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STUDIES IN HUMANS



## Barriers and solutions to improving nutrition among fire academy recruits: a qualitative assessment

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### ABSTRACT

The primary health concerns among US firefighters are cardiovascular disease, cancer, and depression and occur in an occupational setting where dietary habits are suboptimal. To understand if a diet or lifestyle modification works in a fire academy training setting, it is important to evaluate the cultural barriers and challenges that might be faced. A semi-structured telephone interview method followed by a focus group was used to gather common themes among fire service leaders. Twelve leaders participated in the telephonic interviews and a subset of five in the subsequent group session. Five main themes were identified. The study identified a need for staff and recruits to develop a cohesive culture that facilitates long-term change. Participants reported that incentives for good choices and the elimination of certain poor choices from the food environment would promote healthier choices. The study supports an intervention using education of fire recruits and modifications of the fire academy food environment.

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### KEYWORDS

Firefighters; fire academy; Mediterranean diet; lifestyle intervention programme; qualitative study

## Introduction

Cardiovascular disease (CVD) is the leading cause of on-duty death among US firefighters, accounting for essentially 50% of on-duty fatalities (Kales et al. 2007; Soteriades et al. 2011; Smith et al. 2013; Kales and Smith 2017). Research over the last several decades has consistently demonstrated a high prevalence of obesity (around 40%) in the US fire service (Soteriades et al. 2011) with multiple negative consequences on health, performance, safety and costs; an unusually high burden of on-duty deaths due to sudden cardiac death (45%) (Kales et al. 2007; Soteriades et al. 2011; Smith et al. 2013; Kales and Smith 2017). In addition, firefighters face a roughly 10–15% lifetime increase in the risk of a serious cancer diagnosis or cancer death, respectively (Daniels et al. 2014). Furthermore, depression, post-traumatic stress, substance abuse, and suicide are all growing areas of concern for the fire service (Boffa et al. 2017).

In this regard, there is consistent and strong evidence showing that Mediterranean diet is associated with lower risk of diabetes (19–23%) (Esposito et al. 2015), obesity (9%) (Agnoli et al. 2018), CVD (11–13%)

(Martinez-Gonzalez and Bes-Rastrollo 2014; Martínez-González et al. 2017), overall cancer mortality (13%) (Schwingshackl and Hoffmann 2015), depression (22–36%) (Molendijk et al. 2018), cognitive decline (40%) (Psaltopoulou et al. 2013) and other diseases (Grosso et al. 2014; Godos et al. 2017; Grosso et al. 2017) while increasing the quality of life (Sofi et al. 2010). The robust evidence is based on a wealth of diverse research investigations performed over the last 70 years in a variety of settings and in many countries. Thus, the applicability of the traditional Mediterranean diet (D'Alessandro and De Pergola 2018) outside the Mediterranean basin is gaining attention over the last decade (Mocciaro et al. 2018) including the United States, as well as specific working populations, such as US firefighters (Korre et al. 2017; Sotos-Prieto et al. 2017). In addition, when a healthy diet is coupled with other healthy behaviours such as avoiding tobacco, getting sufficient exercise and sleep, and maintaining a healthy weight, the benefits accumulate and also enhance resiliency (Chiuve et al. 2008; Chiuve et al. 2011).

However, research conducted among firefighters has identified a poor diet including high consumption

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of fast foods, sugary drinks, refined carbohydrates and saturated fats (Lowden et al. 2010). Although worksite interventions have shown positive results, few studies have evaluated a lifestyle intervention programme among firefighters (Benedict and Arterburn 2008; MacKinnon 2010; Viester et al. 2018) and none among fire recruits.

