



Contents lists available at ScienceDirect

Safety and Health at Work

journal homepage: www.e-shaw.net

Original Article

Cancer Perceptions Among Smokeless Tobacco Users: A Qualitative Study of US Firefighters

Nattinee Jitnarin*, Walker S.C. Poston, Sara A. Jahnke, Christopher K. Haddock, Hannah N. Kelley

Center for Fire Rescue and EMS Health Research, NDRI – USA, Inc., 1920 West 143rd Street, Suite 120, KS, 66224, USA

ARTICLE INFO

Article history:

Received 11 February 2020

Received in revised form

4 April 2020

Accepted 12 April 2020

Available online 21 April 2020

Keywords:

Cancer

Firefighters

Qualitative methodology

Smokeless tobacco

Tobacco

ABSTRACT

Background: Prevalence rates of smokeless tobacco (SLT) use among firefighters are remarkably high and substantially higher than similar occupational groups and the general U.S. population. The purpose of this study was to explore the perspectives of fire service personnel regarding cancer and its associations with tobacco and SLT use.

Methods: This descriptive study used a qualitative approach. Key informant interviews were conducted in 39 career firefighters and fire service administration from across the U.S. Discussion were recorded, transcribed verbatim and transferred to NVivo software for narrative analysis. Topics explored included cancer perceptions, attitudes and beliefs, and cultural factors related to SLT use behaviors. Results: Major themes that emerged among fire service personnel included concerns about cancer and its risk factors including firefighting tasks, such as fire overhaul operations, and from their lifestyle behaviors, such as alcohol and tobacco use. Firefighters also suggested a number of reasons for their increased SLT use, such as fire department tobacco-free policy and fire service culture.

Conclusion: The current study provides a rich foundation for future research, prevention, and intervention efforts for the fire service and research communities regarding tobacco and SLT use and cancer risk. Additional research on firefighters' cancer beliefs deserves future research in order to improve messaging about the risks of cancer due to firefighting.

© 2020 Occupational Safety and Health Research Institute, Published by Elsevier Korea LLC. This is an open access article under the CC BY-NC-ND license (<http://creativecommons.org/licenses/by-nc-nd/4.0/>).

1. Introduction

Firefighters play a crucial role in protecting lives and property in the communities they serve. They are expected to be the first to respond to emergencies of all types including fire suppression, providing emergency medical services, and rescue operations [1]. Thus, serving as a firefighter is a physically and mentally demanding profession. The occupational exposures from required duties put firefighters at risk for both injuries and diseases, making their sustained health and wellness a key concern [2,3].

There has been considerable research into the relationship between firefighting and cancer due to growing concerns about firefighters' exposures to carcinogens during fire suppression operations [4,5]. Exposure to recognized or probable carcinogens such as benzene, polycyclic aromatic hydrocarbons (PAHs), and volatile organic compounds (VOCs) are common on the fire ground and

during fire combustion [6–8]. Because of these factors, firefighters experience a greater risk and high proportionate mortality ratio of several forms of cancer such as malignant melanoma and multiple myeloma [5,9–15].

While some cancer-related occupational hazards are unavoidable for firefighters, it is critical that modifiable risk factors for cancer be identified and eliminated. Because of the increased risk of cancer for firefighters, there has been a strong emphasis on addressing modifiable risk factors, including encouraging personnel to be tobacco free [2,16]. Firefighters currently have lower smoking rates (13.6%) than the general public (15.5%) and similar occupation groups such as the military (32.2%) [17–19]. In contrast, prevalence of smokeless tobacco (SLT) use in the U.S. Fire Service is high (17.4%) when compared with adult males in the general U.S. population (4.0%) and among military personnel (15.6%) [17,20,21]. The reduction in smoking among firefighters

* Corresponding author. Center for Fire Rescue and EMS Health Research, Institute for Biobehavioral Health Research, National Development and Research Institutes - USA, 1920 143rd Street, Suite 120, Leawood, KS, 66224, USA.

E-mail address: nui@hopehri.com (N. Jitnarin).

over the last several decades (i.e., 61.1% in 1980s) [22] and the subsequent rise in SLT use probably reflects important policy and cultural changes in the Fire Service such as prohibitions against cigarette smoking in fire stations [16]. In addition, personal risk factors such as using SLT as an alternative for smoking cessation may contribute to the high rates of SLT use among firefighters.

A growing body of literature over the past decade highlights SLT use as an important cancer risk factor in addition to smoking. SLT use is likely related to cancer development because it contains more than 30 carcinogens [23,24]. For instance, data from epidemiological studies suggest that the risk of head and neck cancers are significantly higher among SLT users compared to non-SLT users [25]. Moreover, a number of studies have found increased risk for all-cause mortality among SLT users compared to non-tobacco users, ranging from 20–40% excess risk [26,27].

Despite evidence of strong associations between firefighting and cancer, less is known about how firefighters perceive their cancer risks and how their attitudes about health behaviors such as tobacco and SLT use affect their cancer risk perceptions. The purpose of this paper is to analyze qualitative data findings from 39 fire service leaders, firefighters, fire service health promotion personnel, and fire service healthcare providers. Analysis of the data was conducted in order to gather a better understanding of firefighters' perspectives on cancer risk and their tobacco and SLT use. In particular, we explored the SLT's role and patterns of use in the fire service, determined influences that contributed to either increased or reduced use, and examined how the culture of the fire service views SLT use.

