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Review

Exploring Occupational and Behavioral Risk Factors for Obesity in Firefighters: A Theoretical Framework and Study Design

BongKyoo CHOI[1], Peter SCHNALL[1,2], Marnie DOBSON[1], Leslie ISRAEL[1], Paul LANDSBERGIS[3], Pietro GALASSETTI[4], Andria PONTELLO[5], Stacey KOJAKU[1] and Dean BAKER[1]

[1]Center for Occupational and Environmental Health, University of California Irvine, Irvine, [2]Center for Social Epidemiology, Marina Del Rey, CA
[3]Department of Environmental and Occupational Health Sciences, State University of New York Downstate School of Public Health, New York, NY
[4]Departments of Pediatrics and Pharmacology, [5]Institute for Clinical and Translational Science, University of California Irvine, Irvine, CA, USA

Firefighters and police officers have the third highest prevalence of obesity among 41 male occupational groups in the United States (US). However, few studies have examined the relationship of firefighter working conditions and health behaviors with obesity. This paper presents a theoretical framework describing the relationship between working conditions, health behaviors, and obesity in firefighters. In addition, the paper describes a detailed study plan for exploring the role of occupational and behavioral risk factors in the development of obesity in firefighters enrolled in the Orange County Fire Authority Wellness Fitness Program. The study plan will be described with emphasis on its methodological merits: adopting a participatory action research approach, developing a firefighter-specific work and health questionnaire, conducting both a cross-sectional epidemiological study using the questionnaire and a sub-study to assess the validity of the questionnaire with dietary intake and physical activity measures, and evaluating the strengths and weaknesses of the body mass index as an obesity measure in comparison to skinfold-based percent body fat. The study plan based on a theoretical framework can be an essential first step for establishing effective intervention programs for obesity among professional and voluntary firefighters.

Key Words: Obesity, Firefighter, Occupations, Behavior

Introduction

There are almost 1.1 million professional and voluntary firefighters in the United States (US) [1]. Obesity, an excessive accumulation of body fat [2], is a key health issue among firefighters who have a high risk for on-duty cardiovascular disease (CVD) mortality [3,4]. In a recent study using the 1997-2002 National Health Interview Surveys (NHISs), firefighters, along with police officers, ranked third in obesity prevalence (30% having a body mass index [BMI] $\geq$ 30 kg/m^2) among 41 US male occupational groups [5]. In earlier NHISs from 1986-1994, these occupations ranked fifth with the prevalence of 18%, so their obesity prevalence has increased in both relative and absolute measures (Fig.1). Firefighters are among the occupations with the highest prevalence of obesity despite the fact that they are the most active among the 41 male occupational groups and meet the Healthy People 2010 recommended leisure-time physical activity goals [6].

Despite the high obesity prevalence among firefighters [5,7], epidemiological studies on firefighters and obesity [8-13] have tended to focus on the associations between obesity and

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Correspondence to: BongKyoo CHOI
Center for Occupational and Environmental Health, University of California Irvine, 5201 California Avenue, Suite 100, Irvine, CA, 92617, USA
Tel: +1-949-824-5130, **Fax:** +1-949-824-2345
E-mail: b.choi@uci.edu

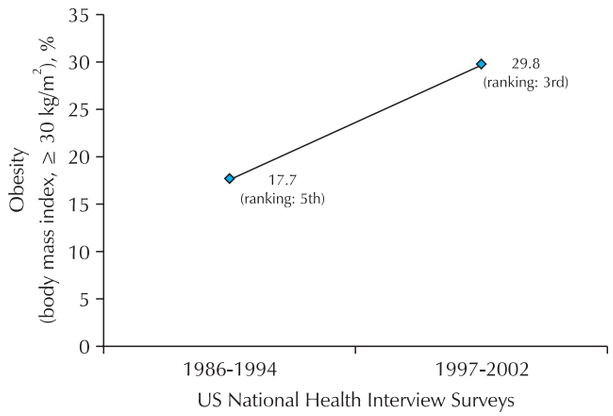

Fig. 1. Obesity prevalences of firefighters and police officers in the 1986-1994 and 1997-2002 National Health Interview Surveys of the United States (US). Ranking among 41 US male occupational groups. Raw data withdrawn from Caban et al. [4].

