



Health Disparities Among Racial and Ethnic Minority Firefighters

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Health Disparities Among Racial and Ethnic Minority Firefighters

Abstract

ABSTRACT

Background: Racial/ethnic minorities are substantially underrepresented in the fire service and this situation is unique when compared to similarly mentally and physically demanding and hazardous occupations such as the military and law enforcement. There is little systematic research to provide greater clarity about this significant disparity. The purpose of this study is to examine physical and behavioral health issues of racial/ethnic minority firefighters when compared to their white, non-Hispanic counterparts and potentially identify areas for future research that might assist in improving their substantial underrepresentation.

Materials and Methods: We report the results of a secondary analysis of data combining the baseline evaluations of two different firefighter health studies, the *Firefighter Injury and Risk Evaluation (FIRE)* and *Fuel 2 Fight (F2F)* studies. Male career firefighters (N=1,404) were from 31 fire departments across the US and its territories. White, non-Hispanic firefighters comprised 72.5% of the sample (n=1,018) and 27.5% classified themselves as a racial/ethnic minority. Firefighters who agreed to participate comprised 94% (F2F) and 97% (FIRE) of those available and all underwent assessments including body composition, fitness, and general/behavioral health, and job satisfaction.

Results: We examined differences in health and job status between minority and non-minority firefighters and between firefighters in minority- (MDCs) and white-dominated communities (WDCs). After adjusting for potential confounds, there were significant main effects for the individual minority status vs. non-minority status on both BMI and BF%, indicating that minority firefighters had significantly higher average BMI ($28.8 \pm 0.3 \text{ kg/m}^2$) and BF% ($24.7 \pm 0.7\%$) when compared to their white, non-Hispanic colleagues ($27.7 \pm 0.2 \text{ kg/m}^2$ and $23.1 \pm 0.6\%$ for BMI and BF%, respectively). Minority firefighters also were 59% more likely to be obese (adjusted [A]OR=1.59; 95% CI=1.16-2.18). Firefighters serving in MDCs reported significantly more poor health days (Mean \pm SE; 3.2 ± 0.2 days) than firefighters serving in WDCs (2.8 ± 0.2 days; $p=0.038$). In addition, minority firefighters reported significantly more poor health days (3.6 ± 0.4 days) than their non-minority colleagues (2.8 ± 0.2 days; $p=0.003$), while the interaction indicates that minority firefighters in MDCs reported more poor health days than the other groups (p

Conclusions: Individual and community minority status (i.e., ethnic density effect) were both significantly associated with a number of important health status indicators, with racial/ethnic minority firefighters demonstrating greater risk for unfavorable body composition and more poor physical health days. In addition, minority firefighters in WDCs reported the highest prevalence of lifetime diagnosis of depression by a physician, while minority firefighters in MDCs had the lowest. Many of these health status indicators have recently been studied within the context of experiences with discrimination, demonstrating that racial discrimination is associated with greater risk for obesity, depression, and poor physical and mental health and could be contributing to health disparities and potentially negatively impacting racial/ethnic minority firefighter health, safety, and retention.

Keywords

firefighter; health disparities; obesity; depression; poor health days

Cover Page Footnote

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Firefighter Injury Risk Evaluation [FIRE] study” (EMW-2007-FP-02571) and the “Fuel to Fight [F2F] Study” (EMW-2009-FP-01971). The authors would like to thank all of the firefighters and their fire departments for participating in this study with the goal of improving firefighter health and operational readiness and the EFSP for their guidance in conducting this study. We also would like to thank staff members at NDRI (Melissa Hyder, Ph.D. and Sarah Cooper) and UTHSPH (Deirdre Douglass, R.D., M.S., Nnenna Ananaba, M.P.H. and Chris Kaipust, B.A.) for their assistance with data collection, entry, and cleaning/verification.

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ABSTRACT

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Methods: We report the results of a secondary analysis of data combining the baseline evaluations of two different firefighter health studies, the *Firefighter Injury and Risk Evaluation (FIRE)* and *Fuel 2 Fight (F2F)* studies. Male career firefighters (N=1,404) were from 31 fire departments across the US and its territories. White, non-Hispanic firefighters comprised 72.5% of the sample (n=1,018) and 27.5% classified themselves as a racial/ethnic minority. Firefighters who agreed to participate comprised 94% (F2F) and 97% (FIRE) of those available and all underwent assessments including body composition, fitness, and general/behavioral health, and job satisfaction.

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colleagues ($27.7 \pm 0.2 \text{ kg/m}^2$ and $23.1 \pm 0.6\%$ for BMI and BF%, respectively). Minority firefighters also were 59% more likely to be obese (adjusted [A]OR=1.59; 95% CI=1.16-2.18). Firefighters serving in MDCs reported significantly more poor health days (Mean \pm SE; 3.2 ± 0.2 days) than firefighters serving in WDCs (2.8 ± 0.2 days; $p=0.038$). In addition, minority firefighters reported significantly more poor health days (3.6 ± 0.4 days) than their non-minority colleagues (2.8 ± 0.2 days; $p=0.003$), while the interaction indicates that minority firefighters in MDCs reported more poor health days than the other groups ($p<0.001$). Firefighters serving MDCs also had 48% (AOR=0.52; 95%CI=0.30-0.91) less risk for lifetime depression than firefighters working in WDCs, but minority firefighters in MDCs were the least likely to have a history of physician diagnosed depression while minorities in WDCs had the highest rate of lifetime history of depression.

Conclusions: Individual and community minority status (i.e., ethnic density effect) were both significantly associated with a number of important health status indicators, with racial/ethnic minority firefighters demonstrating greater risk for unfavorable body composition and more poor physical health days. In addition, minority firefighters in WDCs reported the highest prevalence of lifetime diagnosis of depression by a physician, while minority firefighters in MDCs had the lowest. Many of these health status indicators have recently been studied within the context of experiences with discrimination, demonstrating that racial discrimination is associated with greater risk for obesity, depression, and poor physical and mental health and could be contributing to health disparities and potentially negatively impacting racial/ethnic minority firefighter health, safety, and retention

Keywords: Racial/Ethnic Minority, firefighter, health disparities, health status,

INTRODUCTION

Firefighters play a vital role in providing emergency medical, rescue and fire suppression services and serve as the primary public health safety net for most communities in the US. Because they typically are the first to respond to emergencies of all kinds, firefighting is recognized as a very mentally and physical challenging profession exposing firefighters to a number of occupational hazards including heat stress and dehydration, exposure to smoke-borne toxins and medical hazards, having to work in dangerous environments, and managing strenuous physical challenges (Soteriades, Smith, Tsismenakis, Baur, & Kales, 2001; Smith, 2011).

Despite the occupational hazards, competition for career firefighter positions is fierce and getting hired typically involves several steps including passing written and physical abilities tests, meeting required medical standards, and completing interviews with department leadership (see http://www.i-women.org/women_firefighting.php). Currently there are nearly 350,000 career firefighters serving in the US (Karter, & Stein, 2012), but curiously, very few are racial/ethnic minorities (Hulett, Bendick, Thomas, & Moccio, 2008; Jahnke, Poston, Haddock, Jitnarin, Hyder, & Horvath, 2012). For example, while racial/ethnic minorities (i.e., all non-white Census racial categories and Hispanics of any racial category) represent 36.6% of the US population (US Census Quick Facts, 2013), they are substantially underrepresented in the fire service, representing between 12%-20%, depending on the source and timeframe of the data

(Daniels, 2006; Fox, Hornick, & Hardin, 2006, BLS, 2011; 2012; Jahnke, Poston, Haddock, Jitnarin, Hyder, & Horvath, 2012).

What also is striking is how unique the low racial/ethnic representation is for the fire service compared to other, similarly mentally and physically demanding and hazardous occupations such as the military and law enforcement. For example, racial/ethnic minorities constitute approximately 37% (compared to white, non-Hispanics, who comprised 63%) of the US active duty military forces in the most recent demographic profiles (DoD, 2011; 2012). Similarly, racial/ethnic minorities represent between 25%-30% of police and sheriff's officers depending on the data source and timeframe (BLS, 2012a; 2012b; Matthies, Kellar, Lim, 2012; USDOJ, 2010). Thus, the low rates of racial/ethnic minorities in the US Fire Service is notable and troubling (Hulett, Bendick, Thomas, & Moccio, 2008).