Health promotion that starts during firefighter training in fire academy settings is appealing because it has the potential to shape healthier behaviours across the career span from its onset. Teaching fire recruits to adopt a well-rounded, healthy lifestyle early in their careers is a more desirable and advantageous approach for several reasons. First, the fire academy setting provides considerable protected time (usual range, 12–20 or more weeks) and a protected setting for learning and implementing behaviour changes during a unique period when motivation to succeed as a firefighter is high. Moreover, it is considered easier to sustain good health and fitness than it is to achieve them “from scratch” during middle-age after a considerable period of weight gain and deconditioning. A recent cluster-randomized controlled trial designed to test the efficacy of a Mediterranean diet intervention among career firefighters has developed a nutritional curriculum can be potentially disseminated to other firefighters and fire recruits (Sotos-Prieto et al. 2017).

However, to understand if a diet or lifestyle modification programme will work in the setting of a training academy, it is relevant to know first, the cultural barriers and challenges that might be faced. Thus, the implementation of a new intervention programme can be tailored and adapted to the specific environment of a fire academy to achieve better reception of and adherence to the programme. Therefore, the aim of this study was to conduct a qualitative study to identify the barriers, cultural challenges and relationship of food choices to cost, time and any social stigma that would be faced by a future proposed intervention that would seek to improve nutrition and health habits among candidate firefighters (fire recruits) within the fire academy setting. To accomplish these goals, we first interviewed a select group of national fire service and regional fire training academy leaders. Second, we conducted a follow-up telephonic focus group discussion among the same leaders using themes identified in the individual interviews.

## Methods

### Participants

Selected fire service members from different national (United States) firefighter organisations and fire

training academy leaders/directors from different US regions were recruited through convenience sampling by email to participate in a qualitative study to assess the barriers and solutions to changing eating habits and improving nutrition knowledge among fire academy recruits. To participate in the study, the participants were at least 18 years old. Each participant received the consent form electronically and expressed oral consent to participate voluntarily. A total of 12 participants were recruited and consented for individual interviews and five of these leaders also participated in the subsequent focus group.

A unique identification number was assigned to each participant (a code from #1 to #12) and was used throughout the study. The study was approved by Institutional Research Board at Ohio University (protocol number 18-X-13).

### Data collection

A semi-structured telephone interview strategy (Table S1) was used to collect information from 12 fire service leaders and regional fire training academy directors about the current food environment of fire academies, and potential barriers and solutions to improve nutrition and health habits among fire recruits within fire academy settings. The interview also collected each participant's demographic information. Subsequently, the same participants were asked to also participate in a focus group session to discuss common themes identified in the individual interviews with other fire service leaders. The focus group was conducted via Zoom phone conferencing by a trained moderator to facilitate and to guide the flow of the discussion (Table S2). Both the interviews and the focus group were recorded and transcribed verbatim. Interview questions (Table S1) and focus group discussion guides (Table S2) were developed by the research team. The interviews took approximately 30 min and the focus group around 1 h.

### Data analyses

Three members of the research team independently analysed the qualitative data for content analysis by coding the interviews until saturation was reached and no new themes emerge. The team identified texts that described themes related to barriers and solutions for improving fire recruits' eating habits and nutrition knowledge. Discrepancies were discussed and resolved. Then a coder entered the transcripts using NVivo 10 software (QSR International, Victoria, Australia) to organise, sort and structure the data to facilitate

thematic analysis. Interrater reliability was established, and the Cohen's Kappa Coefficient was 0.92 indicating almost perfect level of agreement (Cohen 1968; Landis and Koch 1977). Analyst triangulation was ensured by using multiple investigators from different disciplines to facilitate validation of data through cross verification (O'Donoghue and Punch 2003). Transferability was supported via rich descriptions and verbatim quotations included in the data (O'Donoghue and Punch 2003).

## Results

The characteristics of the 12 participants who participated in the interviews or the five participants in the focus group are shown in Table 1. Average age of the interview participants was of 49.2 years old and 50.8 for the focus group, while 92–100% were white and male for the interviews and focus group respectively. Their roles in the academy varied: system fire chief, fire academy instructor, captain shift commander, health and wellness coordinator, chief of training, assistant chief of training, etc. The participants were from different fire academies representing various regions/states: Florida, Pennsylvania, Maryland,

Connecticut, Massachusetts, Texas, Indiana, New York, Alabama, and Georgia, as well as volunteer firefighters on a national basis. The characteristics of the fire academies with leaders participating in the study are summarised in Table 1. On average, academies have 2 classes per year. One-third (4/12) of academies have cafeterias. Almost 70% have vending machines.