physiological covariates (e.g., blood pressures and lipid profiles). Only a few studies [14-17] have investigated occupational and behavioral risk factors for obesity in firefighters. Despite the well-documented preventive effects of regular physical activity and a healthy diet on obesity in general populations [18-26], in the few studies available, the associations between regular physical activity and obesity in firefighters are inconsistent. Two epidemiological studies failed to show a significant association between self-reported physical activity and obesity [14,15], while two experimental studies about supervised exercise training programs [16,17] reported a small, but statistically significant reduction of weight and body fat percent. The association between healthy diet behavior and obesity was supported in a recent cross-sectional study [14], but not in a prospective study [15]. To our knowledge, no study has examined the levels of physical activity, food consumption, and the eating behaviors of firefighters at work and during leisure-time in relation to obesity. Gerace and George [15] reported some sociodemographic and behavioral risk factors for obesity in firefighters (i.e., being unmarried, younger, Black, recent ex-smoker, fast-eater at stations, and financial insecurity) and Elliot et al. [14] reported beneficial effects of a supportive health climate at work on promoting healthy behaviors and managing weight.

The primary objective of this paper is to describe a theoretical framework for examining the relationship between working conditions, health behaviors, and obesity in firefighters. The paper will also describe a detailed study plan for exploring occupational and behavioral risk factors for obesity in firefighters that is based on the proposed theoretical framework and uses a participatory action research (PAR) model to ensure that the study incorporates the formal and informal knowledge of firefighters' working conditions and behaviors.

Developing a Theoretical Framework on Work and Obesity in Firefighters

Do adverse working conditions increase the risk for obesity?

Evidence for an association between adverse working conditions and obesity has accumulated in recent experimental and longitudinal epidemiological studies in general working populations, including low work-related physical activity (e.g., sedentary work) [27-29]; shift work [30-33]; long working hours [34,35]; low job control [36,37]; high job demands [37]; high job strain (combination of low job control and high job demands) [36,38]; low social support at work [39]; and iso-strain (high job strain plus low social support at work) [39]. Nonetheless, the associations between working conditions of firefighters and obesity, and the relationships between working conditions and health behaviors for obesity in firefighters remain to be clarified. The working conditions of firefighters are virtually unique among the working population because of the 24-hour work shifts, the quasi-military work organization, and the pattern of generally routine firehouse-based activities interspersed with unpredictable calls for emergency medical care or to fight structural or wild land fires. It is important to understand whether and how occupational risk factors for obesity identified in the general working population are relevant to firefighters, and to consider whether the unique working conditions of firefighters add to or interact with the other risk factors for obesity.

Possible mechanisms for the associations between adverse working conditions and obesity

It is not clear yet how working conditions influence the risk of obesity [40]. However, several possible mechanisms have been proposed. First, a significant reduction of work-related physical activity (e.g., increasing sedentary labor), given the same level of energy consumption, could lead to a positive energy imbalance state [41]. Second, adverse working conditions may function as stressors to induce dysfunction of the hypothalamus [42-44], which could shift energy balance towards the positive via alterations of the autonomic nervous system, endocrine systems, and circadian rhythms in relation to lipid metabolism [42,45-48]. Third, adverse working conditions may cause obesity indirectly via changes in health behaviors. For example, high job demands [49], long working hours and shift work [50-52], and poor social support regarding dietary behaviors from

coworkers and organizations [14] were associated with interruptions of eating rhythms and/or unhealthy eating behaviors (e.g., more take-out meals, overeating, fast-easting, or snacking). Low job control [53], having a passive job [53], high job strain [53], high job effort/reward imbalance [54], physically strenuous jobs and overtime [55] were inversely associated with active leisure-time physical activity. Fourth, adverse psychosocial working conditions may increase the risk for obesity only in those who have unhealthy behaviors [56,57]. It should be noted that these four mechanisms are not mutually exclusive and more than one is likely to be active at the same time. In addition, their specific impacts and interactions as factors in the etiology of obesity could be occupation-specific.