Little has been written about the lack of representation of racial/ethnic minorities in the fire service outside of general articles and editorials in fire service outlets about the value of diversity and the challenges of having a culturally diverse fire service and a PBS documentary on diversity in the fire service (e.g., Dodwell, 2013; McNeil, 2008; Mitrano, 2013; Roberts, 2012; Willing, 2011; PBS Tests of Courage [<http://www.pbs.org/itvs/testofcourage/>]). However, a number of ideas have been offered to explain the low representation of minorities in the fire service including: 1) the belief that fire departments do not make hiring a diverse workforce a priority; 2) "regimenting", described as the process by which family members and friends of current and retired firefighters are provided with inside information about job openings, the testing and interview process, etc. that is not accessible to external groups such a racial/ethnic minorities; 3) that the testing process, particularly the written entry tests, is culturally biased; 4) that fire departments value traditions to such a degree that it becomes a barrier to change and diversity even to the point of maintaining problematic hiring processes; 5) that retaining existing racial/ethnic minorities is not emphasized, and that the culture of most fire departments is not welcoming to racial/ethnic firefighters, which may result in more mental and physical health problems among those who stay and/or poorer retention of racial/ethnic minorities (Daniels, 2006; FairTest Examiner, 2010; 2012; FIRE20/20, 2007; Fox, Hornick, & Hardin, 2006).

For example, it is possible that racial/ethnic minority firefighters experience both overt and subtle episodes of discrimination and/or harassment, which could negatively impact their mental health, perceptions of job-related stress, and result in lower retention, job satisfaction, and other health concerns. In one of the only studies of gender and racial harassment in the fire service, 22 African American women firefighters all reported experiences of gender and racial harassment and 82% either agreed or strongly agreed that racial discrimination was a big problem in their departments (Yoder & Aniakudo, 1996). They also reported that their experiences of discrimination made their work environments feel hostile and isolated and a growing body of scientific literature has established a link between racial discrimination and mental and physical health (Williams, Neighbors, & Jackson, 2003). In addition, it is possible that most fire department cultures, being predominantly based on the values and traditions of the majority of firefighters (who are white/non-Hispanic), are viewed by racial/ethnic minority firefighters as unwelcoming, unwilling to change, stressful, or worse (Daniels, 2006; FIRE20/20, 2007).

Unfortunately, there is little systematic research or evidence to provide greater clarity about this significant disparity and the issue of racial/ethnic minority health and safety, which could play an important role in both recruiting and retaining minority firefighters, was absent in

the most recent fire service research agenda (NFFF, 2011). The purpose of this study is to examine physical and behavioral health issues of racial/ethnic minority firefighters when compared to their white, non-Hispanic counterparts and potentially identify areas for future research that might assist in improving their substantial underrepresentation. We also examined the community context in which they worked by stratifying their communities based on whether they were predominantly minority or white communities. We did this based on theoretical and empirical work referred to as the “ethnic density effect”, which postulates that racial/ethnic composition of the areas in which minorities live or work can affect both their mental and physical health (Shaw, Atkin, Becares, Albor, Stafford, et al., 2012; Becares, Shaw, Nazroo, Stafford, Albor et al., 2012).

Shaw and colleagues (2012) reviewed the existing ethnic density literature on mental disorders and found that living in minority dominated communities (MDCs) was protective against depression for some racial/ethnic minority groups in the US. This theory suggests that MDCs may provide a buffer for racial/ethnic minorities against experiences of discrimination and racism that might negatively affect their mental health while also enhancing their sense of social cohesion, support, and community (Becares, et al., 2012). However, the association between ethnic density and positive physical health outcomes has been less consistent. Overall, this theory may have some application to racial/ethnic minorities in the fire service who are likely to experience racism and discrimination in fire departments, most of which lack substantial diversity, and could result in feelings of isolation and not belonging. However, racial/ethnic minority firefighters working in MDCs may experience a buffering effect by serving in a community that is similar to them, thus improving some of their health parameters (Daniels, 2006; Pickett et al., 2008; Shaw, et al., 2012; Becares, et al., 2012). This study is unique because it is the first to focus on the health and wellness of minority firefighters using data from two of the largest studies on firefighter health (Poston, Haddock, Jahnke, Jitnarin, Tuley, & Kales, 2011a; Poston, Haddock, Jahnke, Jitnarin, & Day, 2013) and also evaluating the potential impact of the ethnic density effect on their health.

METHODS

Participants: Fire Departments and Firefighters

The data reported are from a secondary cross-sectional analysis of baseline assessments from of two different firefighter samples. We combined common data from both studies to maximize the number of minority firefighters available for analysis given their substantial underrepresentation in the fire service (Fox, Hornick, & Hardin, 2006):

The Firefighter Injury and Risk Evaluation (FIRE) Study was funded by the Federal Emergency Management Agency in the Department of Homeland Security (EMW-2007-FP-02571), and examined risk factors for injury in a population-based random sample of both career (N=11 departments with 500 firefighters) and volunteer (N=13 departments with 214 firefighters) fire departments in the International Association of Fire Chief’s (IAFC) Missouri Valley Region (Colorado, Iowa, Kansas, Missouri, North Dakota, Nebraska, South Dakota and Wyoming; see Jahnke, Poston, Haddock, & Jitnarin, 2013a; 2013b; Poston, Haddock, Jahnke, Jitnarin, Tuley, & Kales, 2011a; Poston, Haddock, Jitnarin, & Jahnke, 2012) from 2007-2010.

Volunteer firefighters from the FIRE study were excluded from this analysis because they experience less risk for occupational health exposures and have less frequent interactions with their departments and colleagues than career firefighters. In addition, while there are no

systematic national data on diversity in the volunteer fire service (personal communication, National Volunteer Fire Council, 25 June, 2014), the few published studies that included volunteer firefighters demonstrate they are even less racially and ethnically diverse than the career fire service, with samples being comprised of less than 5% racial/ethnic minorities (Frattaroli, Pollack, Bailey, Schafer, Cheskin, & Holtgrave, 2013; Jahnke, Gist, Poston, & Haddock, 2014; Poston, Haddock, Jahnke, Jitnarin, Tuley, & Kales, 2011a). The representation of racial/ethnic in the FIRE study (13.6%; Poston, Haddock, Jahnke, Jitnarin, Tuley, & Kales, 2011a) closely parallels data from other national sources (e.g., BLS, 2011; 2012; Daniels, 2006; Fox, Hornick, & Hardin, 2006).

The Fuel 2 Fight (F2F) Study was funded by the Assistance to Firefighters Grants program managed by the Federal Emergency Management Agency in the Department of Homeland Security (EMW-2009-FP-01971) from 2009-2012 and focused on the impact of wellness and fitness programs on health and safety in career firefighters only. The national, purposively sampled (Shadish Cook, & Campbell, 2002) group of 20 career fire departments sampled over 1,000 career firefighters at the baseline evaluation. Fire departments were selected based on whether or not they had active health promotion programs which involved meeting or not meeting all of the following criteria: a) NFPA 1582 (NFPA, 2006) compliant annual medical physical examinations to all fire service personnel; b) A designated health/fitness coordinator (this could be a professional position or filled by a firefighter as an extra duty); c) Peer fitness trainers (PFTs) who matriculated in an approved program for the designation of PFT; and d) Time for physical training/working out while on-duty for all fire service personnel (Poston, Haddock, Jahnke, Jitnarin, & Day, 2013).

