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Vaping, Smoking, Dual Use, and Stealth Vaping/Smoking Among First Responders: Law Enforcement, Firefighters, and Paramedics/Emergency Medical Technicians (EMT)

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by

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Abstract

TITLE: Vaping, Smoking, Dual Use, and Stealth Vaping/Smoking Among First Responders: Law Enforcement, Firefighters, and Paramedics/Emergency Medical Technicians (EMT)

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First Responders to emergencies, such as those within the fields of law enforcement, firefighting, and/or emergency medical services, have a higher use of Electronic Nicotine Delivery System (ENDS)than the population in general due to the intense job-related stressors they often encounter as part of their work and the well documented relationship between stress and use of these products. The purpose of this study was to determine the rate of First Responders who utilize ENDS and engage in stealth vaping, and the association between these behaviors and self-perceived level of job stress, health risk perceptions, and other factors.

A total of 757 participants were included in the study (M_{age} = 33.59, *SD* =10.90, age range: 18-74), including 359 (47.5%) men, 395 (52.2%) women. Results from our current study found that 31% of First Responders currently vaped, 22.2% were current smokers, and 11% were current dual users. Of those respondents who endorsed vaping behaviors, 38.0% endorsed stealth vaping, or non-adherence to the workplace rules some of the time and 31.0% endorsed stealth vaping within their work vehicles. While these results were significantly lower than that of the general population ($\chi 2(1, N = 357) = 6.91$, $p < .05$ and $\chi 2(1, N = 360) = 30.39$, $p < .001$, respectively), they highlight a need for intervention to further reduce stealth vaping behaviors in workplace settings.

A significant association between stress levels and vaping and dual use status among First Responders was found; those who reported greater overall stress levels were more likely to be vapers ($\chi^2(1) = 49.17$, $p < .001$) and dual users ($\chi^2(1) = 29.98$, $p < .001$). Significant differences in health risk perceptions, $F(3, 756) = 59.57$, $p < .001$, were also found, depending on smoking and vaping status. First Responders who reported less risk with ENDS use and viewed ENDS as a safer alternative to smoking were more likely to vape. Almost 70% (69.5%) of First Responders perceiving vaping as an effective method of smoking cessation. Lastly, psychosocial factors were examined, with results indicating First Responders who endorsed current ENDS use were significantly more likely to report residing with individuals who smoked, $\chi^2(1) = 4.47$, $p < .05$ and vaped, $\chi^2(1) = 161.47$, $p < .001$, as well as having more friends who vaped, $\chi^2(1) = 60.14$, $p < .001$ compared to non-vapers.

This study addressed many of the gaps that are seen within the ENDS literature, specifically with regards to stealth vaping within the First Responder population. Results from this study indicate the importance of psychoeducation regarding the risks associated with vaping, vaping as a smoking cessation tool, and the importance of regulations for vaping in the workplaces of First Responders. Additionally, targeted interventions that include stress management, peer-support groups, and identifying alternative coping methods are warranted.

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I. Introduction:

Rates of Tobacco Use, Vaping, and Dual Use Among the General U.S. Population

According to the Centers for Disease Control and Prevention (2018), "vaping" is the term for the utilization of an electronic smoking device, e-cigarette, and/or an electronic nicotine delivery system (ENDS) that produces an aerosol vapor to be inhaled or "vaped" by heating a liquid solution. This solution can contain nicotine, although the device may also contain other substances. These devices usually are designed to look like cigarettes, cigars, and/or pipes and were originally advertised as a way to stop smoking. It should be noted that the terms, "vaping", "e-cigarettes", and "ENDS" will be used interchangeably throughout this narrative.

Over the past few years, vaping has rapidly increased among adults and adolescents, with the adjusted national sales increasing from $11.6 million in 2010 to $751.2 million in 2016 (Cantrell, Huang, Greenberg, Willett, Hair, & Vallone, 2018; Kasza, Ambrose, Conway, Borek, Taylor, Goniewicz *et. al* 2017; Rass, Pacek, Johnson, & Johnson, 2015). Brands of ENDS grew from 5 to 53 brands in 6 years, with the tobacco industry controlling over 72% of the brands on the market by 2016 (Cantrell *et. al.* 2018). The National Health Interview Survey (2018) estimated that in 2017, approximately 19.3% of US adults were utilizing tobacco products, including cigarettes, cigars, smokeless tobacco, pipes/hookahs, and e-cigarettes.

Of the 19.3% of tobacco users reported in the National Health Survey (2018), cigarette smoking among adults, ages 18 and over, was estimated to be at approximately 13.7%, or approximately 34.2 million individuals within the United States. Of the cigarette smokers, 74.6% smoked cigarettes daily (CDC, 2018). The CDC indicates that within the United States, 15.6% of

adult males and 12% of adult females smoked cigarettes. Rates for cigarette smoking are highest among individuals identifying as Lesbian, Gay, or Bisexual (20.6%), those within the age range of 25 – 44 years of age (16.5%), and among American Indian/Alaska Natives, Non-Hispanic individuals (22.6%). Higher rates for cigarette smoking were observed among individuals who obtained their GED (36%), were divorced/separated/ or widowed, and those with an income of <$35,000 (21.3%).

Examination of the rates of ENDS use in the U.S, based on data from The National Health Interview Survey (2017), found that 15.3% of adults (18 years and older) have ever vaped and 3.2% were actively vaping in 2016. Individuals within the age range of 18-24 years had a prevalence rate of 4.5%, while 4.2% of 25-44-year-olds vaped. Utilizing data from the 2017 Behavioral Risk Factor Surveillance System, a random telephone survey collecting an array of health data from states around the United States, Kava, Hanna, and Harris (2020) found that rates of e-cigarettes and dual use among employed adults in the U.S. have steadily been rising, increasing from 3.2% in 2016 (NHIS, 2017) to 4.4% in 2017 (Kava *et al.*, 2020).

With the increase in ENDS utilization, identifying high risk demographic groups and patterns of use are important for intervention. Regarding age, young adults within the age range of 18-24 years appear at highest risk, with rates decreasing as age increases (National Academies of Sciences, Engineering, and Medicine, 2018). According to the Monitoring The Future (MTF) national survey conducted by Schulenberg, Johnston, O'Moalley, Bachman, Miech, and Patrick (2016), 26% of college students and young adults reported ever ENDS use, while 5.8% had reported use in the past 30 days. Differences in ENDS utilization is apparent among genders, with greater use among men compared to women. Based on the NIHS (2014)

data, 14.2% of men reported ever using e-cigarettes, significantly higher than the reported 11.2% of female users (National Academies of Sciences, Engineering, and Medicine, 2018; Schoenborn and Gindi, 2015). Adult males, over the age of 25, reported a significantly higher rate of ever ENDS use (18.3%), current ENDS use (6.6%) and frequent ENDS use (1.5%) compared to women (14.7%, 5.0%, and 1.0% respectively) who used ENDS (USDHHS, 2016). Adult e-cigarette usage also varies by ethnic and racial groups with approximately 20.2% of American Indians/Alaska Natives and 14.8% of individuals identifying as non-Hispanic/white reporting having ever used ENDS (National Academies of Sciences, Engineering, and Medicine, 2018; Schoenborn and Gindi, 2015). Interestingly, in the PATH Wave 1 study conducted by Coleman *et. al.* (2017), current e-cigarette use among American Indians/Native Alaskan individuals was the lowest among all ethnic and racial groups (.06%).

Variable outcomes have been reported for e-cigarette use among individuals with differing levels of education. Some studies have found that individuals with some college education/associates degree had the highest rates of current ENDS use, compared to those who obtained a GED (39.2% vs. 9.7% respectively) (Coleman et al., 2017), while other studies suggest that those with a high school diploma had higher rates (36.1%) (Huang, Kim, Vera, & Emery, 2016). Additionally, socioeconomic status (SES) and income appear to be predictors for ENDS use, with mixed results. While some studies suggest that individuals with a household income between $25,000 - $34,999 (3.0%) have higher rates of ENDS use compared to the general population (Sharapova, Singh, Agaku, Kennedy, & King, 2018), other studies have found adults with higher income to be more likely to have ever used e-cigarettes (27.4% of individuals with an income of $75,000-$124,000) (Huang *et al.*, 2016), or have found no association

between income and rates of ENDS use (King, Tael, Nguyen, & Dube, 2015). Finally, marital status may also predict ENDS use, with higher rates reported among individuals who are single/never married/not living with a partner compared to those who are married or living with a partner (7.6% vs. 4.5% respectively) (Sharapova et al., 2018).