How could working conditions of firefighters increase the risk for obesity?

In many communities, the nature of firefighter work has shifted towards emergency medical response, as the incidence of structural fires has declined since 1978 [58], while emergency medical calls have increased significantly and are now the greatest portion of call volumes in a fire department [59,60]. This historical transformation in the tasks and role of firefighters could contribute to an increase in the risk of obesity in firefighters due to the overall reduction of work-related physical activity (energy expenditure) and increased emotional demands and stress. Fig. 2 shows a theoretical framework of the association between firefighter working conditions and obesity risk. The working conditions of firefighters are generally characterized by high mental and physical job demands, unpredictable fire fighting, relatively long calm periods of time between alarms which still require the maintenance of constant vigilance (and some consequent level of biological arousal), and shift work (i.e., 24-hour shifts) [61,62]. Firefighters also reported psychological job demands above the national average and job control below the national average ("job strain") in the Quality of Employment Surveys of the 1970s [63]. As noted above, most of these factors have been reported as risk factors for obesity in general working populations.

The importance of firefighter input in understanding working conditions of firefighters

To learn more about the general working conditions of firefighters, we organized a focus group of firefighters at a local fire station of the Orange County Fire Authority (OCFA), which provides professional firefighting services to a large number of the cities and non-incorporated areas in Orange County, California. The focus group confirmed impressions gained from "ride-alongs" (in which researchers accompanied a fire crew to emergency calls on the vehicles during a 24-hour shift) that there are substantial variations in working conditions among firefighters. There were "slow" and "busy" fire stations in terms of the number of rides (calls) per 24 hours. Firefighters are more likely to be obese in slow stations than in busy stations perhaps due to the reduction of work-related physical activity and the sedentary life at the slower fire stations (although selection factors may play a role and need to be taken into account) [61,64]. In the extremely busy stations, the obesity risk of firefighters could increase due to increased work stress and

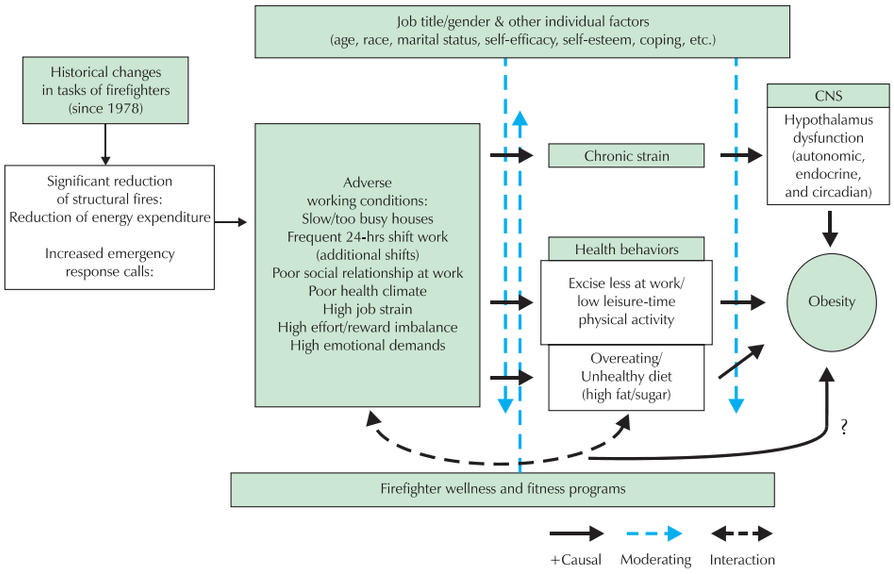

Fig. 2. A theoretical framework on working conditions, health behaviors, and obesity in firefighters. CNS: central nerve system.