## Participants interviews

From participants' interviews, we identified five main themes with multiple subthemes (Table 2) that are summarised below, and supported by the participants' verbatim transcripts. More details on these themes are summarised in Table S3.

## Food environment and food culture

When asked about their current food environment, a few participants (33%) said they have access to a cafeteria. Most participants (67%) indicated that they do

**Table 1.** Characteristics of participants who participated in the interview ( $n = 12$ ) and focus group ( $n = 5$ ) and characteristics of the academies.

	Interviews ( $n = 12$ )	Focus Group ( $n = 5$ )
<i>Participant characteristics</i>		
Age, mean $\pm$ SD	49.2 $\pm$ 8.0	50.8 $\pm$ 6.1
Gender, % male ( $n$ )	91.7 (11)	100 (5)
Race/ethnicity, % ( $n$ )		
White	91.7 (11)	100 (0)
Hispanic or Latino	8.3 (1)	0
Black	0	0
Others	0	0
Education level, % ( $n$ )		
Associate degree	8.3 (1)	20 (1)
Some college	16.7 (2)	0
Bachelor's	50 (6)	60 (3)
Master's	25 (3)	20 (1)
Years have been working in the academy, mean $\pm$ SD	19.4 $\pm$ 11.6	19.4 $\pm$ 11.4
Employed status, % ( $n$ )		
Full time	66.7 (8)	60 (3)
Part time	16.7 (2)	20 (1)
Currently retired	16.7 (2)	20 (1)
<i>Academy characteristics</i>		
Average class size	61.2 $\pm$ 91.7	90.0 $\pm$ 128.8
Classes per year	2.4 $\pm$ 0.8	2.0 $\pm$ 0.4
Class length (weeks)	15.6 $\pm$ 7.1	15.0 $\pm$ 7.1
Number of academies that have a cafeteria	4	1
Number of cafeterias run internally	3	0
Number of academies that have vending machines	8	3
Recruits' approximate age in the classes reported by the participants	24.7 $\pm$ 3.8	25.0 $\pm$ 4.3

**Table 2.** Themes and subthemes identified in the interviews.

Themes	Subthemes
Food Environment and Food Culture	Cafeteria
	Fast food
	Number of Meals eaten at the academy per week
	Vending machines
	Beverages Available
	Differences between the academy food environment and that of the firehouse
	Food culture
	Recruits' eating habits
	Faculty/Staff eating habits
	Current nutrition education
Nutrition Education	Education modalities
	Online resources
Attitudes and Perceptions toward Making Changes	Attitudes towards healthy eating
	Attitudes of recruits towards improving diet
	Importance of nutrition (to faculty and to recruits)
	Online resources
	Importance of physical activity
	Feelings about implementing a new programme
	Feelings about the use of Mediterranean diet
	Willingness to try new foods
	Stigma around being obese and conversely about healthy eating
	Barriers to improve nutrition in the academy
Barriers	Challenges in maintaining nutrition when going into a firehouse as a "rookie" firefighter
	(The Firehouse food culture influences rookies)
Incentives and Motivating Factors to Overcome Barriers and to Improve Nutrition	Competition or group challenges as incentives
	Motivating factors for food choices
	Ways to make it easier to maintain Mediterranean diet

not have a cafeteria in the training facility. For facilities that do not have a cafeteria, the fire recruits would bring their own lunch or go out for food, mostly fast foods. For the training facility which has a cafeteria that serves food, fast food is on the menu. While a few participants stated the fire recruits bring in sandwiches or salads (25%), some participants mentioned the options of fast food (50%).