Examination of rates of dual tobacco product use has found that approximately 70% - 84.1% of users utilized two different tobacco products with the most common combination being cigarettes and e-cigarettes (30.1%) (Coleman, Rostron, Johnson, Ambrose, Pearson, Stanton, *et al.,* 2017; Kasza *et al*., 2017; NHIS, 2016). Prevalence rates for dual use determined by the 2017 Behavioral Risk Factor Surveillance System were highest among employed adults within the age range of 18-24-years (4.1%), males (2.6%), American Indian/Alaska Natives (3.3%), those with a high school diploma (3.4%), and those with an annual household income between $15,000 – $24,000 (3.9%).

Benefits and Risks of Vaping E-Cigarettes

Benefits: Studies have shown that individuals prefer e-cigarettes due to an understanding of presumptive health benefits as well as the individual's perception that e-cigarettes are safer (less ingestion and exposure to toxic chemicals found in cigarette smoke) and aid in smoking cessation (Brikmanis, Peterson, & Doran, 2017; Coleman *et. al.,* 2017; Pepper & Brewer, 2013; Rass *et al,* 2015; Zhu *et al.,* 2013). A recent meta-analysis of 65 studies (Romijnders, Osch, Vries, & Talhout, 2018) indicated that among adult smokers and e-cigarette users, e-cigarettes were used primarily for purposes of smoking cessation. Other reasons for e-cigarette use among both first-time e-cigarette users and former smokers included

convenience, discretion in use, curiosity, and social influences. Users also perceived e-cigarettes as healthier than cigarettes and reported expected health benefits such as improved breathing, increased concentration, and weight control. In the early stages of vaping, users experienced avoidance of smoking restrictions, weight control, regaining their sense of taste and smell, improved breathing, increased alertness, and stress reduction. Additionally, e-cigarette users and dual users perceived a benefit for bystanders' health when e-cigarettes were used instead of traditional combustible cigarettes. Pokherl and Herzog (2014) found that individuals who utilized e-cigarettes rather than combustible cigarettes did so because of the reduced tobacco odor on their bodies or clothing, improved personal hygiene, and savings on the cost of tobacco cigarettes.

Smoking Cessation: Research has shown that individuals often utilize ENDS as an aid to smoking cessation (Coleman *et al.,* 2017; Pokherl & Herzog, 2014). Yet, according to the U.S. Preventative Task Force (2015), there is a lack of evidence supporting the recommendation of ENDS use for tobacco cessation due to mixed findings. Some studies have found that daily ENDS utilization enabled cigarette smokers to quit or reduce cigarette consumption (Berry, Reynolds, Collins, Siegel, Fetterman, Hamburg, Bhatnagar, Benjamin, & Stokes, 2019; Zhu, Zhuang, Wong, Cummins, Tedeschi, 2017), while others have found no association between ENDS utilization and smoking cessation (Brose, Hitchman, Brown, West, McNeill, 2015; Manzoli *et al.*, 2015). Further, studies have found that e-cigarette utilization decreases an individual's ability to abstain or reduce smoking when compared to not using a replacement product (Pepper & Brewer, 2013; Shi, Pierce, White, Vijayaraghavan, Compton, Conway *et al.,* 2017).

Siegel, Tanwar, and Wood (2011) found that after a 6-month period of smoking abstinence, during which time e-cigarettes were utilized as a smoking cessation tool, 66% of participants reported a reduction in number of cigarettes smoked, while 48% reported complete abstinence from smoking cigarettes. Of those individuals who reported not smoking cigarettes at 6 months, only 34.3% reported not utilizing any form of nicotine products or e-cigarettes at the time. However, they also found that individuals who were inhaling their e-cigarettes more than 20 times a day had a quit rate of 70%, suggesting they were replacing cigarette smoking with e-cigarette use. While these findings are suggestive of e-cigarette use as a smoking cessation aid, they are limited by the study's small sample size, self-reported questionnaire, and the use of a single specific e-cigarette brand.

In contrast, Bullen and colleagues (2013) conducted a randomized-controlled trial in New Zealand and found that after 13 weeks of using e-cigarettes containing nicotine, smoking abstinence among participants at 6 months had increased; however, cessation rates were not significantly different when compared to participants who used nicotine replacement patches or e-cigarettes with nicotine-free cartridges. More recently, Hajec and colleagues (2019) randomly assigned participants to receive either a three-month supply of nicotine replacement products of their choice, or an e-cigarette starter pack (a refillable e-cigarette with one bottle of nicotine e-liquid [18mg/ml]. One year later, higher smoking cessation rates were observed for those assigned to the nicotine replacement group (18.0%) than those assigned to the e-cigarette group (9.0%). However, 80% of those in the e-cigarette group continued use of the assigned product compared to 9% of the nicotine replacement group, indicating continued exposure to the toxic substances of the ENDS products.

Health Risks: While it is often assumed by individuals utilizing e-cigarettes that vaping is less harmful than tobacco cigarettes, e-cigarettes have been shown to increase the risk for smoking initiation, escalation, and dependence (Dvorsky & Langberg, 2019; Pepper & Brewer, 2017; Sonji *et al.,* 2017). Further, researchers have found that e-cigarettes are harmful, as they contain toxins and chemicals within the aerosol which are carcinogenic and may cause cancer (CDC, 2019). E-cigarettes also may contain an oxidized free-base nicotine which is highly addictive as well as detrimental to developing fetuses and the adolescent brain (CDC, 2019; Pepper & Brewster, 2017). Additionally, studies have found that individuals who vaped showed long-lasting traces of tobacco-specific nitrosamines (TSNAs) biomarkers in the body, as well as volatile compounds and metals which, although lower than in those who smoke only tobacco cigarettes, were at higher concentrations than those found in non-vapers (Goniewicz, Smith, Edwards, Blount, Caldwell, Feng *et. al.*, 2018). Individuals who used both e-cigarettes and tobacco cigarettes had the highest level of toxins in their body compared to individuals who utilized only one product indicating that vaping increases toxins within the body (Goniewicz *et al.,* 2018). Findings by Soneji *et. al* (2017) suggest that vaping may activate cognitive, psychological and/or behavioral processes which increase the risk of smoking, by creating positive expectations about cigarette smoking, increasing affiliation with peers who smoke cigarettes, and through mimicking behavioral activities (i.e., hand to mouth movements, inhalation and exhalation, and puffing behaviors).

Additional risks associated with ENDS use include introducing nicotine, fine particles, heavy metals, tobacco-specific nitrosamines (TSNAs) and other toxins into the immediate environment (Czogala, Goniewicz, Fidelus, Zielinska-danch, Travers, & Sobczak, 2014).

Commercial e-liquids were tested and found to have high concentrations of Propylene Glycol, a substance that is associated with the irritation of the eyes, upper respiratory systems and mucus membrane (Varughese et al., 2005; Wieslander, Norback, & Lindgren, 2001). Additional harmful compounds, such as formaldehyde (carcinogen), acetaldehyde (probable carcinogen), glycidol (possible carcinogen), and acrolein (respiratory system irritant), are produced when the liquid is heated and aerosolized (Agency for Toxic Substances and Disease Registry [ATSDR], 2007; Bekki et al., 2014; National Toxicology Program [NTP], 2007; U.S. Department of Health and Human Services [USDHHS], 2016). Problematically, research has shown that different ENDS products release different levels of emissions into the environment, creating a greater risk to those nearby than the vaper may realize (Czogala *et al.*, 2014). This is problematic, as over 60% of ENDS users in a national survey, believe they are inhaling "just flavoring" from their vaping devices, and that e-cigarettes are healthier for those in their immediate environment (Romijnders *et al.*, 2018).

Relatedly, the flavoring within e-cigarettes presents their own health risks to the individual when inhaled. This is a substantial problem, considering 75% of ENDS users report flavor as the reason they utilize ENDS (Wang, Zhan, Li, Zeng, & Leischow, 2015; Yingst, Veldheer, Hammett, Hrabovsky, & Foulds, 2017). Chemicals such as diacetyl, acetylpropionyl, and acetoin, which account for the "creamy" flavors of some e-cigarettes have been associated with lung dysfunction resulting in bronchitis, asthma, chronic coughing, and bronchioles inflammation (Kreiss et al., 2002; National Institute for Occupational Safety and Health [NIOSH], 2016), and are found in over 90% of e-cigarettes (Allen et al., 2016). Cinnamaldehyde, a major

chemical in cinnamon and fruit-flavored e-cigarette products, has been found in 50% of e-liquids, at levels considered to be toxic to human cells (Behar et al., 2016).