unhealthy behaviors. Gerace and George [15] described that "the habit of eating fast has developed at fire stations because fire fighters anticipate having their meals interrupted by 'calls'. Eating fast can result in reduced awareness of the quantity eaten and ingesting amounts that exceed the amount necessary for satiety". In addition, the focus group informed us that there was a substantial variation in the number of 24-hour shifts per month among firefighters. Although ten 24 hour shifts per month is a standard work schedule for firefighters, about a third of firefighters do additional four or more shifts per month. Firefighters doing more additional shifts may be more likely to be obese since they are subjected to frequent dysfunction of the hypothalamus (including sleep disturbance) or they may be more likely to cope with the higher demands by utilizing unhealthy behaviors. Furthermore, during our 24-hour ride-along experience, we witnessed variation in the team culture of firefighters due to the leadership of supervisors (captains and chiefs). Previous research has found that conflict with supervisors was the strongest predictor of job dissatisfaction and poor work morale in firefighter paramedics [65], and high intra-and intergroup conflict was a risk factor for depression and/or job dissatisfaction in firefighters [66]. Firefighters with supportive leadership might be less stressed and more likely to maintain healthy behaviors. On the other hand, as noted above, Elliot et al. [14] reported a positive effect of a supportive health climate on promoting healthy behaviors and managing weight in firefighters.

Based on the epidemiological literature of working conditions and obesity risk in the general population, consideration of obesity risk mechanisms, and understanding of the unique working conditions of firefighters, we hypothesize that the following working conditions, in particular, frequent 24-hour shift work (additional shifts), low and extremely high numbers of calls per 24-hour shift, poor social relationships at work, and poor worksite health climate will be risk factors for obesity in firefighters directly or indirectly through promoting unhealthy behaviors. We do not propose strong hypotheses about the role of other psychosocial stressors (e.g., effects of low job control, high job strain, high job effort/reward imbalance, and high emotional demands) in the development of obesity in firefighters because of a lack of preliminary investigations about the internal variation of these psychosocial stressors among OCFA firefighters. Nonetheless, based on the literature and our research [67,68] using the Midlife Development in the United States II dataset, these factors still need to be considered as possible risk factors for obesity in firefighters.

Our preliminary meetings with firefighters and observations did not provide any immediate support for our "moderator" hypothesis: adverse psychosocial working conditions may increase the risk for obesity only in those who have unhealthy behaviors. Nevertheless, we believe there still is possible theoretical support for this hypothesis due to the existence of some evidence in general working populations, so a research study on firefighters' working conditions should still evaluate this "moderator" hypothesis.

Developing a firefighter work and health questionnaire using a PAR approach

A prerequisite to conducting epidemiological research or preventive intervention studies of firefighter working conditions and obesity risk is the development of well validated instruments that are based on an appropriate theoretical framework and that are able to assess both the unique working conditions and health behaviors of firefighters who work on a 24 hour-shift system. There are few questionnaire instruments that assess firefighter working conditions and none that are sufficiently complete to be used for the needed research. Many firefighter wellness and fitness (WEFIT) programs have focused on fitness training and periodic medical examinations. WEFIT programs have not been intended to examine occupational or behavioral determinants of obesity and biological CVD risk factors and the questionnaires used in these programs have not assessed these factors. One exception is the Sources of Occupational Stress (SOOS) questionnaire [65,69] that was developed in the early 1990s mainly to assess various job-related stressors in firefighter and paramedic emergency service workers. The SOOS includes the following scales: job skill concerns, tedium, past critical incidents, conveying news of tragedy, management/labor conflicts, apprehensions regarding personal safety, co-worker conflict, sub-standard equipment, reduction in benefit, discrimination, family/financial strain, second job stress, sleep disturbance, and poor health habits. It is a useful instrument for assessing working conditions of firefighters. Nonetheless, its direct application for conducting research on firefighter working conditions and obesity risk is limited because it does not measure some working conditions that may be important and it does not adequately measure obesity-related behavioral risk factors. The questionnaire does not measure the shift-work related job demands of firefighters (the number of total 24-hour shifts per month, the number of additional 24-hour shifts per month, the number of consecutive shifts per month, and the number of calls per 24-hour shift), worksite health climate, and job decision-making authority (a component scale of job control) which are hypothesized to be obesity risk factors. Although it includes a few items on diet and exercise, the questionnaire was not designed to measure specific obesity-related health behav-

iors of firefighters, thus, the items and scales in these domains are not sufficient. Furthermore, as noted above, the nature of firefighters' work has been evolving, so the relevance of the SOOS items and scales to current working conditions, such as among the OCFA firefighters, should be assessed before their use in an epidemiological study. Therefore, there is still a need to develop a firefighter-relevant work and health questionnaire based on existing standard instruments (on psychosocial working conditions, shift work, and health behaviors) for investigating occupational and behavioral risk factors for obesity in firefighters.

