavior. Students were required to select one of five statements, placed ordinally on a conceptual ladder (Wyse et al., 1995) describing their current exercise behavior and intentions concerning exercise initiation within the next six months. The statements were previously developed for exercise behavior (Marcus, Selby, Niaura, & Rossi, 1992) and have been termed and defined as follows:

- Precontemplation - I presently do not exercise and do not plan to start exercising in the next 6 months.
- Contemplation - I presently do not exercise, but I have been thinking about starting to exercise within the next 6 months.
- Preparation - I presently get some exercise, but not regularly.
- Action - I presently exercise on a regular basis, but I have only begun doing so within the past 6 months.
- Maintenance - I presently exercise on a regular

basis and have been doing so for longer than 6 months.

In the heading of the question, regular exercise was defined as three or more days per week for 20 minutes or more each day of activities such as walking, jogging, swimming, and aerobics.

Additional Physical Activity Questions: Participants were also asked to provide information on the number of days during the past week they engaged in moderate and vigorous physical activity and how much time per week they spend sitting and watching television. These questions were taken directly from the International Physical Activity Questionnaire (IPAQ), which has been shown to be a reliable (Spearman’s $\rho = 0.8$) and valid (Spearman’s $\rho = 0.33$) instrument for obtaining detailed assessments of physical activity in 18-65 year old men and women (Booth, 2000; Craig et al., 2003).

Subjects were classified as meeting vigorous physical activity guidelines if they engaged in at least 10 minutes of vigorous physical activity on three or more days during the past week. They were classified as meeting moderate physical activity guidelines if they engaged in at least 10 minutes of moderate physical activity on five or more days during the past week (Pate et al., 1995).

Estimated maximal oxygen consumption (VO₂max): A non-exercise model was used to estimate VO₂max. The subjects’ age, gender, body mass index (BMI), and SRPA (physical activity level) were entered into a regression equation to estimate VO₂max. This method is as accurate as methods using sub-maximal exercise heart rate to estimate aerobic capacity (Jackson et al., 1995). VO₂ max as the maximum capacity to transport and utilize oxygen during exercise. It is also known as aerobic capacity, which reflects the physical fitness of a person (Astrand & Rodahl, 1986).

Weight management: Questions about weight management were taken from the CDC’s (2002) Behavioral Risk Factor Surveillance System survey questionnaire. Questions about weight practices included: “Are you trying to lose weight?” “Are you eating fewer calories or less fat to lose weight?” “Are you using physical activity or exercise to lose weight?”

Tobacco Use: Questions about tobacco consumption included: “Have you smoked at least 100 cigarettes or the equivalent amount of tobacco in your lifetime?” “Do you now smoke daily, occasionally or not at all?” (CDC, 2002). Smokeless tobacco use was assessed with the following questions: “Have you ever used chewing tobacco, snuff or dip?” “During the past 30 days, on how many days did you use chewing tobacco, snuff or dip?” (Bray et al., 2003).

Alcohol Use: Participants were asked about the number of days in the past month they had drunk alcohol. Next, they were asked how many drinks they drank on average at each instance of drinking. To assess the frequency of binge drinking, participants were asked “Considering all types of alcoholic beverages, how

many times during the past 30 days did you have 5 or more drinks on one occasion?" Finally, they were asked how many times during the past 30 days they had "driven when you've had perhaps too much to drink."

Firefighter Health Beliefs: A list of firefighter health beliefs was developed for the current survey. Perceptions focused on perceived risk for firefighters of cancer, heart disease and early mortality. Questions also focused on perceptions of prevalence of cigarette and smokeless tobacco use among firefighters. Firefighters were asked about their perceptions of department priorities related to physical fitness and nutrition with the items: "My fire department makes physical fitness a priority." "My fire department makes nutrition a priority." They also were asked to what degree they agreed or disagreed with the statements, "The leaders of my department put an emphasis on health and wellness" and "My on-duty health habits are better than my off-duty health habits" using a 5-point Likert scale.

Participants

The sample was primarily firefighters (66.1%; N = 132) but also included a sampling of lieutenants/captains (22.0%) and chief staff (11.8%) and nearly all career (96.2%), with a few volunteer firefighters. More than half (64.6%) of the participants had an associates, bachelors, or advanced degree. The sample was 95.4 percent male and primarily (97.6%) white. The average age of participants was 37.9 years old (SD = 8.9).