E-cigarettes have been shown to have short-term cardiovascular and respiratory health effects. Carnevale and colleagues (2016) found that e-cigarettes users showed a significant increase in reactive oxygen, and decreased levels of antioxidants and nitric acid just 30 minutes after e-cigarette use. Similarly, Moheimani and colleagues (2017) found that e-cigarette users showed a significant increase in levels of low-density lipoproteins and a greater shift in cardiac autonomic balance towards the parasympathetic dominance than those who were non-users. Both of these studies indicate that e-cigarettes promote oxidative stress and impair endothelial function. These outcomes are significant as they are associated with many cardiovascular diseases including diabetes, chronic heart failure, atherosclerosis, and hypertension (Rush, Denniss, & Graham, 2005). Similarly, Vardavas and colleagues (2012) found e-cigarette users showed increased respiratory resistance and peripheral airflow resistance, as well as a reduction in exhaled nitric acid 5 minutes after use. Finally, McConnell *et al.* (2017) identified a significant positive association between prior e-cigarette use over 12 months and rates of chronic bronchitis symptoms. Both of these studies indicate a direct contribution from e-cigarette use to a reduction in pulmonary functioning.

The Association Between Stress, Smoking, and Vaping Behaviors

Stress has been shown to increase the risk for smoking, through increasing vulnerability to an array of addictive behaviors (Ansell, Gu, Tuit & Sinha, 2012; Sinha, 2008). According to the stress-vulnerability model, this is accomplished when cumulative stress results in an adaptation

to one's stress level and a decrease in self-control, as well as an increase in impulsivity and the risk for addiction (Ansell *et al.*, 2012). The vulnerability hypothesis suggests that it is the cumulative levels of stress over the course of an individual's lifetime that create alteration in the brain, increased impulsivity, and increased risk of addictive behaviors such as smoking (Ansell *et al.* 2012).

Stress can be referred to as the process of perception of, and response to, harmful or potentially dangerous stimuli. While this can often be interpreted as a negative effect, stress can have a positive effect when an individual is challenged by a situation leading to cognitive and behavioral responses that generate a sense of mastery and accomplishment (Sinha, 2008). Generally, positive stress relies on an individual's motivation to achieve a goal-directed outcome and then return to homeostasis, meaning that maintaining short intervals of stress can have positive outcomes. However, when stress is extended and ongoing, the individual's sense of mastery, control, and adaptability is reduced, increasing the risk for homeostasis dysregulation (Sinha, 2008). Additionally, neurobiological data has shown that stress impairs executive functioning such as working memory and self-control, adding support to the finding that stress affects an individual's susceptibility for risky behaviors (Sinha, 2008).

An individual's desire to minimize dysregulated homeostasis might lead the person to utilize methods such as substance use to stimulate the reward pathway and return the body back to its original state. In fact, research conducted on specific drug pathways (nicotine, alcohol, marijuana, and amphetamines) indicates the direct effect of drug use on major components of the physiological stress response; drug use acts as a reward system to attempt to return the body to homeostasis (McKee, Sinha, Weinberger, Sofuoglu, Harrison, Lavery, &

Wanzer 2011; Sinha, 2008). Individuals who experience continual stress might utilize substances to relieve feelings of distress, leading to substance addiction. Studies (Ansell *et al.,* 2012; McKee *et. al.,* 2011) have demonstrated an association between cumulative stress and an increased risk for smoking (Ansell *et al.,* 2012; McKee *et. al.,* 2011). Although not extensively studied, chronic stress is likely to result in increased ENDS use as well, particularly for those products that contain nicotine. Related to this idea, a study conducted by Biggs, Fullerton, Reeves, Grieger, Reissman, and Ursano (2010), found that 37.9% of disaster workers who responded to 9/11, including firefighters, medical personnel, police, and search and rescue personnel, had been cigarette smokers prior to the disaster; yet three weeks after 9/11, approximately 54.5% of smokers reported increased tobacco use, with 33.3% having probable acute stress disorder. Vaping behaviors were not assessed in this study.

While there appears to be a relationship between stress and ENDS use, most of the studies to date have examined this association among the general population. Using the National Health Interview Survey (NHIS), Park, Lee, Shearston, & Weitzman (2017) measured psychological distress using the Kessler 6 (K6) scale in relation to cigarette use (at least 100 in their lifetime), ever use of e-cigarettes and cigarettes (ever having used an e-cigarette and/or cigarette), and dual users. They found a relationship between high levels of psychological distress and a greater likelihood of exclusive ever use of e-cigarettes. ever use of e-cigarettes and former cigarette use, current dual use, and exclusive current cigarette use. Additionally, after adjusting for possible cofounders, they found that as an individual's level of distress increased, they were more likely to have tried e-cigarettes. Similarly, in a survey conducted with the general population, Spears and colleagues (2019) determined a positive relationship

between individuals with any psychological distress and lifetime ENDS use as well as current daily ENDS use.

Psychosocial Risk and Protective Factors for ENDS Use

One well studied psychosocial risk factor related to e-cigarette use is mental health status. Individuals with mental health conditions have been identified at greater risk of using ENDS compared to individuals without a mental health condition. In fact, those with a greater number of mental health conditions have been demonstrated to have a greater rate of ENDS utilization (Spears, Jones, Weaver, Pechacek, & Eriksen, 2017). With the exception of schizophrenia (15%), individuals with a mental health condition including bipolar disorder (25.4%), schizoaffective disorder (24.4%), anxiety disorder (19.1%), depression (17.5%), mood disorder (26.3%), and other mental health disorders (18.1%) had higher rates of current ENDS use compared to those with no mental health diagnosis (6.5%). Rates for lifetime use of e-cigarettes, among the general population, were almost doubled for all mental health conditions when compared to individuals without a mental health condition (Spears *et al.*, 2017; Spears et al., 2019). Similarly, Cummins et al., (2019) found that 8.6% of individuals, in the general population, with a mental health condition of anxiety, depression, or "other" were current e-cigarette users, compared to those without a mental health condition (5.4%).

Hefner, Sollazzo, Mullaney, Coker, & Sofuoglu (2019) studied college students and found that 33.6% with a mental health condition had tried e-cigarettes compared to those without any mental health conditions (19.2%). Those reporting a non-alcoholic substance abuse disorder reported having tried ENDS at a greater rate than those without a substance abuse

disorder (55.6% vs, 21.7%). Among those who used alcohol, the more drinks per episode was associated with higher rate of e-cigarette use.

Additionally, research supports the use of combustible cigarettes as a risk factor for ENDS use (Coleman *et. al.*, 2017; Sharpova *et al*., 2018). Studies have shown that current cigarette smokers and individuals who smoked other combustible tobacco products had higher rates of e-cigarette use than those who did not report any other tobacco use (69.7%, 39.2% 16.0%, respectively) (Coleman *et al.*, 2017). Additionally, studies have indicated that current smokers were more likely to identify as ever e-cigarette users compared to former and never smokers, with current smokers having ever used e-cigarette at rates almost 5 times higher than former smokers (50.3 vs.10.1%). (Huang et al., 2016).

Perceived risks and benefits of e-cigarettes have also been shown to influence an individual's ENDS use. One of the most popular reasons for e-cigarette use is the belief that they are less harmful than combustible cigarettes to both the user and others around them (Hefner et al., 2019; Rass et al., 2015). In fact, one study showed that 57% of dual users believed that combustible cigarettes were "much more harmful" then e-cigarettes, while 30% thought cigarettes were "somewhat more harmful", and 12% believed they were equally harmful (Rass et al., 2015). Interestingly, only 3% believed that e-cigarettes were "much more harmful" than nicotine replacement therapy (NRT), 12% believed e-cigarettes were "somewhat more harmful" then NRT, while 15% believed NRT treatment was "somewhat more harmful" than e-cigarette use, and 10% believed NRT treatment was "much more harmful" than e-cigarette use (Rass et al., 2015). An additional risk factor that is highly associated with ENDS use is the perception that use of ENDS products can aid in smoking cessation. Thirty percent to-

71.9% of adults across studies believed that e-cigarettes could help them quit smoking and used e-cigarettes accordingly (Coleman et al., 2017; Pepper, Ribisl, Emery, and Brewer, 2014; Rass et al., 2015).

Pepper et al. (2014) found that a common reason for initiating ENDS use among individuals who had ever used or tried e-cigarettes, was having a family member or friend use, give, or offer them e-cigarettes. This finding was supported by other studies which found a positive association between family members and friends who vaped and initiation of ENDS use (Choi and Foster, 2013; Coleman et al., 2017). Additionally, an individual's belief that they can use e-cigarettes where smoking is prohibited is associated with greater e-cigarette utilization. Research has shown that 45 – 80.8% of individuals begin using e-cigarettes to circumvent smoking bans and to better cope when unable to smoke cigarettes (Coleman et al., 2017; Rass et al., 2015). In fact, legal bans and regulations for ENDS use may also impact rate of utilization, as studies have shown that states with comprehensive policy guidelines had rates that were 20% lower than states without regulations (Huang et al., 2016).