2. Materials and methods

2.1. Design

Sampling Procedures/Firefighters Recruitment. Participants were solicited through two different methods: 1) contacting participants from previous studies [17,28]; and 2) posting on the "Secret List" – a popular email listserv in the fire service. Both outlets provided a study announcement that outlined the purpose of the study as exploring cancer perceptions and SLT use in the fire service. Interested personnel were instructed to contact the project Principal Investigator for possible study inclusion. Selection was based on having range of region (East, Central, West), roles in the fire service (career firefighters, fire service leaders, health promotion personnel, and healthcare providers), and SLT use status (current, former, non-users). Only career firefighters were selected for this study because of the focus on firefighter-related occupational exposures and associated cancer risks. The recruitment strategy was periodically adjusted as required to obtain a maximally diverse sample in relation to role in the fire service and SLT use status. For example, a fire service mailing list was employed to recruit firefighters who were current and former SLT users, and a medical personnel database was used to recruit health promotion personnel and their healthcare providers. Other methods included emailing fire chiefs to distribute a study announcement to their firefighters. We judged that thematic saturation was reached at 39 interviews, when a sufficiently diverse sample had been obtained, and no new themes were emerging from ongoing analysis.

2.2. Participants

The majority of participants were male (89.7%) and Caucasian (94.9%), which is reflective of the general population of the fire service [29]. Approximately 21% of participants were at the firefighter rank ($n = 8$; firefighter, firefighter/paramedic, driver operator) or at officer rank ($n = 8$; Lieutenant, Captain), respectively

Table 1
Demographic characteristics of the 39 participants

Characteristics	
Age (years; SD)	44.8 (8.3)
Gender (% male)	89.7
Race (%)	
Caucasian	94.9
Of Hispanic origin (% yes)	7.7
Time in the fire service (years)	21.5
Rank/position in fire department	
Firefighter	15.4
Firefighter/Paramedic	2.6
Driver operator	2.6
Lieutenant	5.1
Captain	15.4
Battalion chief, deputy chief, etc	28.2
Fire chief	17.9
Civilian (non-department) healthcare providers	12.8

while 46.1% were either fire chiefs or deputy/battalion chiefs ($n = 18$), and the remainder worked in a health capacity within the department (e.g. wellness coordinator, physician; $n = 5$) (Table 1).

2.3. Interview protocol

Phone interviews were scheduled after participants agreed to participate in the study. They also received an email with the Consent Form describing the purpose of the study and the consent process. Prior to the interviews, the purpose and procedures of the study were read and explained to the participants, and they were given the opportunity to ask questions. Once all questions were addressed, participants were asked to provide verbal informed consent and answered a short survey with questions about demographics and occupational history. Interviews were recorded with the interviewee's consent. The confidentiality and anonymity of participants was maintained at all times through adherence to standard ethical procedures. All recruiting and interviewing was conducted between March and August, 2017 and the study was approved by the National Development and Research Inc., Institutional Review Board. Researchers (NJ, CP, HK) carried out the semi-structured interviews; interviews lasted from 20 to 50 minutes. In addition, field notes were taken during the interviews if new themes or arguments emerged.

The interview questions reported here are a subset from a project about cancer risk and the culture of SLT use in the US fire service (Table 2). Participants were asked about their perceptions toward cancer, specifically: "What do you think your chance is of developing cancer while you are in the fire service?" This initial

Table 2
Interview guide: guiding questions and prompts

1. What do you think your chance is of developing cancer while you are in fire service?
 - How would you rate your chance of developing cancer?
 - How do you think your chance of developing cancer compares to the average people your age?
 - What has contributed to the cancer risk factors among firefighters?
2. How common/acceptable is tobacco and SLT use in the fire service?
 - How common is SLT use among the personnel at your department?
 - How have trends in SLT use changed among firefighters over time?
 - What has contributed to the changes in SLT use among firefighters?

exploratory question was designed to elicit their unprompted views on cancer. Prompts were then provided where appropriate. Example prompts were: “How would you rate your chance of developing cancer? How do you think your chance of developing cancer compares to the average person your age?” Participants were asked about their attitudes toward tobacco and SLT use such as “How common or acceptable is tobacco or SLT use in the fire service?” Responses from the resulting discussion are presented.

2.4. Approach to analysis

Interview recordings were transcribed verbatim. A two-phase process was used to capture the meaning behind the transcribed text with the overall purpose of understanding major themes across and between transcripts. First, researchers reviewed the transcribed documents to develop a familiarity with the text and began a thematic analysis by searching for patterns and themes that occurred frequently in a single interview or were common across interviews. The data then were coded by identifying passages that exemplified key concepts or ideas related to major patterns and themes. Use of multiple reviewers assisted in establishing the thematic framework.

Next, the transcripts were uploaded to NVivo [30], a qualitative data analysis program that allows researchers to highlight and code data into “parent” nodes for overall themes and “child” nodes for subthemes. A social cognitive theory (SCT) domain analysis and a grounded theory approach [31,32] were used to analyze recurrent themes, areas of consensus and convergence of opinions, experiences, and perceptions surrounding cancer and tobacco/SLT use. Summaries were then made within each major/parent theme. The two primary coders compared their analyses and any discrepancies were discussed until consensus was reached. The third researcher conducted double-coding of a subset of data in NVivo in order to ensure that the final coding scheme had adequate reliability.