Participation by working people in occupational health research is an important goal of PAR approach [70-72]. PAR encourages a democratization of the research process, decentering the "professional expert" model common to most epidemiological research, revising the role of the research subjects by empowering them as experts with indigenous knowledge of the workplace, and focusing on organizational or social change. PAR is not a specific method, but an approach, a process and a goal encouraging participation along a continuum [73]. It has been successfully employed in several public health studies [65, 74-76] to develop new instruments relevant to a study population, culture, and worksite, and to collect qualitative data from participants concerning the problem under study in order to inform and develop a richer theoretical understanding of the research questions and findings. Therefore, we suggest that use of the PAR approach to incorporate the views and understanding of firefighters in the development of a study instrument is an important step to conduct epidemiological or intervention research in this area.

Skinfold-based per cent body fat may be a better screening measure for CVD risk in firefighters than body mass index

Another measurement issue that must be addressed is identifying the most valid practical method to measure obesity in firefighters. Most previous cardiovascular risk factor studies in firefighters [8,9,12] have been carried out using BMI as the obesity measure. Few studies have used alternative obesity measures such as skinfold-based percent body fat (% fat). BMI is intrinsically blind to the difference between fat body mass and lean body mass. In an exercise training program with firefighter recruits [77], skinfold-based body fat % decreased as a result of training, while BMI did not change significantly. In addition, the association between BMI and body fat differs by age, gender, race, occupation (e.g., athletes), and ethnicity [6,78-81]. This suggests that BMI may be a problematic measure (i.e., overestimation of obesity) to be used as a "standard" surveillance measure for CVD risk in firefighters who build musculature through on-the-job physical training and are of diverse race/ethnicity backgrounds. To our knowledge, no study has explored differential relationships between BMI and skinfold-based % fat by age and ethnicity (e.g., Latinos vs. Whites) and differential relationships of BMI and skinfold-based % fat with other CVD risk factors (e.g., hypertension and blood lipid profiles) in firefighters. Skinfold anthropometry is a more non-invasive and cost effective method than dual-energy X-ray absorptiometry, another commonly used method of calculating body fat %.

Research Design and Methods

The University of California, Irvine, Center for Occupational and Environmental Health (UCI COEH), received funding from the National Institute for Occupational Safety and Health (NIOSH) to conduct a study to develop and validate a firefighter-specific questionnaire and assess firefighters' working conditions and obesity behavioral risk factors. The study is currently underway. Although the study is not yet completed, the initial research design and methods for this study will be informative to practitioners in terms of how to translate the aforementioned theoretical framework and input from the specific working population into a research plan.

The research is a cross-sectional epidemiological study that builds on and takes advantage of an ongoing OCFA WEFIT examinations and available OCFA records of work schedules and duties. We are recruiting at least 360 OCFA firefighters from a pool of 840 active-duty firefighters scheduled for a WEFIT exam at the UCI COEH. The study involves the following steps in chronological order: 1) building a research advisory committee of researchers and firefighters; 2) conducting focus groups of firefighters to review, assess and adapt work environment and health behavior questionnaires to the firefighter work environment; 3) completion of a self-report survey (n > 360) to assess working conditions and health behaviors (dietary quality, eating behaviors, and physical activity); 4) a sub-study (n = 80) to test the validity of the self-report questionnaire against 48 hours of physical activity monitoring and food records, and to test a one-week test-retest reliability of the self-reported questionnaire; 5) data linkage for data analysis: the survey data, the sub-study data, and OCFA archival data about annual call information by local fire station will be linked to existing WEFIT medical data of the firefighters on weight (BMI and body fat %), clinic blood pressure, and other clinical measures (maximal oxygen consumption [VO2 max], total cholesterol, high-density lipoprotein [HDL], low-density lipoprotein [LDL], and triglyc-