Tobacco Use and Vaping Among First Responders

"First Responders" for the purposes of this study include law enforcement personnel, emergency medical technicians/paramedics, and firefighters. They constitute an understudied group, especially when examining risk factors and associated health behaviors. First Responders are exposed to a significant amount of occupational tension and have a higher risk for acute and traumatic stress on a daily basis than the general population (Garner, Baker, & Hagelgans, 2016; Kliem & Westphal, 2011; Lanza *et al.,* 2018). Some potential sources of occupational and

traumatic stress include the need to respond to natural and large-scale disasters, daily encounters with death, shootings, injuries to self or coworkers, often accompanied by a lack of adequate sleep and interrupted meal schedules. Additionally, there is a resistance within this specific population to obtaining psychological services to address these and similar issues, leading them to a high risk of becoming "hidden victims" (Alexander & Klein, 2009). Due to the wide array of potentially traumatic events affecting their cognitions, emotions, and behaviors, prevalence rates of post-traumatic stress disorder (PTSD) within First Responders range from 8% to 37%, compared to the lifetime prevalence rate of 6.8% to 7.8% within the U.S. general population (American Psychiatric Association, 2013; Kleim & Westphal, 2011; Lanza *et al.,* 2018; National Institute of Mental Health, 2017). PTSD is the psychological disorder most often diagnosed among First Responders (Alexander & Klein, 2009) and is generally comorbid with depression, anxiety, and substance abuse.

Other risk factors that increase stress for First Responders include being unmarried, older, female, having lower education attainment, and lower income levels (Alexander & Klein, 2009). Research has suggested that being a First Responder also tends to negatively affect an individual's marriage and interpersonal relationships, acting as a double-edged sword (Alexander & Klein, 2009; Koch, 2010). One's social support is not only important for maintaining control and resiliency but is one of the most robust predictors of PTSD symptoms following an incident (Kleim & Westphal, 2011). It is common knowledge that law enforcement employees tend to circulate within their own "police culture", which often includes socializing with peers and coworkers who tend to have similar work schedules and are able to identify with their perceptions, opinions, and views. However, this clique-like behavior inadvertently

closes off social interactions with those outside their field. Similarly, due to the nature of the work that firefighters and emergency medical responders conduct daily along with their differing work schedules from those of the general population, they would face a similar situation of more restricted social interactions, closing off social support from other peers. Additional predictors for mental health difficulties among First Responders include sustaining an injury during a call, prior endorsement of mental health symptoms or complaints, perception of safety following an incident, as well as level of training (Kleim & Westphal, 2011).

Due to the potential for encountering daily stressful and traumatic situations, those serving as First Responders are at an increased risk for maladaptive behavioral health problems such as social isolation, alcohol, and smoking, including e-cigarettes and use of other tobacco products (i.e. tobacco dip) (Ansell *et al.,* 2012; Kronenberg, Osofsky, Osofsky, Many, Hardy, & Arey, 2008). In a study conducted by McKee *et al.* (2011), subjects were exposed to personalized stressful imagery and then had the option of delaying tobacco administration (by 5-minute increments) for monetary gain or receiving a tobacco self-administration session, in order to determine their ability to resist smoking. McKee et al. (2012) found that the stress imagery undermined the ability to resist smoking, no matter the amount of monetary gain, indicating limited self-control and executive functioning, as well as delayed gratification. Additionally, McKee and colleagues determined that following a stressful situation, subjects smoked their cigarettes more intensely through increased puffs, greater depth of inhalation, and shorter times between puffs. Whether these same behavioral consequences occur with vaping has yet to be examined.

While vaping rates within First Responders have not been determined, rates for tobacco use are available, although limited. Prevalence rates for cigarette smoking among male firefighters are between 9.8% (Jitnarin, Poston, Haddock, Jahnke, Day, 2015) - 13.6% (Haddock, Jitnarin, Walker, Poston, Tuley, Jahnke, 2011), a reduction from 30.0% reported in 1988 (Stellman, Boffetta, & Garfinkel, 1988). While these rates are low for the average male, especially when compared to the general population, a national study suggested the reduction in smoking rates may be due to newly introduced departmental policies and restrictions (Poston *et al.,* 2012). Although implementation of new policies (such as contracts that require nonsmoking/tobacco use as a condition for employment, indoor smoking laws, and disease presumption laws which effects medical retirements) has resulted in promising trends for reduced cigarette smoking among firefighters, it has not substantially impacted the use of smokeless tobacco products such as dip and chew, with approximately 18.4% of firefighters using such products compared to 6.5% of the general U.S. male population (Haddock *et al.*, 2011; Poston *et al.,* 2012). Jitnarin *et al.* (2015) found the average age range for male firefighters who smoked to be 36.4 +/- 9.4, with 88% of them having some college education or a college degree. Forty-seven percent of current smokers were married or living with partners, and 58.1% of them where White, with approximately 12.5 (+/- 8.8) years on the job.

Prevalence rates of cigarette smoking among female firefighters appear to be variable with rates between 5.1% to 22.2%. While the higher rates of smoking among female firefighters were determined in studies not measuring smoking behaviors specifically, they may reflect the unique stressors they encounter on the job (i.e. harassment and discrimination). Additionally, women firefighters are significantly underrepresented within the fire service, and they make up

a smaller proportion of the first responder professions (Jahnke, Haddock, Jitnarin, Kaipust, Hollerback, & Poston, 2019).

Similar to the studies examining prevalence rates of cigarette smoking among firefighters, data for law enforcement are also limited. One of the oldest but most comprehensive studies that examined smoking habits by occupation, found that 33.3% of male police officers and 31.2% of female police officers were cigarette smokers (Stellman *et al.* 1988). More recent studies found that prevalence rates for police officers were approximately 17.2%, with female officers having higher rates of smoking than their male counterparts (26.5% vs. 13.7%, respectively) (Hartley, Violanti, Sarkisian, Fekedulegn, Mnatsakanova, Andrew, & Burchfiel, 2014). Avdija (2013) examined the relationship between smoking and other health related behaviors among police officers and found a significant relationship between the number of days officers were engaged in vigorous activity and smoking, with an increase in vigorous activities leading to less cigarette smoking. Additionally, officers who were married, of female gender, younger in age, and/or with higher level of education had a reduced probability of smoking cigarettes (Avdija, 2013).

Cigarette smoking rates for those within the emergency medical services profession have not been extensively studied and the literature on this topic is limited. However, one study reported the rate of smoking among emergency medical technicians (EMT's) and paramedics to be 19.8% and 16.6%, respectively (Pirrallo, 2005). Female emergency responders (both paramedics and EMT's) had significantly higher smoking rates than their male counterparts (24.8% vs. 15.5% respectively), and minority responders (19.8%) had higher rates than Caucasian responders (18.8%) (Pirrallo, 2005). Years of service appeared to be a factor in

cigarette smoking among medical personnel, such that employees with less than 10 years of experience smoked fewer cigarettes per day than those with 10-19 years of experience (Deloye, Brassard, Larouche, Jauvin, Poirer, Tremblay, & Corbeil, 2015). Reasons for smoking among Pakistan paramedics tended to include “influence of friends” (75.6%), “family influence” (14.9%), “media influence” (4.1%) and “other” (5.4%), while cause for difficulty quitting was “addiction” (41.9%), “lack of will power” (27.0%), “lack of incentive” (12.2%), “social embarrassment” (5.4%), and “other” (13.5%) (Malik, Chaudhry, Karamat, Arif, Cheema, & Rauf, 2010).

Work-Related Policy Restrictions and Stealth Vaping

While the rate of e-cigarette use by First Responders is not well established, the addictive nature of such behaviors begs the question as to how well First Responders can refrain from using tobacco substances while on the job. First Responders interact with ‘at-risk’ populations including those who are ill, in shock, under stress, and in unusual circumstances. Smoking/vaping by First Responders in their presence may create further health risks through secondhand smoking/vaping. Research has shown that the source for secondhand exposure comes from the aerosol and gases exhaled by the primary user. For e-cigarettes, approximately 50% of the emissions inhaled by the users upon taking a “hit” is exhaled thereby serving as a source of secondhand exposure (Thornburg, Malloy, Cho, Studanaker, Lee, 2015).