3. Results

3.1. Cancer risk factors

Many firefighters in our sample discussed the complexities of understanding firefighters' cancer risk. Often noted were their exposures to cancer-causing agents both on- and off-scene. For on-scene exposures, firefighters expressed concerns about the danger of burning materials from fire scenes. They believed that they are exposed to a number of carcinogenic agents during their suppression and overhaul activities. Several cancer-causing chemicals released during overhaul activities such as arsenic, benzene, formaldehyde, and glutaraldehyde have found to be exceeded the American Conference of Governmental Industrial Hygienists (ACGIH) and the National Institute for Occupational Safety and Health (NIOSH) exposure levels [33].

“Our exposure to hazardous substances, unburned products, products of combustion. Everything that we do, in my opinion, in the fire services is designed to kill us. Specifically, when we work around fire mop-up, salvage overhaul operations, we're kicking up all kinds of particles of combustion and byproducts of combustion, from plastic, petroleum products, you name it.” [P10, Captain]

“Toxic fumes or gases, or environments that we may enter like a fire or something like that. I think all that kind of plays into why firefighters have a high cancer rate.” [P25, Deputy Chief]

Another cancer risk factor identified was carcinogens that are present on gear and carried back to the station, as well as from the fire trucks' diesel exhaust. Firefighters recognized their

contaminated turnout gear can transfer toxic agents from the fireground to their fire stations and off-gas contaminants after the fire incident has ended. Data suggested that off-gassing from their gears serves as a source of potential inhalation exposure of volatile organic compounds (VOC) for firefighters [7].

“... And then the gear itself, we put it on the truck. We've got dirty gear, we put it on the truck. If the guys aren't cleaning their gear after every fire, it's in the truck, it's on their clothes. And then that gear is on the truck the whole time. So you're constantly around contaminants.” [P13, Captain]

“After the fire, we're completely out of the structure, building, whatever it may be. [When] we undress, our bunker here is still off-gassing all the poisonous gasses that we were in. And we throw those into our vehicles, into our fire rigs, [either] wear them on the way back to the station. Meanwhile, all of that, of course, is dissipating straight up into the air that we breathe Where we sleep, obviously, you have carbon monoxide given off from the exhaust. And also you have the carbon particles from the diesel.” [P20, Captain]

Several firefighters in our sample noted that job stress and lifestyle and health behaviors such as poor diet, sleep deprivation, inadequate physical activity, and problematic consumption of alcohol and tobacco could increase their risks of developing cancer. Poor nutrition and high rates of tobacco and alcohol have been discussed and were often identified as key health concerns in the fire house [2,34]. Thus, firefighters in the study could connect their health behaviors to increased cancer risk.

“They're nutrition, lifestyle in general, I think all of that is so different to work 24 hours or in other agencies, 48 hours, or 72 hours in a row. Away from your family is just such a different type of a lifestyle. I think all of that are contributing factors.” [P17, Health personnel]

“Diet - generally speaking, firefighters, a lot of fried food, fast food, a lot of alcohol, and tobacco use. And then a lot of guys don't maintain physical fitness like they should, don't get their annual physicals, don't get their annual checkups. But as far as the lifestyle, I think alcohol contributes. I think smokeless tobacco, and I think diet.” [P21, Fire Chief]

Job stress and cancer were consistently raised as an area of concern among firefighters. Evidence showed that a high level of stress negatively impacts firefighters' both psychological and physical health [2,35]. Thus, it is not surprising that participants discussed that chronic stress plays a role in the development and spread of cancer and how their chance of getting cancer is high because of stress.

“I think the chance of cancers being higher in the fire service is we tend to be a higher level of stress initially.” [P10, Captain]

“I guess that is just my theory that stress causes cancer, especially chronic stress over years and years. Yeah, I mean the stress comes from sleep deprivation. Stress comes from working with patients that are suffering. Stress comes from staying physically fit. I mean, stress comes in all different forms.” [P39, Driver Operator].

3.2. Perceptions of cancer risks associated with firefighting

Fire service personnel were very aware of cancer and its relationship to their job duties. This is likely because cancer has been observed as one of the most prevalent health concerns among fire service personnel [2]. However, there were mixed opinions about whether being a firefighter increases the risk of cancer. The

majority of participants indicated that firefighters are likely to have a higher chance of developing cancer than the general public.

"I absolutely believe that there is a higher risk of firefighters contracting different types of cancers than the general population based on the exposures that we have." [P14, Deputy Chief]

"Higher. Firefighters have a higher risk of cancer ... I think the job is contributory, but I also ... lifestyle choices certainly aren't doing ourselves any favors." [P21, Fire Chief]

However, there were firefighters who did not believe that they would develop cancer during their fire service career. In fact, some disregarded the relationship between firefighting and cancer risk. Some viewed the possibility of them getting cancer as fate.

"I think the same to some extent with the whole perception of cancer. That it's not something that's going to kill you day one. So it's not maybe as cultural or even rationalizing. Folks don't see it as large of a threat as say, heart disease or getting injured on the fire ground scene or having a career-ending disability from a traumatic event." [P2, Fire Chief].