The F2F sampling strategy focused on ensuring regional diversity (e.g., we had eight departments from the US Census Pacific and Western regions, eight from the Mountain and Central regions, and four from the North- and Southeastern regions; Poston, Haddock, Jahnke, Jitnarin, & Day, 2013) and also tried to recruit more racially/ethnically diverse fire departments than would be typical for the US Fire Service (Fox, Hornick, & Hardin, 2006). This approach was taken to maximize the generalizability of the findings of the F2F study with regard to understanding the benefits of health and wellness programs in the career fire service. The 1,002 male firefighters from this study were used in this analysis. The proportion of racial/ethnic minorities in the F2F sample was much higher (i.e., ~33%; Poston, Haddock, Jahnke, Jitnarin, & Day, 2013) than the fire service in general.

Measures

Only measures that were assessed in both F2F and FIRE studies were included in the present secondary analysis. Demographics (e.g., age, gender, marital status, educational level, etc.) and occupational history (e.g., current rank and position, years in the fire service, etc.), were collected along with the following:

Body Composition. Height was assessed with a portable stadiometer. Body weight and BF% were determined using the Tanita 300, which is a digital bioelectrical impedance scale. The Tanita 300 demonstrates strong concurrent validity when compared to the “gold standard,” Dual-Energy X-ray Absorptiometry (DEXA; $r=0.94$; $p<0.001$; Rubiano, Nunez, & Heymsfield, 2000) and is commonly used as a field measure because it is portable and minimizes operator error. In addition, we demonstrated significant concordance between BF%- and both BMI- and WC-determined obesity in career firefighters (Poston, Haddock, Jahnke, Jitnarin, Tuley, & Kales, 2011a). WC was assessed using a spring-loaded tape measure in accordance with standard

guidelines [NHLBI, 1998]. Obesity status was computed using BMI, BF%, and WC using standard cut points [NHLBI, 1998].

Physical Activity/Fitness. The Self Report of Physical Activity (SRPA) questionnaire (Jackson et al., 1997) provides a global self-rating of physical activity patterns ranging from 0 (Avoids waking or exertion) to 7 (engages in >3 hours/week of heavy physical activity such as running, swimming, rowing, etc.) over the previous month. The SRPA's validity compared to maximal oxygen consumption has been established (Jackson, & Ross, 1997).

Subjects' age, gender, BMI, and SRPA score were used in a non-exercise model to estimate VO_{2max} (Jackson, & Ross, 1997; Jackson, Blair, Mahar, Wier, Ross, R& Stuteville 1990; Jackson, Beard, Wier, Ross, Stuteville, & Blair 1995; Jackson, Wier, Ayers, Beard, & Stuteville 1996; Jurca et al., 2005; Weir, Jackson, Ayers, & Arenare, 2006). This method has been favorably compared with measured VO_{2max} and demonstrated equal, if not better accuracy than methods using sub-maximal exercise heart rate (Jackson, & Ross, 1997; Jackson, Blair, Mahar, Wier, Ross, R& Stuteville 1990; Jackson, Beard, Wier, Ross, Stuteville, & Blair 1995; Jackson, Wier, Ayers, Beard, & Stuteville 1996; Jurca et al., 2005; Weir, Jackson, Ayers, & Arenare, 2006). We selected this approach for its accuracy and feasibility, given the difficult nature of the field data collection process and cost limitations which precluded having firefighters report to a laboratory for a "gold standard" assessment. Aerobic capacity sufficient to exceed the NFPA minimum post-cardiac event exercise tolerance threshold was evaluated by using estimated VO_{2max} values to compute the suggested cut point of ≥ 12 METs ($\approx VO_{2max} \geq 42$ ml/kg/min) (Donovan, Nelson, Peel, Lipsey, Voyles, & Israel, 2009; NFPA, 2006; Poston, Haddock, Jahnke, Jitnarin, Tuley, & Kales, 2011a).

General and Behavioral Health Conditions : Participants were asked to rate their future risk of serious disease on a 5-point scale with anchors of "Not at all likely" and "Very likely". Measures similar to this have been used in studies of self-rated health in related occupations (Haddock, Poston, Pyle, Klesges, Vander Weg, Peterson, & Debon, 2006). We also assessed the number of poor physical health days during the last 30 days using a question from the CDC Behavioral Risk Factor Surveillance System (BRFSS): "Now thinking about your health, which includes physical illness and injury, for how many days during the past 30 days was your physical health not good" (CDC, 2010a; 2011; Moriarty, Zack, & Kobau, 2003). This question has established reliability and validity (Moriarty, Zack, & Kobau, 2003), is predictive of important longitudinal health care utilization and outcome variables such as physician visits, hospitalizations, and mortality, and is used as part of an overall health rating system for the US (Dominick, Ahern, Gold, & Heller, 2002; United Health Foundation, 2012).

Blood pressure was measured digitally with the Omron HEM-711AC. Participants sat and rested at least five minutes before assessment and then their blood pressure was measured three times and the last two measurements were averaged (NIH/NHLBI, 2004). Hypertension status was defined as systolic blood pressure (SBP) ≥ 140 and/or diastolic blood pressure (DBP) ≥ 90 ; NIH/NHLBI, 2004). Firefighters also were asked to self-report selected medical history (e.g., history of diabetes, heart disease, hypertension, and high cholesterol).

Firefighters were asked to self-report whether they ever had a physician diagnosed depressive or anxiety disorder. The Center for Epidemiological Studies Short Depression Scale (CES-D 10) was used to assess current depressive symptoms and those endorsing four or more items in the negative direction were considered to be in the range of concern for depression (Irwin, Artin, & Oxman, 1999) . The CES-D 10 is highly reliable in the general population

(Spearman-Brown, split halves $r=0.85$) and in patient samples ($r=0.90$) (Irwin, Artin, & Oxman, 1999). Tobacco and alcohol use were assessed using questions from established epidemiologic surveys (CDC, 2010b; Haddock, Jitnarin, Poston, Tuley, & Jahnke, 2011; Haddock, Jahnke, Poston, Jitnarin, Kaipust, Tuley, & Hyder, 2012; Jitnarin, Haddock, Poston, & Jahnke, 2013).

Fire Department Culture: Firefighters were asked to categorize their fire department income using the following item: What is your annual income from the fire department? The response options included <\$25,000, \$25,000-\$50,000, \$50,001-\$75,000, \$75,001-\$100,000, and >\$100,000. Job satisfaction was assessed based on the following items: 1) “I am optimistic about my future success with this fire department”; 2) “I am satisfied with my job at the fire department”; 3) “I am satisfied with the morale of the people I work with in the fire service”; 4) “I am satisfied with the morale of the fire department”; and 5) “My work in the fire department gives me a sense of accomplishment.” Response options were a five-point Likert scale ranging from “Very much disagree” to “Very much agree” and scored in a continuous fashion, consistent with similar scales (Alfonso, 1995).

Procedures

Both the FIRE and F2F studies were led by investigators from the Center for Fire, Rescue, and EMS Health Research at the National Development and Research Institutes (NDRI). The F2F study also involved investigators from the University of Texas Houston Health Sciences Center (UTHHSC). The protocol for the protection of human subjects for the F2F study was approved by the NDRI and UTHHSC Institutional Review Boards and the FIRE study was approved by the NDRI Institutional Review Board. Details about the department and individual firefighter recruitment and consent process can be found in Poston, Haddock, Jahnke, Jitnarin, Tuley, & Kales, 2011a; Poston, Haddock, Jahnke, Jitnarin, & Day, 2013).

Baseline data for both FIRE and F2F studies were collected by a core team of investigators who traveled to each of the participating fire departments for 3-8 days depending on the size and shift structure of the department (e.g., 24-hour vs. 48 hour, number of shifts staffed, etc.), thus maximizing the potential to recruit study participants from all available firefighters. Firefighters who agreed to participate in either study were provided an overview of the protocol, the specific aims, risks, and benefits. We were unable to solicit firefighters for F2F or FIRE who were sick leave, vacation, or attending lengthy emergency calls during study visits. Of the firefighters present and solicited during the baseline visit, 94% from F2F and 97% from FIRE agreed to participate and were consented (see Poston, Haddock, Jahnke, Jitnarin, & Day, 2013 and Poston, Haddock, Jahnke, Jitnarin, Tuley, & Kales, 2011a for details).