"Uh, most of them probably opt for the fast food options – the burgers, the pizza and hotdogs". (#12)

Depending on the fire academy, the recruits typically have zero to ten meals per week at the academy, in combination with meals brought by themselves. Some recruits have five meals per week, mostly lunches. A few also have dinner in the academy.

Participants acknowledged that there was an effort to include some healthy choices, however, they reported that their current vending machines offer mostly candy bars, crackers, chips and soft drinks.

In terms of drinks available in the academy, water is always available (92%), while the next most popular drink type is sugary sodas or soft drinks (83%). Some participants mentioned juice (50%), energy drinks (33%), coffee (33%), tea (17%) and sport drinks (58%). Others said they have seltzer, milk, diet soda and reduced-sugar soft drinks in the vending machine.

"There's soft drink machines that have a variety of energy drinks, not energy drinks, but sports drinks like Gatorade... water, bottled water and of course the soda is there as well". (#2)

Very few participants (16.7%) reported no difference in food environment when comparing a fire academy and a firehouse. Others described the food environment in the fire houses as "not that good" and "lack of facilities" for firefighters to prepare their meals.

"The food environment in most of our firehouses in this county is really not that good, because the firehouse are not built to provide a place for you to cook meals(...)" (#2)

Some participants think in a firehouse people tend to focus less on the health-conscious aspect of food and focus more on taste and quantity rather than the quality of foods, and what they chose to eat was usually restrained by limited budget. Participants also articulated less encouragement towards healthy eating when going into a fire station.

"The difference between the academy and a fire station is (...) the rules are different. So at the fire

station, nobody's gonna be telling you, 'Hey, you can't eat that', or, 'You shouldn't eat that'. (...). At the academy, (...) we are going to discourage them and advise them that that's not going to cut it". (#9)

On the contrary, some said that in firehouses, firefighters can cook and purchase food, while in fire academies this would not be allowed.

Food culture varies by academy. One said participants perceive their diet as "not the healthiest diet". Other participants reported relatively mindful eating patterns such as avoiding greasy or fried foods. When asked about the recruits' eating habits in the academies, some reported quick and easy foods or fast foods nearby. Other participants reported they watch what recruits packed everyday, which were often fruits, vegetables and sandwiches. Some participants find the question hard to answer because they do not offer meals in the academy and recruits pack their own lunch. "They are pretty much on their own as far as bringing their own meals in. So it's kind of hard to answer that one". (#11)

When asked about the instructors or staffs' eating habits, a majority of participants answered their diets are similar to the students. A few reported that their diet is relatively healthy, while the others reported that staff may go off-site and eat unhealthily depending on their culture:

"So the staff does go off-site and eat fast food pretty commonly. (...) that's that older culture. I'd say the younger staff members tend to pack theirs". (#8)

### **Nutrition education**

Some participants (33.3%) reported very little to none nutrition education in the fire academies. A few reported their students received a brief mention of nutrition. Some other participants mentioned either a one-time lecture or a recurring education programme to encourage healthy eating and monitor weight status. "In that they get a lecture on health, wellness, and fitness, which includes a nutritional piece. (...) they get nutrition tips e-mailed to them every week (...)" (#4)

Very few participants said that instructions on eating choices when eating out were given to the recruits.

"We give them a little bit of input on how they should – where they do go out to eat on the weekend or for dinner, to avoid the fried foods, to avoid the sugary stuff, and to really just try to cut those". (#9)



Only one participant stated that they have a dietitian on site. When speaking of the education modalities, most participants stated lectures and presentations, a few conducted the nutrition education via basic awareness or tips as part of their orientation. One participant mentioned sending out weekly emails with nutrition tips and provide recruits with opportunities to make recipes.