"... we're all going to get cancer at some point in our lives. It's going to happen, whether it be skin cancer, lung cancer, lip cancer, it's going to happen, prostate cancer ... We've accepted it." [P37, Fire Chief]

"So [laughs] the healthy mindset is there. But when it comes to cancer, like you were saying, [we] just don't care. They might care, but it doesn't bother them as much as other people because fire fighters are a different breed. They see death. They see destruction. They see nasty stuff that a lot of people don't see. So it's not easy for us to – we're not sensitive, you know what I mean? We're not sensitive people." [P38, Lieutenant]

3.3. Perceptions about tobacco use in the fire service

When asked about the prevalence and trends of tobacco use in the fire service, fire service personnel believed that smoking in fire service has declined and been replaced by SLT. They also noticed that using vapor and e-cigarette products have been on the rise.

"Probably the use of tobacco products such as cigarettes or cigars has decreased culturally and perceived that, in some cases, it may be replaced with smokeless." [P2, Fire Chief]

"A lot of our smokers that actually smoked cigarettes back in the day, most of them have switched over to vaping. I don't – I haven't seen somebody light up a cigarette in our fire department in probably a year or so of vaping is come on. But I've seen more people vaping." [P22, Fire Chief]

"When I first came in 2004 there were way more smokers than there were chewers. And then it changed, and now there're a lot more chewers than smokers. But there're a lot of people that are doing the vaping with the electronic cigarettes or whatever." [P38, Lieutenant]

3.4. Fire department tobacco policies

Fire service organizations have been proactive and assertive about guiding the fire service to becoming a smoke-free profession [2,16]. A number of regulatory factors regarding tobacco use in fire

departments were noted including tobacco-free policies that require no tobacco use for all personnel in the firehouse and no tobacco use contracts as a condition of employment.

"... it's actually a township policy, the township I work for. But it's also something they have to sign when they get started. So our campus, our township campus, just a few buildings, all the buildings are tobacco-free" [P11, Deputy Chief]

"Yeah, that's a prerequisite in the department. You cannot smoke. You cannot chew. You cannot vape. And you have to write that on your application you have to sign. On the application it says you don't do it. So when you start working, or if you get a job, they can say, "Hey, right here, it says you didn't do it. It says you won't do it. So now you're fired for doing it."" [P38, Lieutenant]

Despite tobacco-free policies implemented by some fire departments, several participants reported that their department did not have a policy for SLT or, when they did, it was often not enforced for SLT use. It is interesting to note that our participants' observations regarding a ban or a no-use policy on tobacco have been previously mentioned and recognized a decade ago [36].

"I know one department I work with ... but they have a tobacco-free policy, but members chew. They're chewing. People just turn their heads It's gross and it's not good for you, but they still have it." [P10, Captain]

"Even if the government or the military puts out a policy, no chewing tobacco or smoking within a station or only in designated areas, it's chewing tobacco. That policy really isn't enforced on chewing tobacco" [P26, Fire Chief]

"So on our base, there's still smoking allowed 10 feet away from the buildings in certified smoking areas. But there's no real enforcement policy on smokeless tobacco." [P29, Fire Chief]

3.5. Perceptions about SLT use in the fire service

Jitnarin et al. [17,28], found that the rates of SLT use were very high among firefighters and comparable to rates found among the highest users in the DoD, the Marines [20]. Participants offered their observations on why they thought SLT has increased and become widely acceptable and common in the fire service regardless of whether they were SLT users or non-users. Those observations included fire service culture, smoking regulations, and the convenient of chewing.

"... the smokeless tobacco, it is widely accepted. I would say it's part of our culture. There's individuals, including myself, that actually utilize smokeless tobacco while working, on-the-job, all the time. I think there's a couple of components to this. One, it's just in the culture and it's accepted. There hasn't been a lot of initiative or campaigning against it, especially on a large scale when it comes to our sector or industry." [P9, Battalion Chief]

"I think it allows us the chance to do this even when we're indoors. We don't have to go outside to smoke a cigarette." [P25, Deputy Chief]

"I guess you could say, "Acceptable." It's less frowned on than smoking; I guess that's maybe the best way to put it. Because it doesn't – I don't think it – probably because it doesn't interfere so much with other people, other than people being gross leaving stuff around. With the exception of that, the firefighters are in their

offices or in their bunk rooms or in private spaces; nobody really knows that they're doing it unless they make it obvious. It's a little easier to get away with if you will." [P27, Fire Chief]

3.6. Perception of cancer risks associated with tobacco use

Many fire service personnel noted the association between tobacco use (i.e., cigarette smoking and chewing tobacco) and cancer in general.

"Yeah, I think it's pretty well documented. There's a definitely cancer risk at the very least. Who knows about what other [things] may be associated? I'd say there's a cardiovascular risk associated with the use of nicotine" [P3, Health personnel]

"Obviously smokeless tobacco use has a huge impact on types of cancer and stuff ... because there is that, you know, throat cancer and mouth cancer and stuff like that" [P11, Deputy Chief]

However, some of firefighters disagreed on this notion.

"I don't think there's a big association. I'm sure [that it does], and the majority of the population would agree that there's a link. However, I'm not sure if they outright associate it with it." [P7, Captain]

"I would love to be able to have something that says, "Here. Look at this. We've been able to put this together." Unlike cardiovascular health, we've got a lot of stuff on that. The cancer, I've not seen it yet. I've not seen the tie. What I think and what I can prove it maybe two different things." [P18, Fire Chief]

When asked about the association between SLT use and cancer, there were mixed opinions about whether SLT use particularly increases cancer risk among firefighters. Several firefighters believed that chewing tobacco can cause cancer. However, some personnel did not believe that they would develop cancer because of their SLT consumption and expressed their opinions that they could get cancer from any number of events or actions.