Statistical Approach

We also excluded 77 firefighters did not provide race or ethnicity data. Because of the small proportion of female firefighters in the US Fire Service ($\approx 4\%$; Hulett, Bendick, Thomas, & Moccio, 2008; Jahnke, Poston, Haddock, Jitnarin, Hyder, & Horvath, 2012) and in both the FIRE and F2F studies ($n=54$ for both parent studies) and our resulting inability to examine potential moderating effects of gender, only male career firefighters ($n = 1,404$ total from both samples) were used for this secondary analysis.

We examined differences in health and job status between minority and non-minority firefighters and between firefighters in predominantly white vs. predominantly minority communities. We categorized firefighters as minorities if they reported themselves as a member of any racial minority group recognized by the US Census (e.g., African American, Asian American, Hawaiian or other Pacific Islander, American Indian or Alaskan Native, etc.) or if

they reported being of Hispanic origin, regardless of the racial category (see http://quickfacts.census.gov/qfd/meta/long_RHI225212.htm). Firefighters were classified as non-minorities only if they identified as both white on the racial categorization and not of Hispanic origin.

We chose this approach for several reasons including that: 1) study departments, and the fire service in general, are predominantly staffed by white, non-Hispanic males (Fox, Hornick, & Hardin, 2006); 2) the small numbers of any individual racial or ethnic minority group would make it difficult to examine group-specific differences; 3) the pressures and challenges experienced by racial and ethnic minority firefighters are likely to overlap (Daniels, 2006); and 4) it is not uncommon to dichotomize race and ethnicity in the scientific literature (e.g., Arango-Lasprilla, Mitchell Rosenthal, Deluca, Eugene Komaroff, Sherer, Cifu, & Hanks, 2007; Mozaffarian et al., 2013; Poston, Haddock, Jahnke, Jitnarin, & Day, 2013).

Based on ethnic density effect theory (Shaw, et al., 2012; Becares, et al., 2012), we categorized the communities served by each department as being predominantly minority (minority dominant community; MDC) if the 2011 US Census data summary for the community which was served by a recruited fire department showed that the white, non-Hispanic population was less than 50.0% (n=11 departments total; two from the FIRE study and nine from the F2F study) and white dominated (white dominated community; WDC) if the white, non-Hispanic population was greater than 50.0% (n=20 departments total; nine from the FIRE study and 11 from the F2F study).

We used 2 (individual minority status vs. non-minority white) by 2 (predominant minority vs. non-minority community) factorial models to examine the main effects and the interaction between these factors across all fire service and health status variables (e.g., body composition, fitness and exercise, general and behavioral health, and fire service culture variables) and reported percentages (discrete variables) and means (continuous variables) for variables in each domain. We adjusted our models for any firefighter demographic or occupational factors that were significantly different between the four groups (i.e., age, military service, education, shift type, and occupational rank; see Table 1). To account for the sampling approaches of both the F2F and FIRE studies, where fire department was the unit of selection, we also included department as a random covariate in each statistical model. Thus, both measured (e.g., department size and type) and unmeasured (e.g., call volume and types of calls) differences among departments are addressed through this random factor.

For continuous outcomes, statistical models were developed using SAS 9.3 PROC MIXED. Models with discrete outcomes were constructed with SAS 9.3 PROC GLIMMIX and produced adjusted least squared means. For dichotomous and ordinal variables (e.g., rating scales) (Bender, & Grouven, 1997), the logit linking and cumulative logit linking functions within GLIMMIX were used. Statistical models of ordinal outcomes produced odds ratios which represent the effect of the predictor variables on the odds of being in a lower rather than a higher ordered category while the models for dichotomous outcomes represented the odds of having the outcome of interest (e.g., being obese, hypertensive, etc.) with non-minority (i.e., white, non-Hispanic race/ethnic) or WDC status as the reference groups for the main effects analyses.

Age-standardized overall prevalence rates (i.e., BMI-determined obesity, hypertension, depression, current smoking and smokeless tobacco use, and binge drinking) were computed for some outcomes of interest. We used standard tables from the US Census to facilitate comparison with national estimates (Klein, & Schoenborn, 2001). These tables have been used for direct age

standardization in a number of recent health prevalence studies (e.g., Borrud, Flegal, Looker, Everhart, Harris, & Shepher, 2010; Gonzalez, Berry, McKnight-Eily, Strine, Edwards, Lu, & Croft, 2010; Kanny, Liu, Brewer, Garvin, & Balluz, 2012; Yoon, Burt, Louis, & Carroll, 2012;). StatsDirect Statistical Software version 3.0.117 (StatsDirect Ltd., 2014) was used to compute the age-standardized rates using the direct method of standardization.

RESULTS

Firefighter Demographic and Occupational Characteristics

The total sample for this secondary analysis study was comprised of 1,404 male career firefighters with complete race/ethnicity data. White, non-Hispanic firefighters comprised 72.5% of the sample (n=1,018) and 27.5% classified themselves as a racial/ethnic minority, which combined all racial minority groups and anyone who identified as Hispanic regardless of race. Among all racial/ethnic minorities (n=386), 18.2% were African American/Black (both non-Hispanic and Hispanic), 4.3% were Asian (both non-Hispanic and Hispanic), 15.6% were Pacific Islander (both non-Hispanic and Hispanic), 1.4% were Native American (both non-Hispanic and Hispanic), 23.0% were Multiracial (both non-Hispanic and Hispanic), 18.8% listed themselves as “Other” (both non-Hispanic and Hispanic), and 18.8% were white, but of Hispanic descent.

Firefighters were from 31 fire departments across the US and its territories. With respect to the communities served, 57.5% of firefighters worked in departments serving MDCs (range of proportions of white, non-Hispanics = 7.1%-49.2%; Mean±SD=33.4±12.5%) and 42.5% served in WDCs (range of proportions of white, non-Hispanics =57.8%-92.8%; Mean±SD=77.4±10.0%) based on 2011 US Census profiles. Fire departments were classified into categories based on their size and setting/type. With regard to department size, Large/Metro departments (n=6) were those with more than 350 personnel based on the fire services’ typical classification (IAFC, 2012). Small departments (n=10) were defined as those with three or fewer stations. Medium size departments (n=15) were those with more than three stations but fewer than 350 personnel. Departments within large cities were classified as Urban (n=4). Those not in a large city but nearby one were considered Suburban (n=14). Departments not in or near a large city were considered Rural (n=9). In addition, some department were classified as Mixed (n=4) because they covered urban, suburban, and rural cities/towns.

Not surprisingly, there were substantial differences between minorities and non-minorities with respect to the size ($\chi^2=100.959$, $p<0.001$) and type ($\chi^2=219.148$, $p<0.001$) of departments in which they worked. Most racial/ethnic minority firefighters were based in Large/Metro departments (65.8% vs. 37.8% for white, non-Hispanic firefighters) while only 29.0% (vs. 40.8% for white, non-Hispanic firefighters) and 5.2% (vs. 21.4% for white, non-Hispanic firefighters) worked in medium or small departments, respectively. Similarly, most racial/ethnic minority firefighters were based in Mixed (46.9% vs. 13.6% for white, non-Hispanic firefighters) and Urban (30.6% vs. 27.0% for white, non-Hispanic firefighters) areas, with only 18.1% (vs. 39.6% for white, non-Hispanic firefighters) and 4.4% (vs. 19.8% for white, non-Hispanic firefighters) based in suburban and rural departments, respectively.

Table 1 provides the demographic and fire service characteristics of 1,404 enrolled male career firefighters by individual and community minority status.

Table 1 Demographic and Occupational Characteristics Stratified by Minority and Community Status Among Male Firefighters (M; SD or %).