Results

Physical Health

Overall Physical Health. On average, the firefighters had a body mass index (BMI) of 27.65 (SD = 4.06, range 19 to 42.72). Of those surveyed, 27.6 percent were in the normal range, 47.2 percent were in the overweight range, and 25.2 percent were in the obese range (N = 127; see Table 1). The prevalence rate of self-reported co-morbidities of other health concerns was 12.6 percent for high blood pressure and 23.4 percent for elevated cholesterol. When asked, "Would you say your overall physical health is Poor, Fair, Good, Very Good or Excellent?" only 3.9 percent reported being in poor or fair health.

Physical Activity. According to responses on the IPAQ, participants engaged in vigorous physical activity an average of 3.3 (SD = 1.6) days per week. Participants reported engaging in moderate physical activity an average of 3.7 (SD=2.0) days per week. The participants reported watching 11.4 hours of TV per week (1.6 hours/day) and spending 29.8 hours/week sitting (4.3 hours/day). Most of the participants were in the action and maintenance stages of change (48.5% action and 13.8% maintenance) and only 3.1 percent were in the pre-contemplation (n= 1) and contemplation (n = 4) stages or change. The average estimated VO₂max was 41.0 ml.kg-1.min-1, which is slightly less than the average for young, untrained males (45.0 .ml.kg-1.min-1).

Table 1: Overall physical health of firefighters (n = 132)

	Percent
Body Mass Index	
Underweight (BMI < 18.5kg/m ²)	0.0
Normal Weight (BMI range 18.3-24.9 kg/m ²)	27.6
Overweight (BMI range 25.0-29.9 kg/m ²)	47.2
Obese (BMI > 30.0 kg/m ²)	25.2
Self-Rated Physical Health	
Poor	0.8
Fair	3.1
Good	41.5
Very Good	44.6
Excellent	10.0
Co-Morbidities (% responding "yes")	
Type I diabetes	2.3
Type II diabetes	0.1
High blood pressure	12.6
High Cholesterol	23.3
Arthritis	11.6
Asthma	10.4
Heart disease	1.6
Cancer	0.1

The lowest VO_2 max was 10.8 ml.kg-1.min-1, with the highest being 53.6 ml.kg-1.min-1. Slightly over 18 percent of the subjects had a VO_2 max under 35 ml.kg-1.min-1, a level below which risk of all-cause mortality significantly increases (Blair et al., 1989).

Weight Management. Of those surveyed, 56.2 percent reported that they were trying to lose weight. Nearly half (48.4%) reported eating fewer calories or less fat to lose weight and more than half (57.3%) reported using physical activity or exercise to lose weight.

Health Behaviors

Only 11.1 percent of the sample reported using cigarettes daily or occasionally and had smoked at least 100 cigarettes in their lifetime. A small group (4.8%) reported being experimental smokers who smoked occasionally but had not smoked at least 100 cigarettes in their lifetime. Of the sample, 22.0 percent reported using chewing tobacco, snuff or dip in the last 30 days. With regard to alcohol, 83.3 percent reported consump-

tion in the past 30 days. Of those who reported drinking one or more times in the last month, they drank an average of 10.0 days of the month (SD = 6.8 days). During periods of alcohol consumption, participants drank, on average, 3.1 drinks (SD = 2.3 drinks) each day. They reported drinking five or more drinks at a single occasion two times (SD = 4.1 times) during the past month. Of those who reported drinking alcohol in the past month, 14.5 percent reported driving when they had perhaps had "too much" to drink.

Beliefs about the Fire Service and Health

When asked about their beliefs concerning firefighter health, 58.3 percent reported that firefighters die earlier than the average person in the United States (see Table 2). With regard to heart disease, 56.8 percent reported believing that firefighters have higher rates of heart disease than the average person in the United States. About 48 percent believed that firefighters have a higher rate of cancer than the average person in the

Table 2: Health beliefs about the fire service (n = 132)

	% Responding "True"
Do firefighters die earlier than the average person in the United States?	58.8%
Do firefighters have higher rates of heart disease than the average person in the United States?	57.3%
Do firefighters have higher rates of cancer than the average person in the United States?	50.0%
My fire department makes physical fitness a priority	
Strongly disagree	2.3
Disagree	8.5
Neutral	13.0
Agree	46.2
Strongly agree	30.0
My fire department makes good nutrition a priority	
Strongly disagree	7.8
Disagree	23.4
Neutral	36.7
Agree	25.8
Strongly agree	6.3
The leaders of my department put an emphasis on health and wellness	
Strongly disagree	3.1
Disagree	3.1
Neutral	20.0
Agree	51.5
Strongly agree	22.3
My on-duty health habits are better than my off duty health habits	
Strongly disagree	6.9
Disagree	32.3
Neutral	26.9
Agree	30.8
Strongly agree	3.1

United States. On average, firefighters believed that 32.1 percent (SD = 16.4, range 2-85) of firefighters smoke and 31.25 percent (SD = 17.9, range 5-90) of firefighters use chewing tobacco.