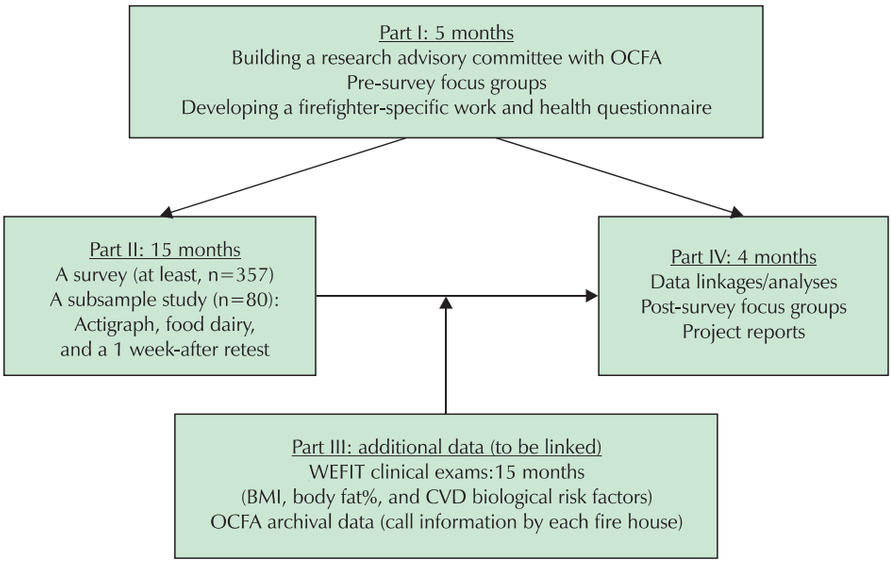

Fig. 3. Schedule of data collection and research activities. OCFA: Orange County Fire Authority, WEFIT: wellness and fitness, BMI: body mass index, CVD: cardiovascular disease.

erides); and 6) reconvening the firefighter focus groups to assess and evaluate study findings in order to develop recommendations for reducing weight and obesity in the OCFA. The overall schedule of data collection and research activities is shown in Fig. 3. The study has convened the Advisory Committee and has begun to conduct the focus groups.

Research Advisory Committee with OCFA

The Research Advisory Committee meetings contribute to a PAR approach, and are held bimonthly (every two months) in one-hour sessions with participation of the UCI COEH research team, the OCFA risk manager, the OCFA WEFIT coordinator, a representative of the International Association of Fire Fighters (IAFF) Local 3631, a representative of the (Battalion) Chiefs Officer Association, and a rank-and-file firefighter, to provide oversight and facilitate the study.

Pre-survey/Work Group: Focus group methodology

We have used focus group methodology to facilitate firefighter participation and to gain their expertise in the review, assessment, and adaptation of work environment and health behavior questionnaires. In addition, the focus group participants have provided a qualitative assessment of the obesity problem from a firefighter perspective. The same focus group participants will participate in a post-study evaluation of study findings and development of recommendations for reducing weight and obesity in the OCFA.

Pre-Survey/Work Group: Groups made up of firefighters are being recruited to participate in focus groups to review, assess, and adapt work environment and health behavior questionnaires for the firefighter work environment. Focus groups will be conducted as follows: Group 1 made up of firefighters and engineers only (n = 10); Group 2, Captains only (n = 5); and Group 3, Battalion Chiefs only (n = 5). It is an important aspect of focus group methodology that individuals should be similar in terms of job status and rank as differences between participants are known to reduce the quality of the data [82,83]. A series of focused-group discussions will be guided by a member of the UCI COEH research team with experience in qualitative research methods.