"Folks that are using tobacco in any form or fashion, they're increasing their odds of getting some kind of cancer." [P27, Fire Chief]

"Yeah, you already know that the risk is high by using it ... it says right on the can" [P32, Firefighter]

"I live down in the south ... here in [State deleted]. So I'm out in the sun all the time. Could I end up with some sort of skin cancer or something? Yeah. Could I end up with cancer from smokeless tobacco? Yeah. Could I end up with cancer from something I breathed in at work? Absolutely. So I don't ... Does it make me more of a risk? Yeah. But until I start taking things ... If I never go in the sun, I don't necessarily have to worry about skin cancer" [P23, Firefighter]

"... Anything you do there's a cancer risk nowadays, it seems like ... There's risks everywhere" [P25, Deputy Chief]

3.7. Future intentions regarding tobacco use

Although many firefighters in our sample noted the association between cancer and SLT use, a few participants expressed the opinion that they had no intention of quitting their current SLT use.

"I'm going to get cancer anyway, so what the hell's the point of my having a chew? What's wrong with it, you know what I mean? I'm going to get it anyway And as soon as dinner's done, or as soon as we're done working out, "Let's go have a cigarette. Let's go have a

chew." So [laughs] the healthy mindset is there. But when it comes to cancer, like you were saying, [we] just don't care. I know a lot of guys that – it's kind of a joke around the Fire Service. What kind of cancer do you think you're going to get?" [P38, Lieutenant]

However, several participants were aware of the relationship between cancer and SLT use and were willing to take an action (i.e., quitting SLT).

"People are really starting to – it's starting to come to the forefront, and you've had some high-profile people in this area especially that have died from rare forms of cancer in the last three or four years who people, my employees respect and think the world of. And now they're realizing that it could be them." [P12, Fire Chief]

4. Discussion

Thematic analysis of the interview data indicated that cancer remains a significant concern among fire service personnel and they appeared to recognize that factors such as chemical exposures during fire suppression and health behaviors like tobacco use play a role in increasing risk for cancer. While there was some disagreement about the chances of firefighters developing cancer compared to the general population, many believed that firefighters have a greater risk due to their chosen occupation. The concern regarding cancer that emerged from these interviews showed that participants believe that firefighting has an unavoidable and negative impact on health and imparts higher risk for cancer when compared to the general population, just as has been described by several studies [2,4,12,13,37].

A number of reasons were posited for higher cancer risk among firefighters including their firefighting tasks (e.g., direct risk factors), such as fire overhaul operations and from their lifestyle behaviors (e.g., indirect risk factors) such as alcohol and tobacco use. However, at the same time, some participants disregarded the relationship between cancer and firefighting despite evidence supporting this relationship [5,38]. Fire service organizations have been advocating for increased awareness of cancer risk, including medical screening for early cancer detection, and encouraging use of personal protective equipment [PPE] to reduce carcinogen exposures [39]. However, debate about relationship between cancer and firefighting remains among firefighters and it is possible that those who disregard the relationship between firefighting and cancer may also be less attentive or concerned about occupational exposures. Additional research on their beliefs deserve future research in order to improve messaging about the risks of cancer due to firefighting.

Another important cancer risk factor cited by fire service personnel is individual lifestyle health behaviors, particularly tobacco use. There were different opinions about the relationship between cancer and tobacco use, including SLT use, in our sample. A number of people believed that tobacco and/or SLT use is unrelated to their chance of developing cancer during their firefighting careers. These findings highlight the importance of the efforts by fire service organizations on cancer prevention behaviors. Fire service organizations have encouraged their personnel to change job-related behaviors at the individual level (i.e., cleaning PPE consistently or showering post-fire response) [37] and at the department level (i.e., employing department Hood Swap program) [40] to decrease their risk for cancer. However, educational programs focusing on firefighters' lifestyle behaviors that contribute to cancer prevention often are overlooked. Our results suggest that the initial focus of intervention efforts among firefighters should be increasing their awareness about tobacco use behaviors and cancer risk in addition to their job-related personal behaviors.

Findings from the present study suggests that the smoking rate continues to decline among fire service personnel while the use of SLT and e-cigarettes has increased. Available epidemiologic evidence suggests that rates of smoking among firefighters are lower than the general population [17,41] but the prevalence of SLT use is almost double [17,28]. Fire service organizations have been proactive and assertive about guiding the fire service to becoming a smoke-free profession, including implementing tobacco-free policies. In addition, the International Association of Fire Fighters [42], the union representing career firefighters, formed a partnership with Pfizer to create a campaign for a smoke-free union, which provides smoking cessation counseling and resources.