### *Attitudes and perceptions toward making changes*

When asked about how healthy eating is looked upon within the academy, some said positively and the other reported somewhere between neutral to positive. All participants stated that they think the recruits would be interested in improving diet. Additionally, almost all participants said that they think nutrition is very important for the faculty (91.7%). Some participants mentioned faculty members could lead by example:

"We try to set the example. My philosophy is that you wanna lead, you lead by example". (#6)

Opinions varied when asked how important do recruits believe nutrition is to their training. Most of the participants think that the recruits do not have a thorough understanding of the importance of nutrition. "I believe they don't realise the importance of it. But, if shown the importance, I think they'd be receptive". (#12)

Many participants thought that physical fitness is important to faculty and recruits: "They're not going to be able to get through it if they're not physically and mentally fit". (#11)

All participants indicated they would welcome the implementation of a new programme. While most (75%) participants thought online resources would be useful, a few found the online format could potentially be a barrier for recruits to learn.

"But just looking at an online presentation, it's something that our members are growing frustrated with". (#9)

When asked how might current attitudes influence the use of Mediterranean diet, most of them commented positively.

"I think that there is an openness to learn about the Mediterranean diet, (...)". (#7)

Almost all participants thought that recruits are willing to try new foods. Some participants indicated that if education is provided, or if instructor could

lead by example, recruits would be very willing to try new foods: "Yes, provided the education". (#1)

Most participants thought there is a stigma around being obese. When asked about the stigmatising around healthy eating, participants' opinion varied. Some participants said there was no stigmatising:

"No there's no stigma against wanting to be healthy(...)". (#2)

### *Barriers*

When speaking of challenges, some participants (16.7%) mentioned that lacking ways to implement their goals serves as a hindrance either to their adherence to a healthy lifestyle or to implement a new programme: "... the issue is in a lot of cases they don't know how to do it". (#2)

When asked about the challenges after recruits graduated, most participants (75%) said the difficulty is how graduates maintain a healthy lifestyle in firehouses.

"When you get into a station as a new rookie and you're told to keep your mouth shut and do as you're told and you know sit at the table and eat with your crew and you don't dare tell the crew, 'I'm not going to eat that because it's not healthy'. (#2)

One participant said that a lack of follow up when recruits graduated is a hindrance of the continuation of a healthy lifestyle. When the graduated recruits experience relapses, their motivation decreases and hence effects their dietary adherence.

"But the follow up is probably the key. We don't follow everybody. We have over 257 firefighters and you don't watch them everyday and you just maybe run into them every now and then and you say, 'Oh, yeah. You're still saying in shape', or, 'Oh, no. What happened to you?'" (#8)

A majority of participants (58%) indicated that rookies are influenced by peer pressure from senior firefighters and have little power in deciding what to eat. Some participants (41.7%) mentioned that lack of education could be a major barrier to eating better and to maintaining physical fitness, which contribute to healthier lifestyle:

"I think that there's a lack of education about nutrition" (#3)

One participant commented that although efforts were made to include healthy options in the vending

machines, popular yet less healthy food which may generate more profit back to the machine vendor.

### *Incentives and motivating factors to overcome barriers and to improve nutrition*

When asked about incentives that would influence fire academy food choices, several participants suggested establishing a reward system that gets recruits involved by introducing competition (50%). The reward could be money, prizes, or recognition. "... offering quality rewards, prizes at the end of this for those that win whatever the challenge is and it certainly could be something health related ..." (#2)

When speaking of discounts or coupons, almost all participants said that getting those would help recruits make food choices. More than half of the participants believed that food cost and values are important to recruit when making choices.

"They're gonna be budgetarily constrained by the low salary... So, any kind of low-cost quality food that they can identify would certainly be of benefit to them". (#6)

When asked what motivates recruits of making food choices, some participants said convenience, what's easy, quick, and filling. Similarly, one participant thought hunger was their motivator because "they'll just eat whatever is in hand" (#3); several participants mentioned the taste of food. Another participant commented that peer pressure is a motivating factor of making food choices.