Thornburg *et al.* (2015) reported that the size of the room, movement of those within the room, air exchange, and location of air supply, will determine the levels of secondhand exposure. Research has shown that second-hand smoking, even short-term, can cause overt

cardiac oxidative stress, intracellular Ca^{2+} dysfunction, and interstitial fibrosis, as well as many other cardiac dysfunctions, leading to apoptosis, the death of blood cells, and mitochondrial damage (Hu, Han, Lane, Gao, Zhang, & Ren, 2013). Additionally, second-hand smoking, even at low levels of exposure, had been shown to compromise cardiac performance, which is one of the leading causes for ambulatory and emergency services (Beillon, Suserud, Karlberg, & Herlitz, 2009; Moller, Ersboll, Tolstrup, Ostergaard, Viereck, Overton, Folke, & Lippert, 2015; Law and Wald, 2003). Considering these risks, it would be expected that cigarette smoking and vaping would be prohibited within the emergency services or at least within a certain distance of the stations and emergency vehicles used by First Responders. When interviewing firefighters, Poston *et al.* (2012) found a decline in the prevalence of cigarette smoking when policy changes and restrictions regarding smoking behaviors (i.e., no tobacco contracts, informing new recruits they could not smoke on the job, and no smoking laws stating firefighters could not smoke within 50 ft of the station) were in place.

No-smoking policies were implemented in the U.S. to protect non-smokers from secondhand smoke and to promote smoking reduction among current smokers (Campaign for Tobacco Free Kids, July 11, 2019). Research supports comprehensive smoke free laws which prohibit smoking in indoor public areas, including the workplace (Bohac *et al*., 2010; Marin &Diaz-Toro, 2011). Within the U.S., 28 states along with the District of Columbia, have passed comprehensive smoke-free laws. Yet, zero states have approved of comprehensive smoke-free workplace laws, while19 states have banned smoking in private workplaces (American Lung Association [ALA], 2020; General Services Administration [GSA], 2008).

First Responders are not always considered federal employees, such as those employed by private medical departments as well as city firefighter and police departments, meaning they are not regulated under one agency or law. Under the strictest of requirements, Massachusetts general law Section 101A, enacted in 1988, states that any individual who smokes any tobacco products is not eligible to work as a police officer or firefighter. The law was amended in 2018 stating that any officers or firefighters who are found smoking after employment must be given the opportunity to enter a smoking cessation program prior to termination (The General Court of the Commonwealth of Massachusetts, 2018). While the state of Massachusetts, along with a few other states, have implemented smoking policies across the state, others have left policy making to the individual cities and/or places of employment to develop similar rules and regulations for their departments (Patel & Schmimdt, 2017).

In a national survey examining tobacco use among firefighters, many participants reported to having to abide by a “no tobacco use contract”, which is a contract signed by new employees, similar to Massachusetts general law, stating that they will not smoke, on or off duty, as a condition of employment (Poston et al., 2012). An additional regulation that was related to their employment was the indoor smoking law, stating firefighters could not smoke within the firehouse, as well as within 50ft of the building, acting as a deterrent for smoking. One of the most important laws for First Responders and implemented in 33 states, is that of Disease Presumption Law. In the general population, the burden is placed on the worker to prove that a disease was caused by a work-related incident or exposure. According to the Disease Presumption law, the burden falls on the employer to prove that work conditions were not sufficient to cause the illness. This means that most cancers and illnesses resulting from

smoke inhalation, are automatically approved, as long as they meet state regulations (First Responder Center for Excellence [FRCE]). However, diseases and cancers caused by smoking or other tobacco use, is generally an exception to the Disease Presumption law in most states and can be rebutted or denied when the individual uses tobacco (FRCE; Poston et. al., 2012).

Additional regulations have been implemented to include emergency vehicles, although such regulations are state and/or agency specific. For example, New York state policy number 89-10 (No smoking in Ambulances), specifies that emergency medical personnel are not permitted to smoke "in or around any ambulance or EMS response vehicle at any time" (New York State Department of Health, 2000). This policy includes vehicle bays and garages and during an incident, when a patient is being treated. No smoking within emergency vehicles was also echoed by the National Fire Protection Association (NFPA), informing firefighters that there should be no smoking within or around a firetruck. According to American Medical Response (AMR) guidelines, an EMS agency, smoking is prohibited "at all times while on scene, while in the patient compartment of the ambulance, and while performing cleaning or decontamination procedures" (National EMS Safety Council [NEMSSC], 2017. pg. 100). Another agency, MedStar, developed a policy stating the use of any tobacco product while in their vehicles, on any scene in public view, or while in no smoking areas, was prohibited (National EMS Safety Council [NEMSSC], 2017). Some agencies have a simple policy of no-smoking while in the work vehicle or building, but do not specify restrictions in the surrounding areas. Additionally, the ability to monitor smoking habits within work vehicles and areas of employment is not addressed.

Across the U.S., it was difficult to find an emergency agency that did not implement no-smoking policies for employees while in their vehicle or within the department

workplace/building. To date, policies have not been universally extended to vaping and e-cigarette use. As these regulations are state and agency specific, few departments have taken to revising or incorporating no-vaping regulations into their policies. However, after a release by the U.S. Surgeon General in 2016 regarding the harmful chemicals released through e-cigarettes, 15 states, along with the District of Columbia, have added e-cigarettes to their smoke free laws (ALA, 2020); many other states and jurisdictions have not determined public-place vaping regulations.

Armed with this updated information, it would be expected that the use of e-cigarettes among First Responders within the confinements of emergency vehicle and workspace would be prohibited. While that may be the case, the highly nicotine dependent individual may find it difficult to refrain from smoking behavior while on the job. For example, Yingst, Veldheer, Hammett Hrabovsky, & Foulds (2017) found that of those who were restricted from vaping in non-smoking areas, 12% reported difficulty refraining from vaping. These respondents also exhibited a stronger dependence on their e-cigarettes, had stronger e-cigarette cravings, and were more likely to vape within the first 30 minutes of their day, compared to those who did not report difficulty refraining from e-cigarette use in non-smoking areas. Additional findings suggested that individuals who had recently just quit smoking cigarettes had greater difficulty refraining from vaping in areas in which it was prohibited.

Therefore, how do individuals who have difficulty refraining from vaping cope with their cravings? Research has found that individuals reported “stealth vaping”, the behavior of discreetly vaping in places where smoking is prohibited to circumvent smoking prohibitions (Brikmanis *et al.,* 2017; Coleman *et al.*, 2017; Yingst *et al.,* 2018). A simple Google search for

'stealth vaping' produced approximately 593,000 results, with the top suggestions linking to sites on "stealth and zero vaping: what it is and how to do it", "stealth vaping techniques", "the ultimate guide to stealth vaping", and "how to stealth vape like a boss". Additionally, looking at stealth vaping devices, Google obtained approximately 953,000 results on different vaping devices which look like everyday objects, such as USB ports, pens, lip balms, and palm size devices, all for the purpose of concealing the utilization of vaping. While stealth vaping is commonly discussed online, as is indicated by the number of search results found, research on these behaviors is limited. Brikmanis *et al.* (2017) found that the frequency of using ENDS to circumvent smoking bans was a significant predictor for regular vaping among young US adults. Results indicated that although smokers continued to smoke in areas where it was prohibited, they also engaged in vaping. Brikmanis *et al.* (2017) suggested this was indicative of a desire to avoid nicotine withdrawal, by using e-cigarettes to bypass smoking restrictions.

The prevalence of ENDS use by dual users in smoke-free locations among the general population appears to be a greater risk to individuals within the age range of 25-34 years (27.2%), although following closely are those between 35-44 years of age (23.5%). Dunbar *et al.*, (2020) found no significant difference between the rates of male (50.8%) and female (49.2%) stealth vapers. Surprisingly, individuals identifying as heterosexual were significantly more likely to stealth vape than those identifying within the LGBTQ+ communities (88.4% vs. 10.4% respectively). Those who were married (60.9%) had a higher rate of stealth vaping than those who were single (39.1%). Likewise, those with a college education had a significantly higher risk for stealth vapers than those with a high school diploma (53.0% vs 12.6%

respectively). Lastly, individuals with a higher household income were more likely to stealth vape compared to individuals with a lower household income (50.5% vs. 43.3% respectively).