Demographics	White Firefighters		Minority Firefighters	
	WDC (n=532; 37.9%)	MDC (n=486; 34.6%)	WDC (n=72; 5.1%)	MDC (n=314; 22.4%)
Age (years)*	37.4(9.9)	40.0(8.8)	36.8(10.4)	39.9(7.9)
Marital Status (% married or part of unmarried couple)	75.8	77.9	63.4	78.8
Served in Military (% yes)*	25.5	17.2	38.9	26.9
Education (% some college or more)*	91.7	92.3	81.9	87.7
Fire Service Status				
Years in the Fire Service (years)	14.0(9.1)	14.6(8.8)	13.3(10.4)	13.7(7.5)
Rank (%)*				
-Firefighter/Firefighter-Paramedic/Driver-Operator)	61.4	71.0	73.2	75.6
-Company Officer (LT, CAPT)	25.6	22.8	19.7	15.3
-Any Chief (e.g., Battalion Chief, Division Chief, Chief, etc.)	7.6	3.9	2.8	2.9
Shift Type (% 24 hour shift vs. other)*	70.9	85.1	79.7	88.6
Second Job Outside of Fire Department (% yes)	50.3	49.3	36.6	44.5

*Note. Statistically significant main or interaction effects are presented in the text.

Abbreviations: MDC=Minority dominated community; WDC=White, non-Hispanic dominated community.

There were no significant main or interaction effects for marital status, years in the fire service, or having a second job outside of the department. However, there were group differences for age, prior military service, education, fire service rank, and the shift schedule worked. With regard to age, there was a main effect for type of community, with firefighters working in MDCs being significantly older (Mean±SE; 39.9±0.33 years) than those working in WDCs (37.1±0.57 years; $F=18.195$, $p<0.001$). Minority fighters were less likely to be classified as having at least some college (Odds Ratio [OR]=0.50; 95% confidence interval [CI]=0.33-0.75, $p=0.001$). Minority firefighters were 81% (OR=1.81; 95% CI=1.33-2.47, $p<0.001$) more likely to have served in the military than white firefighters, while those working in MDCs were less likely to have served (OR=0.59; 95% CI=0.44-0.81, $p=0.001$) than those in WDCs, which was largely due to the number of white firefighter veterans who worked in WDCs.

With regard to fire department cultural factors, there was a significant main effect for minority status on the proportion of firefighters serving in the firefighter ranks, as opposed to being a company or chief officer. Minority firefighters were significantly more likely (OR=1.48; 95% CI=1.07-2.04, $p=0.037$) to hold the rank of firefighter, firefighter/paramedic and/or driver operator (vs. those holding company officer or any chief status) than white firefighters. Finally, firefighters serving in MDCs also were more likely to work 24 hour shifts (OR=2.15; 95% CI=1.44-3.13, $p<0.001$) than firefighters in WDCs.

Body Composition, Physical Activity, and Exercise

The overall crude prevalence of BMI-determined obesity (i.e., $BMI \geq 30.0 \text{ kg/m}^2$; NHLBI, 1998) was 30.8% while the age-standardized rate was 34.0%, which is similar to the US age-standardize prevalence of 33.8% (Borrud, Flegal, Looker, Everhart, Harris, & Shepher, 2010). Table 2 presents data on body composition and physical activity for the four groups of firefighters.

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Table 2. Comparisons (adjusted Least Square Mean±SE or unadjusted %*) between Male Minority and White Firefighters on Body Composition and Fitness Measures.**

Body Composition	White Firefighters		Minority Firefighters	
	WDC (n=532; 37.9%)	MDC (n=486; 34.6%)	WDC (n=72; 5.1%)	MDC (n=314; 22.4%)
BMI (kg/m ²) [§]	27.6±0.3	28.6±0.5	27.9±0.3	29.0±0.3
BF% (%) [§]	23.0±0.6	24.7±1.0	23.2±0.7	24.7±0.8
WC (cm)	95.3±0.7	95.2±1.4	95.7±0.8	95.6±0.9
Obesity Status				
-BMI defined (% BMI>30.0) [§]	24.2	30.9	35.2	40.1
-BF% defined (% BF%>25%)	35.7	39.9	40.8	47.6
-WC defined (% WC>102.0 cm or 40.0 inches)	25.4	28.2	31.9	31.9
Physical Activity and Exercise				
Physical Activity Level (SRPA)	4.5±0.1	4.7±0.2	4.4±0.2	4.4±0.2
Estimated VO _{2max} (mL/kg/min)	40.4±0.4	40.0±0.7	40.0±0.5	39.1±0.6
Met NFPA Standard (12.0 METs; % yes)	50.4	41.4	49.3	36.3

*Adjusted mixed models for categorical or ordinal outcomes with adjusted ORs [AOR] presented in text.

**All models were adjusted for demographic or occupation factors found to be statistically different between groups listed in Table 1 (i.e., firefighters' age, education, military service occupational rank, shift type) and differences due to department variability as they were unit of selection and not individuals.

[§]Significant main or interaction effects in the adjusted model. Adjusted main effects mean difference or AOR/95% CI and p-values are presented in the text.

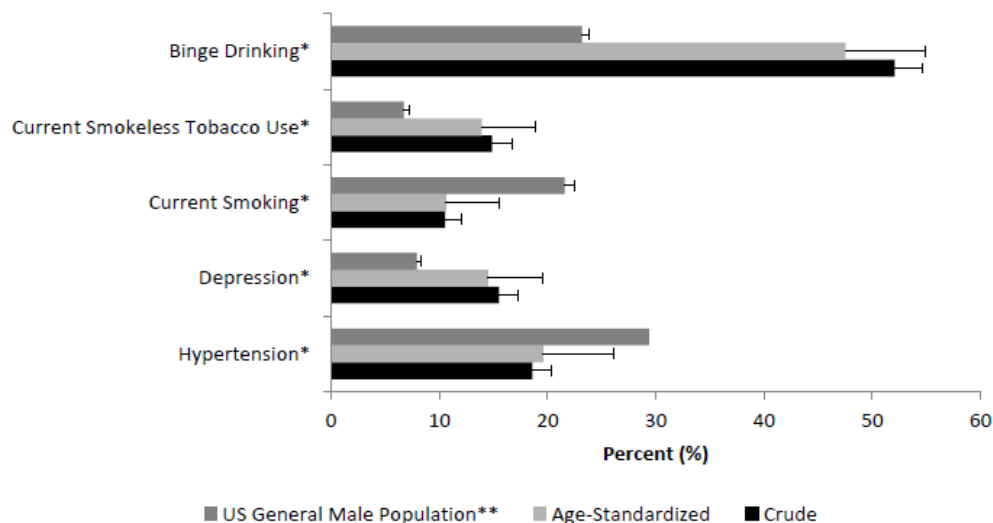
Abbreviations: MDC=Minority dominated community; WDC=White, non-Hispanic dominated community; BMI=body mass index; BF%=body fat percentage; WC=waist circumference; SRPA=self-reported physical activity; NFPA=National Fire Protection Association.

After adjusting for potential confounds, there were significant main effects for the individual minority status vs. non-minority status on both BMI and BF%, indicating that minority firefighters had significantly higher average BMI (28.8±0.3kg/m²) and BF% (24.7± 0.7%) when compared to their non-minority colleagues (27.7±0.2kg/m² and 23.1±0.6% for BMI and BF%, respectively). Minority firefighters also were 59% more likely to be obese (adjusted [A]OR=1.59; 95% CI=1.16-2.18; adjusted p=0.001; unadjusted prevalence of 39.2% for minority firefighters vs. 27.4% for non-minority firefighters) than their non-minority counterparts. There were no other significant main or interaction effects for any of the body composition, physical activity, or exercise variables.

General and Behavioral Health

We computed age-standardized overall prevalence rate for hypertension (based on measured blood pressure), depression (based on the CESD10), current smoking and smokeless tobacco use, and binge drinking, using standard definitions (see Haddock, Poston, Tuley, & Jahnke, 2011; Haddock, Jahnke, Poston, Jitnarin, Kaipust, Tuley, & Hyder, 2012; NIH/NHLBI, 2004; Poston, Haddock, Jahnke, Jitnarin, Tuley, & Kales, 2011a). The crude and age-standardized prevalence for these conditions are presented in Figure 1.

Figure 1. Crude and Age-Standardized Prevalence for General and Behavioral Health Conditions Among Male Career Firefighters.