"I think if they see that people they're sitting down eating with are eating healthier or they're eating bad, that's going to influence the way they eat". (#8)

When talking about ways to make it easier to maintain a Mediterranean diet, some participants (33.3%) mentioned providing nutritional education that includes information such as what Mediterranean diet means, how to cook Mediterranean diet, and education on the benefits of following a Mediterranean diet. "It would be information around the who, what, when, where, why, and how, meaning you know this is what Mediterranean style of eating or healthier style of eating means. This is what it includes, this is how you go about it, here are tips, tools, recipes, you know here are suggestions, so information and education". (#4)

Others mentioned participating in the cooking or serving process in firehouses would help one know better about foods and influence other cohorts:

"one of the ways that you can help other people eat more healthy is if you control the cooking in the firehouse". (#2)

### *Focus group*

According to the data collected in the focus group, themes generated corroborated those discovered in the interview study. Themes discussed by participants in the focus group and examples were shown in Table 3.

### *Discussion*

This is the first published study to examine potential barriers to nutrition-based lifestyle interventions targeting fire academy recruits. Given the overwhelming proportion of on-duty CVD-related deaths, and the overall morbidity related to obesity, cancer and depression among firefighters, the need for preventive measures targeting these chronic diseases is increasingly recognised as a priority for improving safety and reducing mortality in the fire service. The Mediterranean Diet has been shown to effectively reduce the risk of these chronic diseases, and would be an ideal dietary pattern to adopt in the fire service. This study identifies the challenges a nutrition-based intervention would have to address in order to effectively influence food choices among fire academy recruits.

In our study, the most consistently cited barriers to improving nutrition among fire academy recruits included lack of financial and other resources, lack of knowledge and lack of a supportive culture from senior staff. With regard to resources, several participants noted a lack of funding to provide meals, lack of kitchen space to prepare meals and lack of equipment such as refrigerators to store fresh food. While some academy leaders had control over what snack foods were available in vending machines, others lamented that they did not. A nutrition intervention intended for academy recruits would have to account for the lack of food preparation space in most academies, and rely on educating and incentivizing individuals to make better food choices themselves, with the expectation that such decisions would influence future firehouse food culture and also guide eating patterns in recruits' private lives. Research on nutrition interventions among adult populations and in the workplace corroborate the utility of both education and control of the food environment as key elements for a successful intervention strategy

**Table 3.** Thematic examples of the focus group.

Themes	Summary	Examples
Food Environment and Food Culture	The food environment differs among fire academies. Recruits typically bring in their own food for lunch. Healthy options for vending machines were rare.	"I've done my best to try to get healthy snacks in those machines, but there still are some less-than-healthy snacks". (#7)
Nutrition Education	All participants reported some types of nutrition education, including lectures, weekly nutrition tips via emails and cooking demonstrations for extra credits. Online resources were thought to be effective tools for nutrition education.	"... the recruits are given a one-hour lecture on healthy and necessary eating habits to increase performance". (#7) "...using online education is an effective move". (#7)
Attitudes and Perceptions	Participants generally agreed upon the influence of cultural diversity on their perception of healthy eating. Participants brought up the importance of nutrition education to the recruits.	"So I think that has to be considered at least in terms of a variety standpoint and couple that with the education that there's lots of different ways to maintain a healthy nutritional outlook". (#2) "I found that some recruits think that because they're eating fish, it's healthy even if it's fried. So what I found is the education goes a long way to having certain cultures and what is healthy and what is not healthy". (#7) "I think that the education piece is very important in terms of the recruits being in class and being taught more about their own health and fitness just in general". (#2)
Barriers	Participants brought up that food cost and culture change are barriers to adopt healthy eating style. Recruits lack power to apply what they've learned in academy to real life. Engineering of meals become impossible due to large class size.  Participants discussed challenges in maintaining nutrition: lacking control over what the firefighters eat, lacking equipment to store foods, lacking time to conduct nutrition education, etc.	"... we provide the food and one of the barriers is cost and cultural change". (#4) "... that's a huge barrier for an individual coming into the academy that we've given him all this education and now, unfortunately, they don't have the power to use the education they received". (#7) "However, logistically we've been doing classes of 320 recruits pretty much 9/11 so for us to engineer or provide meals for our recruits would be relatively impossible although I think that would be a great idea". (#7) "Generally the cook is pretty much deciding what they're going to make or maybe a small group decides on what they're going to make". (#7) "We try to do our best to provide healthy snacks. Sometimes that's not possible, just given the lack of refrigeration or places to store whatever we do take with us". (#6) "However, some of the vending machines are not under our control so there continues to be sugary beverages available". (#7) "... the biggest hurdle that we have outside of just overall cultural change, a culture shift that needs to take place, it's just time". (#6) "... they're not allowed to work out while on duty and I totally disagree with that". (#7) "You get a rookie who comes in and he might be responsible for the meal and the senior guy's gonna say "Don't bother cooking us anything healthy. We're a meat-and-potatoes shift"(#4) "... the need or the option so education first and then engineering the means with which to pull it off would be two directions for us". (#4) "Make the less healthy stuff more expensive" (#2)
Solution	Most participants agreed on using education and meal engineering to improve healthy eating among recruits.  Others supported increasing price for unhealthy food while providing free water or making healthier options less expensive. One participant mentioned having social support from organisations.  Another participant suggested getting more training for the training faculty members.  Organizational understanding of prioritising health and fitness should start from the top down, as mentioned by one participant. Some participants brought up making physical fitness mandatory across the country as criteria to graduate or to stay in the academy. Participants mentioned monetary incentives and competitions that similar to individual interviews.	"IFF Wellness Fitness Initiative has also helped". (#7) "So maybe if we got a little more support or attention from the national organisations, that would help us"(#7) "... we're trying to help ourselves. We just recently had a couple of years ago four of us went and obtained our personal trainers licence from Peer Fitness. Now we have myself and another one as well who are becoming health coaches". (#11) "We have to make health and fitness a top priority across the board from the top down". (#2) "I think the first thing we need to do is make physical fitness in fire academies across the country mandatory". (#7) "... sometimes there can be a prize of up to \$2,000.00 at a fire station to win the Fat-Off". (#7)