In a related study, Yingst *et al.* (2018) found that approximately 64.3% of participants admitted to stealth vaping, with an additional 31% having a smaller device for that specific purpose. Among the prohibited areas, Yingst *et al.* (2018) found that individuals most commonly stealth vaped while at their workplace (46.85), bars/night clubs (42.1%), restaurants (37.7%), movies (35.4%), and other locations (33%). Additionally, the most commonly reported reason for stealth vaping was difficulty refraining from using the e-cigarette in no-smoking locations. Those who reported greater usage of e-cigarettes per day in the past 30 days and earlier times to first use in a day were most likely to engage in stealth vaping. Additionally, stealth vaping appeared to be preferred by young adults due to the ease and rapid ability to "hit" and conceal in any location (Peters, Meshack, Lin, Hill, & Abughosh, 2013).

II. Study Rationale and Justification

Despite the known health effects associated with ENDS, use of these products within the United States has continued to rise (Cantrell *et al.*, 2018; Kasza *et al,* 2017; Rass *et al.*, 2015). First Responders are a population at higher risk for using ENDS and/or dual use of cigarettes and ENDS. Demographically, First Responders tend to be male and Caucasian, falling between the age range of 25 – 44 years (Schafer, Sutter, & Gibbons, 2015), all risk factors for increased substance use including smoking. Psychologically, they are also at greater risk for

anxiety, depression, and PTSD, which increases their vulnerability to dependence on substances and addictive behaviors (Ansell *et al.*, 2008; SAMHSA, 2018). Adding to their vulnerability is the occupational stress they experience on a regular basis (SAMHSA, 2018; Schafer *et al*., 2015). Police and firefighters tend to have a higher likelihood of occupational injuries and missed workdays compared to the general population, and all First Responders are at higher risk for injuries from violent situations, over-exertion, and work-related fatalities (Schafer *et al*., 2015). Coupled with this increased susceptibility to stress and substance use, many First Responders are unmarried and/or lack the necessary social support outside of their work relationships (Koch, 2010) to manage these challenges.

While smoking is widely prohibited in the workplace within the U.S., particularly within the emergency field, restrictions on vaping in the workplace are much less specific. While vaping within the confines of an emergency vehicle (the First Responders' workplace) can create added stress and health risk to both the First Responders and their occupants, the patients, some smokers/vapers are unable to resist their craving and may engage in stealth smoking/vaping behaviors (Yingst *et al.*, 2017). Stealth smoking/vaping can create a greater risk for patients, as a majority of those utilizing emergency services tend to be in cardiac distress, which can be exacerbated by the effects of secondhand smoke and vapors (Beillon *et al.*, 2009; Hu *et al*., 2013).

Despite a substantial body of literature on the smoking and vaping behaviors of the general population, there is minimal research examining the rates of vaping and vaping habits among First Responders. Little is known about the impact of psychosocial and occupational stress variables on their vaping behaviors. Additionally, as research is minimal regarding stealth

vaping, the importance of determining such actions within workplace vehicles and in the context of delivering emergency services is paramount. This study will aim to examine the rates of vaping and vaping patterns among First Responders and the factors that impact their decision to vape. Additionally, we will examine rates of stealth vaping/smoking and how often First Responders use e-cigarettes/smoke within their emergency vehicles and while individuals are under their care. This information will inform interventions for First Responders who are at risk, as well as promote bans and regulations regarding vaping/smoking. From a public health perspective, it is important to promote positive health behaviors in First Responders and ensure patient safety while in the care of First Responders.

III. Aims and Hypotheses

Objective 1: To describe past and current rates of vaping, use of combustible cigarettes, and dual products (concurrent vaping and combustible cigarettes) among First Responders.

Hypothesis 1.1: First Responders will have higher rates of vaping, smoking, and dual use than the general population.

Objective 2: To describe rates and patterns of stealth vaping/smoking, the discreet utilization of vaping/smoking in prohibited areas, with and without patients/individuals under their care present, among First Responders.

Hypothesis 2.1: First Responders will engage in stealth vaping, smoking, and/or dual use at higher rates than the general population in the workplace.

Hypothesis 2.2: First Responders will engage in stealth vaping, while in their respective work vehicles, at rates higher than the general population in the workplace.

Hypothesis 2.3: First Responders will engage in stealth vaping, within the presence of patients/individuals under their care, at rates lower than the general population in the workplace.

Objective 3: To determine the factors associated with vaping and dual use among First Responders. Primary predictor variables to be examined include, but are not limited to demographic, psychosocial and tobacco-related variables, such as age, gender, stress level, health risk perceptions, and family and friends who vape.

Hypothesis 3.1. First Responders who are younger, male, unmarried, and less educated/lower SES will report higher rates of vaping and dual use (concurrent vaping and smoking).

Hypothesis 3.2. First Responders who report greater levels of stress, through years on the job and number of trauma-related calls, and lower health risk perceptions, will report higher rates of vaping and dual product use.

Hypothesis 3.3. First Responders who reside with other smokers/vapers, who have friends and family who vape/smoke, and who do not have children living in the home, will report higher rates of vaping and dual product use.

IV. Methods

Participants and Recruitment:

Participants selected for this study were ≥18years of age, able to read English fluently, and previously worked or were currently working as law enforcement, firefighters, and/or

emergency medical technicians/paramedics. Participants were recruited through the internet via requests for voluntary participation in an anonymous questionnaire. Additionally, individual departments were contacted to request the survey be distributed to its members, across the United States. Prior to the start of the recruitment process, approval was obtained from the Florida Institute of Technology Review Board. Each participant was asked to provide informed consent prior to data collection.

Methods and Procedures:

Participants were asked to complete an anonymous online survey regarding their vaping/smoking habits through an attached link on the recruitment letter. The online survey took approximately 15-20 minutes to complete. Survey information was distributed via the internet by means of applications like Facebook, Instagram, and email using the Qualtrics software program. Informed consent was obtained on the first page, prior to participants beginning the survey. No names or places of employment were collected. Participants were able to respond or decline to answer any question and were able to return to previous questions through a "back" button, and to withdraw from the survey at any time. All information collected was entered in a HIPAA compliant database and all personal information collected was de-identified. Participants who completed the survey were provided the option of entering a drawing to win a $100 gift card.

Outcome Measures

This study utilized an online questionnaire that was developed for the purpose of this study. The survey consisted of 60 questions regarding demographics, employment, stress index,

smoking and vaping status and history, as well as the occurrence of any vaping/smoking without the employer's knowledge or consent ("stealth vaping/stealth smoking"). Core components of the survey included (see Appendix A):

Demographics: Demographic characteristics collected included age, gender, ethnicity/race, relationship status, income, education level, number of children living in the home, and residential location including state of residence within the U.S.A.

Employment: Participants were questioned regarding current or past employment to identify those who work within the first responder area of law enforcement/firefighter, and/ or EMT/ paramedics. Additionally, participants were asked about their length of time within the field and the number of especially stressful experiences encountered within their careers.

Stress Index: Participants were asked about negative experiences they have encountered while at work, as well as general questions regarding prior and current mental health diagnoses. Stress index questions have been adapted from the Operational Police Stress Questionnaire (PSQ-Op) survey by McCreary and Thompson (2006). The PSQ-Op was developed specifically for police officers with a focus on field specific stressors. Due to the nature of this survey, questions were adapted in order to accommodate all those in the first responder field, including firefighters and emergency medical personnel. Seventeen stress related experiences were listed, divided into three questions (five, six, and six experiences in the three questions respectively), and participants were asked to select all that apply. A stress score ranging from 0-17 was computed based off of the number of experiences selected within these three questions. A total stress index score was then computed utilizing the stress score (0 – 17),

endorsements of mental health conditions (0 - 7), years on the job (1 – 5), the perceived effects of COVID-19 and recent events (i.e., riots and protests) on smoking and vaping behaviors (0 - 12), as well as the endorsement of utilizing smoking and ENDS products to reduce feelings of stress (0 - 4). A total stress index score ranging from 1 – 45 was computed, with higher stress scores indicating greater levels of felt distress.

Perceptions of Health Risks Associated with ENDS: Participants were asked about their perceptions of harm associated with ENDS, the use of ENDS as an aid to smoking cessation, whether they perceived ENDS use as harmful to others around them, and whether they perceived exposure to vapors from ENDS harmful to those in their care (i.e., present in their work vehicles). Items were adapted from the co-investigator's previous research (Tyc, Lensing, Vukadinovich, & Hovell, 2013) for the current study. Items were rated on a 4-point scale ranging from "Strongly Disagree" to "Strongly Agree" or a 3-point scale with options of "less harmful," "as harmful", or "more harmful." A health risk perception score ranging from 10 to 38 was computed. Higher scores were indicative of a lower perception of risk from vaping behaviors, while lower scores indicated a higher perception of risk from vaping. Additionally, participants were asked two questions regarding their perceptions of ENDS use in relation to smoking cessation.