Recognition of the harmful consequences of smoking by fire service leadership has led to effective actions to reduce smoking. For example, several departments have successfully mandated tobacco-free policies predominantly targeting smoking, and implemented no tobacco use contracts requiring no cigarette smoking as a condition of employment [16]. With these tobacco use regulations and policies, along with the negative view and well-documented adverse health consequences of smoking among firefighters, SLT has inadvertently been promoted as a harm reduction strategy, which reflects on the low smoking rates. Consequently, firefighters have become more accepting of SLT and e-cigarettes use, as noted by our participants. It was interesting that many firefighters noticed their departments' tobacco-free policy strongly emphasized smoking but did not fully enforce restrictions on SLT users. Given the increased rates of SLT use and the history of substantially reduced smoking rates, firefighters represent an ideal group for developing SLT prevention and cessation programs. Although smoking rates in fire service have declined, continued vigilance and encouragement of leadership effort to promote a tobacco-free profession are still needed. In addition, fire departments should be proactively address concerns regarding adverse consequences associated with SLT and should establish a health approach to SLT addiction that includes preventing initiation after joining fire service, facilitating SLT cessation, and promoting abstinence from all tobacco products by current users.

Another important finding from this study is firefighters' fatalistic beliefs about cancer. Cancer fatalism is the belief that cancer is a matter of fate and beyond an individual's power or control [43]. It has been proposed as a barrier to cancer prevention and screening [44,45], cancer information seeking [46], and delays in symptomatic presentation [47,48]. In this study, some participants made fatalistic statements at multiple stages of the cancer continuum [49], from screening ("*... and we have annual screening checks, and there's, you know, looking for indicators of potential cancer – Fire Chief*") to prevention ("*... When you tell a firefighter, they're going to get cancer from smokeless tobacco that means nothing to them because they understand the risk of cancer from the other portions of the job anyway*" – Firefighter) and to survivorship ("*... we're all going to get cancer at some point in our lives. It's going to happen*" – Lieutenant). Participants, regardless of rank or position, expressed and held fatalistic beliefs about cancer (e.g. "*... we're all going to die, we're all dying of something – Fire Chief*" or "*we're all going to get cancer at some point in our lives ... we've accepted it*" – Lieutenant or "*We're probably going to die of fire cancer. Firefighters die young*" – Firefighter) which could discourage them from changing their negative health behaviors, such as quitting tobacco or SLT, or from engaging in help-seeking behaviors [46,49]. The fatalistic beliefs about cancer prevention in our sample were in line with research indicating high prevalence of cancer among US adults and that perceptions are characterized by confusion, pessimism, and helplessness of individuals to avoid getting cancer [43,49,50]. Future qualitative studies should seek to examine the associations

between fatalistic beliefs and cancer prevention behaviors among different sectors (e.g. age, region, role) of fire service personnel.

The present study has a number of notable strengths. First, the study provides a unique perspective on the attitude and perceptions about tobacco use, and SLT in particular, and cancer risk in the fire service. We also utilized rigorous qualitative data analysis methods including the use of multiple coders and audits. Finally, the current study includes a diverse sample of firefighters, fire service leaders, health promotion personnel and medical directors from across the country. Despite the study strengths, limitations exist. For instance, we recruited a small sample of the target population and it might not be representative of whole fire service in general. Even though saturation was achieved, there may be selection biases, in that there were more fire chiefs presenting in the interviews. Next, the fire service personnel were not randomly selected but rather were the result of each participant volunteering for the study in response to an email about the study. In addition, it is not clear whether the findings generalize to volunteer firefighters due to different occupational exposures. Last, but not least, participants were asked about their cancer risk perceptions during their current service. Thus, it is possible that their perceptions regarding cancer risk could change overtime and be different from their lifetime perception. Despite these limitations, the findings provide a rich foundation for future research, prevention, and intervention efforts for the fire service and research communities in terms of tobacco and SLT use and cancer risk. Benefits of the study include a diverse range of personnel from a number of ranks and regions. Findings provide a strong framework for intervention and prevention efforts for the U.S. fire service.

Disclaimer

None.

Conflicts of interest

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

Acknowledgments and funding

The authors would like to thank the firefighters for their support and participation with the research. This work was supported by the American Cancer Society; Grant number: 129326-MRSG-1610401-CPPB.

Appendix A. Supplementary data

Supplementary data to this article can be found online at <https://doi.org/10.1016/j.shaw.2020.04.004>.

References

- [1] Federal Emergency Management Agency. United States fire administration: fiscal year 2017 report to congress [internet]. U.S. Fire Administration. 2018 [cited 2019 Feb 10]. Available from: https://www.usfa.fema.gov/downloads/pdf/annual_report_fy17.pdf.
- [2] Jahnke SA, Poston WSC, Jitnarin N, Haddock CK. Health concerns of the U.S. Fire service: perspectives from the firehouse. *Am J Health Promot* 2012 Nov;27(2):111–8.
- [3] Poston WSC, Jitnarin N, Haddock CK, Jahnke SA, Tuley BC. Obesity and injury-related absenteeism in a population-based firefighter cohort. *Obesity* 2011;19(10):2076–81.
- [4] Anderson DA, Harrison TR, Yang F, Muhamad JW, Morgan SE. Firefighter perceptions of cancer risk: results of a qualitative study. *Am J Ind Med* 2017;60(7):644–50.