The departments surveyed reportedly placed emphasis on physical fitness. When asked whether their department makes physical fitness a priority, 76.2 percent agreed or strongly agreed that it did. Less emphasis was put on proper nutrition in that only 32.1 percent agreed or strongly agreed that their department makes good nutrition a priority. Overall, 73.8 percent agreed or strongly agreed that the leaders of their department put an emphasis on health and wellness. Only about a third (33.9%) of firefighters sampled reported agreeing or strongly agreeing that their on-duty health habits were better than their off-duty health habits.

Discussion

Of those surveyed, 72.4 percent were in the overweight or obese range, which is higher than the national average but consistent with other findings among firefighters (e.g., Mancuso, 2003). However, given their high rate of physical activity, it is possible that BMI is not a valid measure of weight status in this population. Criticism over BMI has been expressed because the numerator (weight) does not discriminate between muscle, fat, bone, or vital organ tissue. An individual with high fat-free mass relative to stature (e.g., physically active person) might have a high BMI but not be overweight (Wellens et al., 1996). On the other hand, more than half of the firefighters said they wanted to lose weight and many studies have demonstrated that respondents tend to overreport their physical activity levels when compared with objective measures (Sallis & Saelens, 2000). More attention needs to be paid to weight in the fire service, how to measure diet and exercise, and how to gauge weight most effectively with this population.

Rates of tobacco use in the current sample were relatively low while rates of alcohol consumption were relatively high. Several reported frequent use of alcohol and frequent binge drinking (5 or more drinks consumed at a single occasion). While rates of reported cigarette and smokeless tobacco consumption were relatively low, perceptions of the rates of firefighter tobacco use were relatively high. It will be important to examine whether this particular sample was less likely than their peers to be tobacco users and whether the perception of tobacco in the fire service is inaccurate.

It is interesting to note that nearly two thirds of participants reported a belief that firefighters die earlier than the average person in the United States, more than half reported a belief that firefighters are at higher risk for heart disease and half reported a belief that firefighters are at higher risk for cancer. While there is evidence that firefighters are at higher risk for some types of cancer (LeMasters et al., 2006) and heart disease (Aronson, Tomlinson, & Smith, 1994; Bates, 1987; Feuer & Rosenman, 1986), there is not yet conclusive evidence about age of mortality among this population. As the

scientific literature provides more conclusive data on the links between relative risk of disease and fire fighting, it will be important to educate fire service personnel about these dangers. Even if the scientific literature does not conclude that fire service personnel are at increased risk for disease or death, the nature of fire fighting should make health and wellness a priority as a means of reducing shared risk. As one firefighter stated, "when we hit the fire ground, your risk factors become my risk" (Mast, personal communication). Fireground medical emergencies place not only the compromised firefighter at risk, but also the rest of the crew who has to respond to the medical emergency in the context of an existing emergency situation.

The departments surveyed reported that they placed a good deal of emphasis on health and wellness as well as physical activity. However, when compared with the previous two constructs, the departments placed relatively less emphasis on proper nutrition. Only a third of firefighters reported that their on-duty nutrition habits are better than their off-duty nutrition habits.

Limitations to the Current Study

While the results provide an interesting snapshot of the health of firefighters, the study has limitations. For example, the survey was introduced to participants as a study focusing on firefighter health as it relates to cardiovascular risk factors. This introduction might have increased social desirability to some questions. Only two departments were solicited for participation and the departments were very different with regard to composition (one was a large primarily career suburban department while the other department was a smaller more rural department comprised of a mix of volunteers and career firefighters). Given this limitation, the generalizability of the results to the fire service as a whole is limited although the results offer some interesting findings for testing hypotheses.

Directions for Future Research

Our results provide guidance for future research. For instance, more attention needs to be paid to nutritional intake among firefighters and to the interplay between diet and physical activity as they relate to BMI and physical health in general. A more diverse range of departments should be solicited for participation in future studies so the impact of exogenous variables such as years of service, region (e.g., Midwestern, Eastern, Western, Southern), type of department (e.g., paid, volunteer, combination), departmental programs can more accurately be determined. In addition, actual physicals measuring height and weight and using other forms of body composition (e.g., percent body fat, waist circumference, etc.) would be useful in identifying the most representative measure of physical fitness. Also, more probing questions also need to be asked about topics such as nutrition and eating habits. In addition, ways that the occupation of fire fighting encourages or discourages good health habits should be explored.

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