Smoking Status and History: Participants were asked about their current and past cigarette use. "Ever smokers" were considered those who had smoked at least 100 cigarettes in their lifetime but who reported no smoking at the time of the survey (USDHHS, 2016). "Never smokers" were those individuals who denied current smoking and who have smoked less than 100 cigarettes in their lifetime. "Current smokers" included those who reported smoking at

least 100 cigarettes in their lifetime and reported current use of cigarettes "everyday" or "some days" at the time of the survey. Participants were also asked about the cigarette smoking behaviors by their partner/spouse recorded as Yes, No, or N/A (no spouse). They were also questioned about the number of smokers who resided in their home, and about the number of close friends who smoked categorized into "none, 1-2, and 3 or more smokers."

Vaping Status and History: Participants were asked about their current and past vaping habits. "Never ENDS users" were those individuals who denied ever vaping any ENDS products in their lifetime. "Ever ENDS users" were those who reported using ENDS products at least once in their lifetime but denied using them within the previous 30 days. "Current ENDS users" were those who reported using any ENDS products at least once in their lifetime and within the previous 30 days. Participants were asked about their partner's/spouse's use of ENDS products, with responses coded as "Yes, No, or N/A (no spouse)". They were also asked about the number of vapers who resided in their home, and about the number of close friends who vaped listed as "None, 1-2, or 3 or more vaping friends." Participants reporting use of ENDS products were asked about nicotine and other products used within their device, and age of first use.

Stealth Vaping/Smoking: Participants were asked about the rules, regulations, and policies regarding vaping/smoking-- both while working and while in their vehicles used while on their job, and the extent of their adherence to those rules and policies.

Research Design and Data Collection

This study utilized a cross-sectional design. Data was collected via an online survey, which was published through the Qualtrics software program. The survey was available through

the Florida Institute of Technology's partnership with Qualtrics and was maintained on the Qualtrics website. All data was analyzed using the Statistical Package for the Social Sciences (SPSS), version 25.0. All analyses were considered significant at the $p < .05$ level.

Results

Participants: A total of 949 participants were involved in this study. Of these participants, 910 agreed to participate, while the remaining 38 declined participation. From those who agreed to participate, one participant was under the age of 18, seven were not First Responders, and 39 did not reside within the United States; 107 participants were removed from the sample due to a lack of sufficient number of survey responses completed. The final sample consisted of 757 participants (M_{age} = 33.59, *SD* =10.90, age range: 18-74), including 359 (47.5%) men, 395 (52.2%) women, one (0.1%) individual who identified as transgender, one (0.1%) individual who identified as gender fluid, and one individual who did not identify a gender. Most participants identified as White/Caucasian (*n* = 706, 93.6%) and Non-Hispanic/Latino (*n* = 708, 94.7%). Overall, most participants endorsed having a GED/technical degree/ or certificate (*n* = 222, 29.3%) or an associate degree (*n* = 198, 20.9%) as their highest level of education. The majority of participants endorsed being single (*n* = 341; 45.2%) or married (*n* = 338; 44.8%). Most participants endorsed living with their partner (*n*= 455, 60.1%), while 204 (26.9%) denied having a partner. Most participants denied having children (n= 439, 58.0%) in their home, while 31.4% (*n*= 238) reported having 1-2 children in the home, and 10.6% (*n*= 80) reported having 3 or more children in the home. In the total sample, 21.1% (*n* = 160) endorsed having at least one member in their home who smoked and 21.2% (*n* = 161) endorsed having at least one member in their home who vaped. Additionally, 73.2% (*n* = 554)

of respondents endorsed having at least one friend who smoked cigarettes and 76.2% (*n* = 577) of respondents endorsed having at least one friend who vaped. For further demographic and psychosocial details, see Table 1 and Table 2, respectively.

Hypothesis 1

Hypothesis 1.1: First Responders will have higher rates of vaping, smoking, and dual use than the general population.

The proportion of First Responders in this study who endorsed being current vapers, current smokers, and current dual users were compared to the rates of smoking, vaping, and dual use among adults in the general population as based on recent national surveys and studies. In the current study, 31% (*n* = 234) of First Responders were current vapers, 22.2% (*n* = 168) were current smokers, and 11% (*n* = 83) were dual users (concurrent smokers and vapers). Almost 58% (*n* = 435) reported having utilized ENDS products in the past and 50.3% (*n* = 380) reported past cigarette use (Table 1).

Results of a Chi square goodness of fit test demonstrated rates of current cigarette use among First Responders (22.2%) were significantly higher than that of the general population using rates determined from the National Health Interview Survey (CDC, 2019), $\chi 2(1, N = 757) = 42.20$, $p < .001$, in which 14% of adults in the general population were current smokers. According to the National Health Interview Survey (CDC, 2018), 3.2% of adults in the general population were current vapers. Results of a Chi Square goodness of fit test indicated that First Responders had a significantly higher rate of vaping (31%), $\chi 2(1, N = 757) = 1881.18$, $p < .001$ than that of the general population. Based on the 2017 Behavioral Risk Factor Surveillance

System data (Kava et al., 2020), 2% of adults in the general population were current dual users. Results from a Chi square goodness of fit test indicated First Responders had a significantly higher rate of dual use (11%), $\chi 2(1, N = 757) = 310.37$, $p < .001$ than the general population.

Hypothesis 2

Hypothesis 2.1: First Responders will engage in stealth vaping, smoking, and/or dual use at higher rates than the general population in the workplace.

Hypothesis 2.2: First Responders will engage in stealth vaping, while in their respective work vehicles, at rates higher than the general population in the workplace.

Stealth vaping/smoking was coded for those who endorsed vaping/smoking in areas which prohibited them from doing so. Stealth vapers and smokers included those participants who reported adherence to their workplace rules some of the time (versus those who endorsed adhering to workplace rules all of the time) in either their work vehicle or workplace. Individuals who reported no workplace rules were not included within the total stealth vaping/smoking outcomes. In this study, 23.0% (*n* = 174) and 72.4% (*n* = 548) of First Responders reported vaping was prohibited by anyone, anywhere, or at any time in the workplace and work vehicle (respectively), while 55.4% (*n* = 419) and 8.2% (*n* = 62) reported vaping was allowed in certain locations, times, or designated areas within the workplace and work vehicle, respectively. An additional 7.4% (*n* = 56) and 3.5% (*n* = 26) of participants reported having no rules regarding vaping in the workplace and work vehicle (respectively), while 11.8% (*n* = 89) and 13.7% (*n* = 101) reported uncertainty regarding rules for vaping in the workplace and work vehicles, respectively. Of those who endorsed vaping, 38.0% (*n* = 143)

endorsed non-adherence to workplace rules some of the time, while 31.0% (*n* = 117) endorsed non-adherence to work vehicle rules some of the time.

Chi square goodness of fit tests were conducted to compare the rates of stealth vaping and smoking in the study sample to rates reported in the general population. Results of the current study found that 38.0% (*n* = 143) of First Responders who endorsed ENDS use reported non-adherence to ENDS rules within their workplace some of the time (i.e., stealth vapers), compared to the 56.9% (*n* = 214) of ENDS users who endorsed adhering to workplace rules all of the time, and 5.1% (*n*= 19) of ENDS users who reported no ENDS rules within their workplace. Looking at work vehicle adherence, 31.0% (*n* = 117) reported non-adherence to ENDS rules within their work vehicle, some of the time, compared to 64.3% (*n* = 243) who endorsed adhering to work vehicle rules all the time, and 4.8% (*n*= 18) who reported no workplace rules regarding ENDS use in their work vehicle. In a study conducted by Yingst *et al.* (2018), 46.8% of adults in the general population admitted to stealth vaping behaviors in the workplace. Results of a Chi square goodness of fit test indicated First Responders were significantly less likely to stealth vape in their workplace, $\chi 2(1, N = 357) = 6.91$, $p < .05$, and work vehicle, $\chi 2(1, N = 360) = 30.39$, $p < .001$, when compared to stealth vaping rates of the general population.

In terms of stealth smoking behaviors, 15.5% (*n* = 43) of First Responders who endorsed smoking admitted non-adherence to workplace rules regarding smoking some of the time, compared to 83.0% (*n* = 230) of smokers who endorsed adhering to workplaces rules all the time, and 1.4% (*n* = 4) of smokers who endorsed no workplace smoking rules. Regarding work vehicles rules, 7.4% (*n* =20) of smokers reported non-adherence to smoking rules, some of the

time, while in their work vehicles, compared to the 92.3% (*n* = 251) of smokers who reported adherence to work vehicle rules, all the time, and 0.4% (*n* = 1) of smokers who reported no workplace rules for smoking in their work vehicles. Results of a Chi square goodness of fit test, comparing rates of stealth smoking among participants in the study sample to the rates of stealth vaping in the general population, showed First Responders were significantly less likely to stealth smoke within their workplace, $\chi2(1, N =273) = 107.02$, $p < .001$, and work vehicle, $\chi2(1, N =271) = 170.77$, $p < .001$ than those among the general population.