The purpose of these focus groups will be to review and discuss the validity of pre-existing domains from the perspectives of firefighters in relation to their working conditions and health behaviors and to assess/review the final survey questionnaire before it is administered. While these focus groups will also be used to generate "themes" about the causes of obesity among firefighters, these focus groups will also be more structured than typical focus groups because of the objective to develop a concise, firefighter-relevant work and health questionnaire. The interaction between researcher and participants is to be reciprocal with participants challenging and informing pre-existing research knowledge and the researcher guiding the discussion and including education about survey research methods.

Existing standardized questionnaire domains (Table 1) of working conditions and health behaviors based on a literature review will be presented to the focus group for review. During the focus group, members will be led in a discussion of the following areas and questions:

- List the main areas in order of importance needed to as-

Table 1. The questionnaire domains on working conditions and health behaviors of firefighters for the focus group discussion

• Workload (e.g., shifts)
• Job demands/efforts
• Skill use
• Decision-making authority
• Social support and conflict
• Intra- and inter-group conflict
• Quality of leadership
• Organizational culture
• Reward
• Emotional labor/demands
• Work-family conflict
• Exposure to critical incidents/trauma
• Concern over personal safety
• Discrimination/harassment
• Health climate at station
• Physical activity on-duty and off-duty
• Eating behaviors on-duty and off-duty
• Sleep quality on-duty and off-duty

sess firefighter health behaviors related to weight gain and obesity.

- List the different areas of the firefighter work environment that might be contributing to these health behaviors (e.g., workload, shift work, work-family stress). Firefighters will be encouraged to use their own wording.
- Are there any domains that are not covered by the existing questionnaires/scales that still need to be developed?
- Discussion of strengths and limitations of each domain. For example, are there any items that are difficult to understand in the context of the firefighter work environment, and are there any questions that focus group participants would like to include if possible?

Survey study recruitment

During the initial months of the project, we will send out emails publicizing the study, post flyers at the OCFA local fire stations and headquarters as well as at the COEH clinic, and publish information about the study in the quarterly WEFIT newsletter. Firefighters will be recruited for the survey that will be developed and validated through assessment by the focus groups at the time of their biennial WEFIT exam at the UCI COEH. On average 10-12 firefighters, scheduled by the OCFA, are seen each week at the UCI COEH. Recruitment and data collection will continue for approximately 15 months or until we enroll at least 360 firefighters (both males and females, although the OCFA firefighters are predominately males). Our power analysis in planning the study indicated that we would need to recruit at least 360 firefighters to detect a small effect size (i.e., Cohen's d = 0.30, equivalent to 3.5 kg difference with a standard deviation of 11.9 from the initial WEFIT evaluation dataset [2004-2007]) between exposed and control groups. A weight reduction intervention study [84] in non-hypertensive US adults reported that a weight loss of 3.9 kg was significantly associated with diastolic blood pressure change of -2.3 mmHg and systolic blood pressure change of -2.9 mmHg. Considering potential gender differences in the relationship between working conditions, health behaviors, and obesity [18, 35], statistical analyses will be conducted separately for men and women. The completed survey results will be subjected to statistical validation methods comparing self-reported data with objective measures (e.g., physical activity monitor).

Sub-study recruitment (N = 80)

Eighty of the firefighter participants will be recruited with a stipend to participate in the sub-study. One unit out of the four that attend the WEFIT exam each week will be randomly recruited to jointly participate in this sub-study. There are approximately 3-4 firefighters (including one captain, one engineer and 1-2 firefighters) in each unit. Every unit attending the WEFIT clinic on Monday mornings will be recruited to participate in the sub-study until we have 80 subjects, all of whom have provided completed actigraphs and food consumption records. Our power analysis in planning this component of the study indicated that we would need to see at least 64 firefighters to detect a moderate effect size (i.e., Pearson correlation r = 0.30) between the measured and self-reported physical activity levels. Several validity studies [85,86] of the European Prospective Investigation into Cancer and Nutrition (EPIC) physical activity questionnaire and International Physical Activity Questionnaire-Short Form reported similar correlation coefficients against measured values by accelerometers.

Two-day food record

Dietary intake will be assessed by a 2-day food record. After detailed instruction, participants will be asked to record all food intakes over two pre-determined days (one 24 hour shift day and one 24 hour off day). Records will be analyzed by a trained

dietitian utilizing the Nutrition Data Systems for Research 2009 (University of Minnesota).