*Note: All conditions defined using standardized definitions (see Haddock et al., 2011; 2012; Poston et al., 2011a; NIH/NHLBI, 2004): 1) Binge drinking = percent having ≥ 5 drinks in one occasion; 2) Heavy drinking = percent of women having ≥ 2 drinks per day or men having ≥ 3 drinks per day; 3) Current smokeless tobacco use = whether participant reported chewing tobacco, snuff, or dip in the last 30 days; 4) Current smoking = whether participants answered affirmatively to the following three questions: a) having ever smoked a cigarette, even a puff?, b) having smoked at least 100 cigarettes in their entire life?; and c) having smoked a cigarette, even a puff, in the past 30 days questions were current smokers; 5) Depression = percent of participants with a CESD10 score ≥ 4 ; and 6) Hypertension = percent of individuals with systolic blood pressure ≥ 140 and/or diastolic blood pressure ≥ 90 .

**Data for general male population from published, age-standardized (Klein et al., 2001) articles including the following: 1. Hypertension – Yoon et al., 2012 (note that 95% Confidence Intervals were not provided for prevalence estimates in the general population; 2) Depression – Gonzalez et al., 2010; 3) Smokeless tobacco – US Department of Health and Human Services, Substance Abuse and Mental Health Services Administration: Results from the 2009 National Survey on Drug Use and Health: Detailed Tables (available at <http://www.samhsa.gov/data/NSDUH/2k9NSDUH/MH/2K9MHRResults.pdf>); 4) Cigarette smoking – Agaku et al., 2012; 5) Binge drinking – Kanny et al., 2012; and 6) Heavy drinking – Alcohol consumption 2012, heavy drinkers (available at <http://apps.nccd.cdc.gov/brfss/list.asp?cat=AC&yr=2012&qkey=8381&state=All>).

Table 3 presents the data for general and behavioral health variables for all firefighter groups.

Table 3. Comparisons (adjusted Least Square Mean±SE or unadjusted %*) between Male Minority and White Firefighters on General and Behavioral Health Conditions and Substance Use.**

General Health Conditions	White Firefighters		Minority Firefighters	
	WDC (n=532; 37.9%)	MDC (n=486; 34.6%)	WDC (n=72; 5.1%)	MDC (n=314; 22.4%)
Self-Rating of risk for serious disease in the future	2.4±0.1	2.4±0.1	2.5±0.1	2.4±0.1
Number of Poor Physical Health Days (during last 30; days) ^{§,¶}	2.8±0.3, 0, 30, 57.5	2.7±0.3, 0, 30, 59.6	2.8±0.7, 0, 30, 60.0	3.9±0.4, 0, 30, 54.9
Self-Reported Health Conditions				
-Type 2 Diabetes (% yes)	1.1	1.7	1.4	2.3
-High Blood Pressure (% yes)	12.2	15.3	15.5	15.3
-High Cholesterol (% yes)	21.7	28.1	26.8	32.7
-Heart Disease (% yes)	0.8	1.4	0.0	1.0
Measured Hypertension (% SBP≥140 and/or DBP≥90)	15.7	19.4	20.8	21.7
Behavioral Health Conditions				
Physician Diagnosis of Anxiety Disorder (% yes)	6.3	7.5	8.3	5.5
Physician Diagnosis of Depressive Disorder (% yes) [§]	7.8	8.5	9.7	3.5
Depressive Symptom Score (CESD10)	1.7±0.2	1.4±0.2	1.4±0.2	1.4±0.2
CESD10≥4 (%)	18.0	13.6	12.9	14.6
Smoking Status (% Current)	9.9	10.5	13.0	11.0
SLT User (% Current) [§]	15.6	18.3	12.5	9.9
Alcohol Use Category (%) ^{§,¶¶}				
-Abstinent	15.2	9.9	15.9	21.5
-Moderate: 1-2 drinks per day	40.4	39.5	34.8	30.3
- Heavy: 3 or more drinks per day	44.4	50.5	49.3	48.2
Binge Drinker (% >5 drinks in one occasion)	51.6	56.5	55.9	45.8

*Adjusted mixed models for categorical or ordinal outcomes with adjusted ORs [AOR] presented in text.

**All models were adjusted for demographic or occupation factors found to be statistically different between groups listed in Table 1 (i.e., firefighters' age, education, military service occupational rank, shift type) and differences due to department variability as they were unit of selection and not individuals.

[§]Significant main or interaction effects in the adjusted model. Adjusted main effects mean difference or AOR/95% CI and p-values are presented in the text.

[¶]Data presented include unadjusted mean, SE, median, range, and % having zero days given the skewness of the distribution. Variable modeled using Poisson regression.

^{¶¶}Variable dichotomized in the generalized linear mixed model to "heavy drinker" vs. moderate and abstinent combined.

Abbreviations: MDC=Minority dominated community; WDC=White, non-Hispanic dominated community; CESD10= Center for Epidemiological Studies Short Depression Scale; SLT=smokeless tobacco.

There were both significant main (individual minority status vs. non-minority white status and MDC vs. WDC) and interaction effects for the number of self-reported poor physical health days. Firefighters serving in MDCs reported significantly more poor health days (Mean±SE; 3.2±0.2 days) than firefighters serving in WDCs (2.8±0.2 days; p=0.038). In addition, minority firefighters reported significantly more poor health days (3.6±0.4 days) than their non-minority colleagues (2.8±0.2 days; p=0.003), while the interaction indicates that minority firefighters in MDCs reported more poor health days than the other groups (p<0.001).

While there were no important group differences on any of the measures of current depressive symptoms (measured with the CESD10), there was a significant main effect for community status on having a history of a physician diagnosis of depression, with firefighters serving MDCs having 48% (AOR=0.52; 95%CI=0.30-0.91) less risk than firefighters working in WDCs. For this contrast, the unadjusted prevalence for those working in MDCs was 6.7% vs.

8.3% for those working in WDCs (adjusted $p=0.023$). The significant interaction ($p=0.028$) indicates minority firefighters in MDCs were the least likely to have a history of physician diagnosed depression while minorities in WDCs had the highest rate of lifetime history of depression.

There was a significant main effect for individual minority status on current smokeless tobacco use, with minority firefighters 41% (AOR=0.59; 95%CI=0.38-0.92; unadjusted prevalence of 10.4% for minority firefighters vs. 16.9% for white, non-Hispanic firefighters, adjusted $p=0.019$) significantly less likely to use smokeless tobacco than their white colleagues, after adjustment for potential confounds. Heavy alcohol consumption was associated with community, with firefighters in MDCs 40% more likely to report heavy drinking (AOR=1.40; 95%CI=1.02-1.92; unadjusted prevalence of 49.4% for those in minority communities vs. 44.5% for those working in white communities, adjusted $p=0.037$) than firefighters working in WDCs.

Fire Department Culture

Table 4 presents fire department variables for all groups by individual and community minority status.

Table 4. Comparisons (adjusted Least Square Mean±SE or unadjusted %*) between Male Minority and White Firefighters on Department Culture.**

Fire Department Culture	White Firefighters		Minority Firefighters	
	WDC (n=532; 37.9%)	MDC (n=486; 34.6%)	WDC (n=72; 5.1%)	MDC (n=314; 22.4%)
Income from Department (%) ^{§,¶¶}				
-<\$25,000	4.2	0.2	5.7	0.0
-\$25,000-\$50,000	22.5	10.3	28.6	15.9
-\$50,001-\$75,000	40.3	44.7	35.7	44.3
-\$75,001-\$100,000	26.1	24.6	25.7	21.4
->\$100,000	6.8	20.2	4.3	18.4
Job Satisfaction				
-Optimistic	3.9±0.1	4.0±0.1	4.1±0.1	4.0±0.1
-Satisfied with Job	4.1±0.1	4.3±0.1	4.3±0.1	4.3±0.1
-Satisfied with the Morale of Co-workers [§]	3.6±0.1	3.6±0.1	3.7±0.1	3.8±0.1
-Sense of Accomplishment	4.1±0.1	4.2±0.1	4.2±0.1	4.3±0.1

*Adjusted mixed models for categorical or ordinal outcomes with adjusted ORs [AOR] presented in text.