(Anderson et al. 2009; Brambila-Macias et al. 2011; Luckner et al. 2012; Maes et al. 2012; Moredich and Kessler 2014; Nava et al. 2015; Roy et al. 2015).

When asked about potential approaches to overcoming these barriers, study participants were supportive of incorporating more nutrition education along with incentives and competitions to promote healthier eating behaviours. Training for both recruits and staff was suggested to help address nutrition knowledge disparities and promote a cohesive culture of healthy eating that would be supported from the top down, both in theory and practice. Promoting healthier food choices through cost incentives and eliminating unhealthy vending options were suggested as means of nudging recruits towards healthier food options. These suggestions are congruent with behavioural economics research in recent years which support the efficacy of well-designed incentive strategies in influencing food choice (Roberto and Kawachi 2014; List and Samek 2015; Harnack et al. 2016). Establishing good eating habits as a valued part of professional identity early in the career of firefighters is a necessary component of long-term culture change and effective risk reduction of chronic diseases among fire service workers.

The primary strengths of this study include consistency in results among independent trainers and leaders, representing academies from multiple regions across the United States and internationally, and the quality of data arising from the rich experience and expertise possessed by study participants. Our study design sought to minimise the influence of researcher bias by separating data collection and data coding among independent research team members. Similar barriers to better nutrition were independently and repeatedly identified from each source, and results corroborated closely with those obtained from the focus group session. Limitations include the absence of direct input from recruits, and the potential for bias inherent in self-reported data.

Our research supports an education and incentive-based approach to influencing food choices among fire academy recruits, and reveals interest among academy leaders and trainers in developing a healthier nutrition culture. By addressing the culture within fire academies, good nutrition habits can be more successfully maintained by fire recruits as they transition into firehouses and help transform the food culture that exists there. As part of a multi-faceted approach to reducing morbidity and mortality in the fire service, a nutrition-based intervention accounting for the barriers identified in this study could be effective in

helping reduce long-term chronic disease risk among fire academy recruits.

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## Disclosure statement

No potential conflict of interest was reported by the author(s).

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