- [5] LeMasters GK, Genaidy AM, Succop P, Deddens J, Sobeih T, Barriera-Viruet H, et al. Cancer risk among firefighters: a review and meta-analysis of 32 studies. *J Occup Environ Med* 2006 Nov;48(11):1189–202.
- [6] Fent KW, Eisenberg J, Snawder J, Sammons D, Pleil JD, Stiegel MA, et al. Systemic exposure to PAHs and benzene in firefighters suppressing controlled structure fires. *Ann Occup Hyg* 2014 Aug;58(7):830–45.
- [7] Fent KW, Evans DE, Booher D, Pleil JD, Stiegel MA, Horn GP, et al. Volatile organic compounds off-gassing from firefighters' personal protective equipment ensembles after use. *J Occup Environ Hyg* 2015;12(6):404–14.
- [8] Fent KW, Evans DE. Assessing the risk to firefighters from chemical vapors and gases during vehicle fire suppression. *J Environ Monit* 2011 Mar;13(3):536–43.
- [9] Bates MN, Lane L. Testicular cancer in fire fighters: a cluster investigation. *N Z Med J* 1995 Aug;108(1006):334–7.
- [10] Bigert C, Gustavsson P, Straif K, Taeger D, Pesch B, Kendzia B, et al. Lung cancer among firefighters: smoking-adjusted risk estimates in a pooled analysis of case-control studies. *J Occup Environ Med* 2016 Nov;58(11):1137.
- [11] Glass DC, Del Monaco A, Pircher S, Vander Hoorn S, Sim MR. Mortality and cancer incidence at a fire training college. *Occup Med (Lond)* 2016 Oct 1;66(7):536–42.
- [12] Daniels RD, Kubale TL, Yiin JH, Dahm MM, Hales TR, Baris D, et al. Mortality and cancer incidence in a pooled cohort of US firefighters from San Francisco, Chicago and Philadelphia (1950–2009). *Occup Environ Med* 2014 Jun 1;71(6):388–97.
- [13] Daniels RD, Bertke S, Dahm MM, Yiin JH, Kubale TL, Hales TR, et al. Exposure-response relationships for select cancer and non-cancer health outcomes in a cohort of US firefighters from San Francisco, Chicago and Philadelphia (1950–2009). *Occup Environ Med* 2015 Oct 1;72(10):699–706.
- [14] Brantom PG, Brown I, Baril M, McNamee R. Epidemiological literature review on the risk of cancer among firefighters [Internet]. Montreal, Quebec: IRSST – Communications and Knowledge Transfer Division. 2018 Mar. 139 p. Available from: <https://www.irsst.qc.ca/media/documents/PublIRSST/R-1012.pdf?v=2019-07-02>.
- [15] Jalilian H, Ziaei M, Weiderpass E, Rueegg CS, Khosravi Y, Kjaerheim K. Cancer incidence and mortality among firefighters. *Int J Cancer* 2019 Feb 8.
- [16] Poston WS, Haddock CK, Jitnarin N, Jahnke SA. A national qualitative study of tobacco use among career firefighters and department health personnel. *Nicotine Tob Res* 2012 Jun 1;14(6):734–41.
- [17] Jitnarin N, Poston WS, Haddock CK, Jahnke SA, Day RS. Tobacco use pattern among a national firefighter cohort. *Nicotine Tob Res* 2015 Jan;17(1):66–73.
- [18] Institute of Medicine (Us). Committee on smoking cessation in military and veteran populations. In: Bondurant S, Wedge R, editors. Combating tobacco use in military and veteran populations [internet]. Washington (DC): National Academies Press (US). 2009 [cited 2019 Feb 12]. Available from: <http://www.ncbi.nlm.nih.gov/books/NBK215333/>.
- [19] Jamal A, Phillips E, Gentzke AS, Homa DM, Babb SD, King BA, et al. Current cigarette smoking among adults — United States, 2016. *MMWR Morbidity Mortality Weekly Rep* 2018 Jan 19;67(2):53–9.
- [20] Meadows S, Engel C, Collins R, Beckman R, Cefalu M, Hawes-Dawson J, et al. 2015 department of defense health related behaviors survey (HRBS) [internet]. RAND Corporation. 2018 [cited 2019 Jan 7]. Available from: https://www.rand.org/pubs/research_reports/RR1695.html.
- [21] Wang TW, Asman K, Gentzke AS, Cullen KA, Holder-Hayes E, Reyes-Guzman C, et al. Tobacco product use among adults — United States, 2017. *MMWR Morb Mortal Wkly Rep* 2018 Nov 9;67(44):1225–32.
- [22] Dibbs E, He JrU Thomas, Weiss ST, Sparrow D. Fire fighting and coronary heart disease. *Circulation* 1982 May;65(5):943–6.
- [23] Coglianò V, Straif K, Baan R, Grosse Y, Secretan B, El Ghissassi F, et al. Smokeless tobacco and tobacco-related nitrosamines. *Lancet Oncol* 2004 Dec;5(12):708.
- [24] Richter P, Hodge K, Stanfill S, Zhang L, Watson C. Surveillance of moist snuff: total nicotine, moisture, pH, un-ionized nicotine, and tobacco-specific nitrosamines. *Nicotine Tob Res* 2008 Nov;10(11):1645–52.
- [25] Wyss AB, Hashibe M, Lee Y-CA, Chuang S-C, Muscat J, Chen C, et al. Smokeless tobacco use and the risk of head and neck cancer: pooled analysis of US studies in the INHANCE consortium. *Am J Epidemiol* 2016 Nov 15;184(10):703–16.