**All models were adjusted for demographic or occupation factors found to be statistically different between groups listed in Table 1 (i.e., firefighters' age, education, military service occupational rank, shift type) and differences due to department variability as they were unit of selection and not individuals.

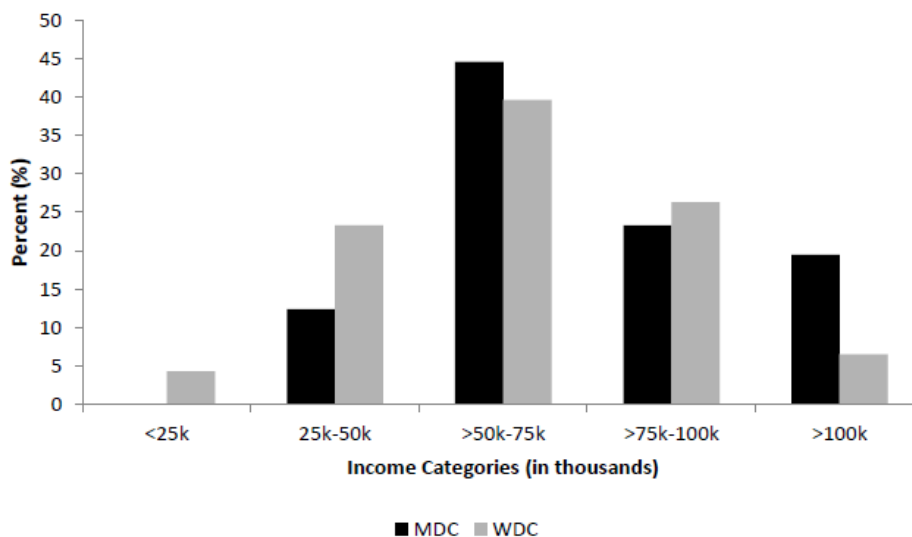
[§]Significant main or interaction effects in the adjusted model. Adjusted main effects mean difference or AOR/95% CI and p-values are presented in the text.

^{¶¶}Cumulative logit linking function within GLIMMIX used to model ordinal outcomes (five income categories); this produces an AOR which represent the effect of the predictor variables on the odds of being in a lower rather than a higher ordered category.

Abbreviations: MDC=Minority dominated community; WDC=White, non-Hispanic dominated community.

Firefighters working in MDCs were significantly less likely (AOR=0.49; 95%CI=0.37-0.65; $p<0.001$) to be in a lower income category when compared to their counterparts working in WDCs. Figure 2 illustrates the unadjusted proportions of firefighters in each income category by the community status factor.

Figure 2. Income Categories by Community Status Among Male Career Firefighters.



Abbreviations: MDC=Minority dominated community; WDC=White, non-Hispanic dominated community.

Firefighters in MDCs also were more satisfied with the morale of their co-workers than those working in WDCs (3.7 ± 0.1 vs. 3.6 ± 0.1 , $p=0.033$, respectively)

DISCUSSION

Minority firefighters had higher BMIs and BF% and were significantly more likely to be obese based on BMI than their white, non-Hispanic colleagues regardless of the community context in which they worked. These racial/ethnic differences in BMI, BF%, and obesity rates parallel those found in the general US adult population, where non-Hispanic whites' obesity prevalence is at least six percentage points lower than all Hispanics and more than 10 percentage points lower than African Americans (Borrud, Flegal, Looker, Everhart, Harris, & Shepher, 2010). They also are consistent with findings in the ethnic density literature, which have found that ethnic density is not protective against obesity, at least among African Americans (Becares et al., 2012). Despite the greater obesity burden, there were no statistically significant differences between racial/ethnic minority and white, non-Hispanic firefighters on any of the physical activity/fitness variables. However, it should be noted that proportion of firefighters meeting the NFPA fitness standard (NFPA, 2006) was less than 50% for all groups, raising concerns about firefighters' ability to meet the physical demands of their jobs and also increasing their risks for a number of health concerns including cardiac death and cardiovascular disease (Soteriades, Smith, Tsismenakis, Baur, & Kales, 2011; Smith, 2011).

The overall age-standardized obesity prevalence for our combined FIRE and F2F firefighter sample of 34.0% is nearly identical to that reported for US adults aged 20 or older (33.8%; Borrud, Flegal, Looker, Everhart, Harris, & Shepher, 2010). In addition, prevalence of obesity based on other body composition indices (BF% and WC) also were elevated in a manner similar to the general public and related occupational groups like police officers (Borrud, Flegal, Looker, Everhart, Harris, & Shepher, 2010). It is notable that that at least one other occupational group which also has significant physical demands, the US military, has substantially lower rates of obesity (13.0%; Barlas, Higgins, Pflieger, & Diecker, 2013). This could be largely

attributable to differences in how obesity is managed. For example, military personnel not meeting standards can receive a number of actions including placement in mandatory weight and fitness programs, administrative penalty, and separation from the military (Brown, 2013; Poston, Haddock, Talcott, Klesges, Lando, & Peterson, 2002) and all service branches require regular physical training and fitness assessments while the fire service does not (Donovan, Nelson, Peel, Lipsey, Voyles, & Israel, 2009; Poston, Jitnarin, Haddock, Jahnke, & Tuley, 2011b; Smith, 2011).

Firefighters serving in MDCs and minority firefighters both reported significantly more poor physical health days, with minority firefighters in MDCs reporting the most poor physical health days. The number of poor physical health days is used as an index of health-related quality of life and has demonstrated predictive validity with both health care utilization and mortality (Dominick, Ahern, Gold, & Heller, 2002; United Health Foundation, 2012). It has been consistently reported that weight status and obesity are associated with higher numbers of poor physical health days, so it is not surprising that minority firefighters overall and those in MDCs reported more poor physical health days given the substantially higher rates of obesity (Andresen, & Brownson, 2000; Juarez, Samoa, Chung, & Seto, 2010).

The higher number of poor physical health days among firefighters working in MDCs could be explained by two factors: 1) the ethnic density literature suggests that it is associated with adverse effects with respect to physical morbidity (Becares et al., 2012); and 2) firefighters who were minorities were more highly represented in departments serving MDCs when compared to those serving WDCs (39.1% vs. 12.1%, respectively) and individual minority status was strongly associated with obesity in our sample. Race is less consistently associated with the number of poor physical health days and tends to be attenuated by other factors such as income, education, age, and other health variables (Andresen, & Brownson, 2000; Juarez, Samoa, Chung, & Seto, 2010; Mwachofi, & Broyles, 2007). The average number of poor physical health days in the US was reported to be 3.9 days (United Health Foundation, 2012) which is influenced by a number of factors including age, race, income, education, and weight status (Andresen, & Brownson, 2000; Juarez, Samoa, Chung, & Seto, 2010; Mwachofi, & Broyles, 2007).

It should be noted that the number of poor physical health days reported by firefighters in this study were generally similar or lower than those reported for the US and a number of different racial and ethnic groups (Andresen, & Brownson, 2000; Juarez, Samoa, Chung, & Seto, 2010). This also was true for the prevalence of hypertension, which was lower than that found in the general US population, but is consistent with equivalent or lower rates found in similar occupational groups like police and the military (Barlas, Higgins, Pflieger, & Diecker, 2013; Yoon, Burt, Louis, & Carroll, 2012). Both findings are probably due in part to the “healthy worker effect” because fire departments tend to exclude unhealthy applicants by typically requiring physical abilities and fitness testing at entry, even though they are not required after accession, and many also have a number of medical exclusions and/or periodic medical assessments (Donovan, Nelson, Peel, Lipsey, Voyles, & Israel, 2009; Soteriades, Smith, Tsismenakis, Baur, & Kales, 2011). In order to make more valid comparisons, it has been suggested that similar occupational groups be compared on health status variables rather than comparing occupational groups to general populations (Li, & Sung, 1999).