Physical activity monitor

We will monitor the intensity and pattern of physical activity of firefighters using a physical activity monitor (i.e., Actigraph) which continuously detects body movement over a 24-hour period and is worn at the waist. This device has been validated against the gold standard of the doubly labeled water (DLW) methodology for measuring energy expenditure under free-living conditions [87]. In addition, physical activity monitors have a clear merit over the DLW method in that they provide diverse information of physical activity beyond caloric expenditure [88,89]. The Actigraph accelerometer is a small and lightweight tri-axial accelerometer. It provides the following information for analysis: activity counts, step counts, caloric expenditure (kcal/day), and activity levels (sedentary, light, moderate, and vigorous physical activities, min/day). For instance, the minute-by-minute accelerometer counts will be classified as moderate-to-vigorous physical activity using both the widely-used cut-off of 1,953 counts/min [90] and the recently suggested alternative cut-off of 760 counts/min [91].

A short-form survey questionnaire

A short form survey questionnaire including only the working conditions and health behaviors scales/items of the full survey questionnaire will be filled in one week after completing the initial survey (at WEFIT exam) for a one-week test-retest reliability of those variables.

OCFA archival data on the calls/WEFIT questionnaire and medical/fitness exams records

Information about the annual (2004-2011) calls of each OCFA fire station will be obtained from the OCFA (with consent) in order to characterize each fire station in terms of slow, medium, busy stations. In addition, detailed information of each call (fire calls, emergency medical call, etc.) will also be obtained to characterize the nature of the service of each fire station. The following variables will be extracted from the WEFIT clinic exams and WEFIT questionnaire completed at the time of the study: alcohol use, smoking, use of medications, Body Fat % (based on skin fold measures on three sites [92]), BMI, estimated VO2 max, blood pressure, total cholesterol, HDL, LDL, and triglycerides. All of the medical and fitness exams are conducted at the UCI COEH, according to contemporary standard protocols to reduce measurement errors [93,94].

Post-survey/Work Group

During the last four months of the study, the same firefighters involved in the pre-survey focus groups will be asked to participate in one additional focus group discussion. Participants in each group will be guided in a strategic process to develop recommendations to reduce weight among OCFA firefighters. A presentation of the key findings in the study will be made by researchers to each group, after which participants will be guided through a series of general questions to elicit reactions to the results in each area of the questionnaire. Questions will begin with more general prompts such as:

- Which results did you find most surprising or interesting? Order them in priority of importance to the group.
- Are there any results that do not make sense to you? Why/Why not?
- Are these results different or similar to what you would have expected? Why/Why not?
- What are the implications of this result to firefighters, to OCFA, and to IAFF Local 3631?
- What do you think might be an appropriate response to this result by the organization? By the IAFF Local 3631? By individual firefighters?
- What kinds of recommendations would you make to improve this situation?

These recommendations will be presented to OCFA management and the IAFF Local 3631, and will serve as the groundwork for designing a future intervention study to reduce firefighters' weight and obesity.

Conclusion

The theoretical framework and epidemiological study will contribute to understanding the complex etiology of obesity and establishing effective intervention programs for obesity in firefighters as a part of firefighter WEFIT programs. In addition, this study will facilitate future studies on the relationships between work, health behaviors, and CVD risk in firefighters by developing a firefighter work and health questionnaire utilizing a PAR approach. The methodological investigation of BMI and skinfold body fat % in firefighters will contribute to making guidelines for medical surveillance of obesity in firefighters [12]. We will work towards building a collaborative task force with OCFA firefighters to 1) participate in the development and validation of the comprehensive work and health questionnaire and 2) plan future interventions to reduce obesity and CVD risk factors based on the findings of the cross-sectional study.

The approach of developing a theoretical framework with input by the specific working population, followed by rigorous

procedures to develop and validate the study instruments using a PAR approach, is a model for research on the working conditions and health risks of other occupations that may also have relatively unique characteristics.

Conflict of Interest

No potential conflict of interest relevant to this article was reported.

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