- [26] Colilla SA. An epidemiologic review of smokeless tobacco health effects and harm reduction potential. *Regul Toxicol Pharmacol* 2010 Mar;56(2):197–211.
- [27] Roosaar A, Johansson ALV, Sandborgh-Englund G, Axéll T, Nyrén O. Cancer and mortality among users and nonusers of snus. *Int J Cancer* 2008 Jul 1;123(1):168–73.
- [28] Jitnarin N, Haddock CK, Poston WSC, Jahnke S. Smokeless tobacco and dual use among firefighters in the Central United States. *J Environ Public Health* 2013;2013:1–7.
- [29] Fox KA, Hornick CW, Hardin E. International association of fire fighters diversity initiative: achieving and retaining a diverse fire service workforce, vol. 71; 2006.
- [30] Qsr International Pty Ltd. NVivo qualitative data analysis Software; 2018.
- [31] Patton MQ, Patton MQ. Qualitative research and evaluation methods. Thousand Oaks, Calif. Sage; 2002 [etc.].
- [32] Côté-Arsenault D, Morrison-Beedy D. Maintaining your focus in focus groups: avoiding common mistakes: common mistakes with FOCUS groups/côté-ARSENAULT and marrison-beedy. *Res Nurs Health* 2005 Apr;28(2):172–9.
- [33] Bolstad-Johnson DM, Burgess JL, Crutchfield CD, Storment S, Gerkin R, Wilson JR. Characterization of firefighter exposures during fire overhaul. *AIHAJ* 2000 Oct;61(5):636–41.
- [34] Jahnke S, Poston W, Haddock C. Perceptions of alcohol use among US firefighters, vol. 7; 2014.
- [35] Carey MG, Al-Zaiti SS, Dean GE, Sessanna L, Finnell DS. Sleep problems, depression, substance use, social bonding, and quality of life in professional firefighters. *J Occup Environ Med* 2011 Aug;53(8):928–33.
- [36] December roundtable: tobacco use [internet]. *Fire Engineering*. 2009 [cited 2019 Sep 9]. Available from: <https://www.fireengineering.com/articles/2009/12/december-roundtable.html>.
- [37] Solle NS, Caban-Martinez AJ, Levy RA, Young B, Lee D, Harrison T, et al. Perceptions of health and cancer risk among newly recruited firefighters in South Florida. *Am J Ind Med* 2018;61(1):77–84.
- [38] Kales SN, Polyhronopoulos GN, Aldrich JM, Leitao EO, Christiani DC. Correlates of body mass index in hazardous materials firefighters. *J Occup Environ Med* 1999 Jul;41(7):589–95.
- [39] International Association of Fire Fighter (Iaff). The fire service joint labor management wellness-fitness initiative [Internet]. Washington, DC; 2008 [cited 2019 Feb 6]. Available from: <http://www.iaff.org/library/pdfs/hs/wfif%203rd%20edition%20low%20resolution.pdf>.
- [40] LeDuc TJ, Eaton SA. Fire service cancer drives nationwide collaboration in Florida [internet]; 2017 [cited 2019 Feb 9]. Available from: <https://www.fireengineering.com/articles/print/volume-170/issue-6/features/fire-service-cancer-drives-regionwide-collaboration-in-florida.html>.
- [41] Haddock CK, Jitnarin N, Poston WSC, Tuley B, Jahnke SA. Tobacco use among firefighters in the central United States. *Am J Ind Med* 2011 Sep;54(9):697–706.
- [42] International Association of Fire Fighters (Iaff). Campaign for a smoke-free union: an IAFF-Pfizer smoking cessation program [Internet]; 2010 [cited 2019 Feb 7]. Available from: <http://www.iaff.org/smokefree/>.
- [43] Straughan PT, Seow A. Fatalism reconceptualized: a concept to predict health screening behavior. *J Gen Culture, Health* 1998 Jun 1;3(2):85–100.
- [44] Espinosa de los Monteros K, Gallo LC. The relevance of fatalism in the study of latinás' cancer screening behavior: a systematic review of the literature. *Int J Behav Med* 2011 Dec 1;18(4):310–8.
- [45] Lasser KE, Ayanian JZ, Fletcher RH, Good M-JD. Barriers to colorectal cancer screening in community health centers: a qualitative study. *BMC Fam Pract* 2008 Feb 27;9(1):15.
- [46] Kobayashi LC, Smith SG. Cancer fatalism, literacy, and cancer information seeking in the American public. *Health Educ Behav* 2016 Aug;43(4):461–70.
- [47] Beeken RJ, Simon AE, Wagner C von, Whitaker KL, Wardle J. Cancer fatalism: deterring early presentation and increasing social inequalities? *Cancer Epidemiol Biomarkers Prev* 2011 Oct 1;20(10):2127–31.
- [48] Lyratzopoulos G, Liu MP-H, Abel GA, Wardle J, Keating NL. The association between fatalistic beliefs and late stage at diagnosis of lung and colorectal cancer. *Cancer Epidemiol Biomarkers Prev* 2015 Apr 1;24(4):720–6.
- [49] Niederdeppe J, Levy AG. Fatalistic beliefs about cancer prevention and three prevention behaviors. *Cancer Epidemiol Biomarkers Prev* 2007 May 1;16(5):998–1003.
- [50] Powe BD, Finnie R. Cancer fatalism: the state of the science. *Cancer Nurs* 2003 Dec;26(6):454–65 quiz 466–7.