Firefighters working in WDCs, and in particular, minority firefighters working in WDCs, had higher rates of lifetime physician diagnosis of depression. In contrast, minority firefighters serving MDCs had the lowest rate of history of lifetime physician diagnosed depression. It is

possible that the higher rates of lifetime depression among firefighters serving WDCs is the result of more of them having served in the military and being exposed to atypical stressors. For example, regardless of wartime era, rates of lifetime and current depression range from 5% to nearly 50%, depending several factors such as number of deployments and combat exposure (Tanielian & Jaycox, 2008). However, we did control for veteran status statistically in our models.

It also is possible that the higher rates of history of depression for firefighters in WDCs is primarily driven by the much higher rate among minority firefighters serving in these communities while the rate was so low among minority firefighters serving in MDCs. This pattern of results suggests there are likely challenges for minority firefighters working in WDCs vs. MDCs, but unfortunately we did not measure such factors because this was not a primary aim of either of the original studies. It is critical for future studies to examine constructs related to experiences with or perceptions of racism and discrimination and coping with racism and discrimination to better understand these types of differences and how they may impact different health status measures (McNeilly et al., 1996; Williams, Neighbors, & Jackson, 2003; Williams, Yu, Jackson, & Anderson, 1997).

There were no significant group differences in current depressive symptoms, as measured by the CESD10 between any groups. However, the CESD10-determined rate current depression (both crude and age-standardized) in our sample was more than one and a half times greater than found among the general US adult population for any depression (see Figure 1; Gonzalez, Berry, McKnight-Eily, Strine, Edwards, Lu, & Croft, 2010) or active duty military personnel (e.g., 9.6% Barlas, Higgins, Pflieger, & Diecker, 2013). Findings are consistent with previous research that indicates increased rates of depressive symptoms among firefighters compared to the general population (Boxer & Wild, 1993; Carey, Al-Zaiti, Dean, Sessanna, & Finnell, 2011; Pyle, Graham, Suminski, Poston, Haddock, & Glaros, 2009; Tak, Driscoll, Bernard, & West, 2007). It has been posited that these negative symptoms are related to the psychological stress associated with a job that exposes individuals regularly to traumatic events (Barnes, 2000). It should be noted that the prevalence of current depressive symptoms in our firefighter sample was comparable to that of police officers (12.0%).

Minority firefighters were substantially less likely to use smokeless tobacco than their white, non-Hispanic colleagues, which is consistent with some ethnic density studies with respect to protective effects against tobacco use (Becares et al., 2012). However, all groups were nearly three to almost six times more likely to use smokeless tobacco than the overall rate for US adults (CDC, 2010b). In fact, the overall age-standardized prevalence for our sample of male firefighters (13.9%) is higher than any published for any demographic or occupational group in the US (CDC, 2010b; Dietz, et al., 2011; Barlas, Higgins, Pflieger, & Diecker, 2013). For example, Dietz and colleagues (2011) reported that the highest prevalence of smokeless use was among farm workers (10.5%), followed by blue collar workers (7.3%). Among farm workers, Black (14.7%) and White (12.7%) males had the highest prevalence of smokeless use. Barlas and associates (2013) reported the prevalence of current (past 30 days) smokeless use in the military was 12.8%.

In contrast, the smoking prevalence among firefighters is relatively low (i.e., almost 50% lower) when compared to the general adult US population or comparable occupational groups like the military or police (Barlas, Higgins, Pflieger, & Diecker, 2013). For example, the age-standardized rate of current smoking in our sample of 10.6% was almost half the age-

standardized prevalence for US adults (Agaku, King, & Dube, 2012). We explored potential reasons for this phenomenon in a national qualitative study of firefighters' tobacco use with over 300 firefighters and health promotion personnel from 28 career departments (Poston, Haddock, Jitnarin, & Jahnke, 2012). Fire service personnel indicated concerns such as the increasing use of tobacco free employment agreements, concerns about being exempted from disease presumption laws for occupational exposures that might increase risks for diseases also associated with smoking (e.g., heart and lung diseases), and the understanding that firefighters are already overexposed to toxins (Poston, Haddock, Jitnarin, & Jahnke, 2012).

Firefighters serving in MDCs were more likely to engage in heavy drinking when compared to those working in WDCs after controlling for potential confounds. Some ethnic density studies also have found it is associated with higher rates of substance abuse (Becares et al., 2012). However, heaving and binge drinking were both common among all groups with numbers far higher than those reported for the US adults (see Figure 1). For example, the age-standardized prevalence of 47.5% for binge drinking is nearly three times higher than the general public (CDC, 2012; Kanny, Liu, Brewer, Garvin, & Balluz, 2013) and also higher than that found in the military (e.g., 33.1%; Barlas, Higgins, Pflieger, & Diecker, 2013). Other investigators have reported similarly elevated rates among firefighters (Carey, Al-Zaiti, Dean, Sessanna, & Finnell, 2011). These are problematic drinking behaviors occurred in the context that firefighters are not allowed to drink on duty or come to work under the influence (obviating heavy drinking proximal to their next shift). As well they typically work 10, 24-hour shifts per month, only leaving about 15 days per month to engage in these patterns (Haddock, Jahnke, Poston, Jitnarin, Kaipust, Tuley, & Hyder, 2012). While no studies have yet elucidated the reasons for greater alcohol use and higher rates of problem drinking patterns, drinking has been suggested to serve as an important "social lubricant" in the fire service and a way to reduce stresses related to the job. The repeated traumatic events to which they are exposed during rescues and emergency medical calls (Jahnke, Poston, Haddock, Jitnarin, Hyder, & Horvath, 2012), and the high rates of depression noted in our sample and stress reported by Carey and associates (2011) support the presence of a high stress environment.

With respect to their fire department cultures, there were no differences in income based on individual minority status, but firefighters in MDCs were more likely to be in the higher income categories. This is likely explained by the observation that most of the MDCs were in urban and mixed areas and principally served by Large/Metro departments. All firefighters generally rated their job satisfaction levels in the upper ranges, but those working in MDCs had significantly higher ratings than those working in WDCs on satisfaction with the morale of their coworkers, which could potentially reflect their sense that the cultures of the departments and surrounding communities, as well as their colleagues in these departments were more welcoming than departments in WDCs. Yoder et al. (1996) also reported high job satisfaction ratings in their sample of female minority firefighters who concurrently reported high rates of racial and gender discrimination and harassment.

Our sample had a very small number of female firefighters whom were excluded from analyses because of our inability to examine differences between male and female racial/ethnic minority firefighters, but the low percentage of women in our sample parallels that of the US Fire Service (3.7%; see Hulett, Bendick, Thomas, & Moccio, 2008). Our study also is limited because of its cross-sectional design, thus restricting our ability to make causal inferences with respect to how the minority composition of communities may impact health. However, because

minority status, like gender and genetic loci are exposures that are unalterable over time, this is not an issue for examining the main effect of racial/ethnic minority status on health variables. Finally, because the FIRE or F2F studies were designed for other purposes, we could only examine variables that were measured similarly in both studies, so some important health status variables (e.g., injury, nutrient intake) were not available for this analysis. In addition, because of the nature of the original studies, we did not have any measures of experiences with discrimination. Study strengths include the fact that this is the first study to examine health issues of racial/ethnic minority firefighters using data from two well-designed observational studies of firefighter health.

In conclusion, individual and community minority status significantly impacted a number of important health status indicators, with racial/ethnic minority firefighters demonstrating greater risk for unfavorable body composition and more poor physical health days. The higher number of poor physical health days among minority firefighters in MDCs is likely due in part to the higher prevalence of obesity and its relationship with number of poor physical health days (Andresen, & Brownson, 2000; Juarez, Samoa, Chung, & Seto, 2010). Most notable, however, was the fact that minority firefighters in WDCs reported the highest prevalence of lifetime diagnosis of depression by a physician, while minority firefighters in MDCs had the lowest. Many of these health status indicators have recently been studied within the context of experiences with discrimination, demonstrating that racial discrimination is associated with greater risk for obesity, depression, and poor physical and mental health (Gee, Ro, Gavin, & Takeuchi, 2008; Williams, Neighbors, & Jackson, 2003) and could be contributing to health disparities and potentially negatively impacting racial/ethnic minority firefighter health, safety, and retention.

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