Hypothesis 3

Hypothesis 3.1. First Responders who are younger, male, unmarried, less educated and of lower SES will report higher rates of vaping and dual use (concurrent vaping and smoking).

For purposes of analyses, participants were categorized into groups of males vs. all other genders, younger (ages 18 – 35) vs. older (ages 36-74) participants, lower socioeconomic status ($0 - $59,000) vs. higher socioeconomic status ($60,000 - $120,00), single (single, divorced, or widowed) vs. married, and lower education level (GED/ High school diploma, or Technical/Certificate degree) - vs. higher education level (Associates degree – Doctoral degree).

Results of a Chi square test for independence (with Yates' Continuity Correction) showed no significant association between gender and vaping status, $\chi2(1) = 0.13$, $p >.05$. However, significant associations were found between vaping status and the other demographic variables assessed. Younger individuals in our sample were significantly more likely to be vapers than older individuals, $\chi2(1) = 22.54$, $p <.001$. Additionally, a significantly greater proportion of participants who were single were vapers compared to those who

reported being married, $\chi2(1) = 19.78$, $p < .001$. Similarly, participants who reported lower socioeconomic level and lower education level were significantly more likely to vape than those who endorsed higher socioeconomic status and higher educational levels, $\chi2(1) = 23.74$, $p < .001$ and $\chi2(1) = 18.69$, $p < .05$, respectively (see Table 1).

When examining the results of the Chi square test for independence for dual users, no significant association was found between gender and dual use, $\chi2(1) = .04$, $p > .05$ or between age and dual use, $\chi2(1) = .162$, $p > .05$. However, those who were single were significantly more likely to report dual use than married participants, $\chi2(1) = 5.11$, $p < .05$. Lastly, a significantly greater proportion of participants who reported lower socioeconomic status and lower education levels were dual users compared to those who reported higher socioeconomic status, $\chi2(1) = 4.37$, $p < .05$ and higher education levels, $\chi2(1) = .7.42$, $p < .05$, respectively.

Hypothesis 3.2. First Responders who report greater levels of stress, through years on the job and number of trauma-related calls, and lower health risk perceptions, will report higher rates of vaping and dual product use.

To investigate the relationship between stress level, (M = 15.48, SD = 6.34; Range: 0 - 45), health risk perceptions ($M = 26.62$, $SD = 3.94$; range: 10-38) and vaping/dual use, a median split was conducted to categorize participants into groups based on their stress and health risk perception scores. Total levels of stress were determined based on the individual's endorsement of experienced stress on the job, endorsement of a mental health diagnosis and the number of diagnoses, number of years employed, reported cigarette and vaping response to COVID-19 and recent events of riots and protests, as well as endorsement of utilization of

cigarettes and ENDS products due to stress. Participants in the Low Stress group had scores of 0-15 on the Stress Index outcome and those in the High Stress group had scores of 16 – 45 on this outcome. Total health risk scores were determined based on an individual's endorsement of perception of risk of ENDS use. Individuals with higher scores had lower health risk perceptions associated with ENDS. Participants in the High Health Risk Perceptions group had scores of 10-23 and those in the Low Health Risk Perceptions group had scores of 24-38 on this outcome.

Results from Chi square tests for independence (with Yates' Continuity Correction) showed a significant association between stress level and vaping status/dual use. Responders who reported higher levels of stress were significantly more likely to vape and dual use than those with lower stress levels, $\chi^2(1) = 49.17$, $p < .001$ and $\chi^2(1) = 29.98$, $p < .001$, respectively. Similarly, responders who endorsed lower perceived health risks were significantly more likely to vape and dual use than those with higher perceived health risks, $\chi^2(1) = 108.70$, $p < .001$ and $\chi^2(1) = 30.17$, $p < .001$, respectively.

A one-way between-groups analysis of variance (ANOVA) analysis was utilized to compare the mean health risk perception scores and mean total stress scores between current vapers, current smokers, current dual users, and those who denied past or recent ENDS or cigarette use (within the last 30 days). Results indicated significant differences in health risk perceptions, $F(3, 756) = 59.57$, $p < .001$, depending on smoking and vaping status. Post hoc comparisons using the Tukey HSD test showed significant differences in health risk perceptions between participants who reported never or past use of ENDS and cigarettes ($M = 26.62$, $SD = 3.94$), compared to those who reported current smoking ($M = 28.24$, $SD = 3.97$), vaping ($M =$

31.65, *SD* = 3.61), and dual use (*M* = 31.71, *SD* = 3.63) with those who have not used ENDS or cigarettes endorsing higher health risk perceptions. First Responders who were current vapers and dual users endorsed lower health risk perceptions compared to those who currently smoked. However, no significant difference was found between current vapers and dual users regarding health risk perceptions. With respect to perceptions of ENDS as a smoking cessation tool, 69.5% of First Responders endorsed that they "Strongly Agreed" or "Agreed" that e-cigarettes could help them and others quit smoking. Similarly, 78.3% of participants "Strongly Agreed" or "Agreed" that e-cigarettes could help them and others reduce the number of cigarettes smoked.

Results from a one-way between-groups ANOVA showed a significant difference in total stress levels for the groups defined by their smoking and vaping status, $F(3, 753) = 53.91$, $p < .001$. Post hoc comparisons using the Tukey HSD test indicated that the mean stress scores for those who reported never or past use (*M* = 13.29, *SD* = 5.05), were significantly lower compared to those who reported current vaping (*M* = 17.87, *SD* = 6.83), current smoking (*M* = 17.91, *SD* = 5.92), and dual use (*M* = 20.25, *SD* = 6.90). Participants who reported dual use, endorsed higher total stress levels compared to current smokers and vapers. Interestingly, no significant difference was seen in total stress levels between current smokers and vapers.

Examining the different levels of vaping behaviors, results of an ANOVA indicated significant differences in health risk perception depending on the First Responder's frequency of vaping, $F(2, 753) = 87.07$, $p < .001$. Post hoc comparisons using the Tukey HSD test indicated that the mean scores for First Responders who reported vaping every day endorsed lower health risk perception (*M* = 32.46, *SD* = 3.54) compared to those who endorsed vaping

somedays (*M* = 30.04, *SD* = 3.19), and those who denied vaping within the last 30 days (*M* = 26.90, *SD* = 3.98). Additionally, First Responders who reported vaping only some days endorsed lower health risk perceptions than those who denied vaping within the last 30 days.

An ANOVA was also conducted to examine the difference in mean total stress scores depending on the frequency of vaping. ANOVA results indicated significant differences in frequency of ENDS use depending on level of stress, $F(2, 753) = 50.585$, $p < .001$. Post hoc comparisons using the Tukey HSD test indicated that the mean scores for First Responders who reported vaping every day (*M* = 19.03, *SD* = 6.77) and some days (*M* = 18.07, *SD* = 7.26), endorsed higher total stress levels compared to those who denied vaping within the last 30 days (*M* = 14.03, *SD* = 5.47). However, First Responders who reported daily vaping did not endorse significantly higher stress levels than those who reported vaping only on some days.

Hypothesis 3.3. First Responders who reside with other smokers/vapers, who have friends and family who vape/smoke, and who do not have children living in the home, will report higher rates of vaping and dual product use.

A Chi square test for independence (with Yates' continuity correction) was conducted to determine if there was an association between psychosocial variables and vaping. Results indicated that First Responders who endorsed current ENDS use were significantly more likely to report residing with individuals who smoked, $\chi^2(1) = 4.47$, $p < .05$ and vaped, $\chi^2(1) = 161.468$, $p < .001$, as well as having more friends who vaped $\chi^2(1) = 60.14$, $p < .001$ compared to non-vapers. There was no significant association between current ENDS use and whether or not

children lived in their homes, $\chi^2(1) = 1.11$, $p > .05$ or having friends who smoked, $\chi^2(1) = 3.84$, $p > .05$ compared to those who did not endorse current ENDS use.

Results of a Chi square of independence (with Yates' continuity correction) indicated that First Responders who endorsed dual use of vaping and tobacco products were significantly more likely to report having friends who vaped, $\chi^2(1) = 13.08$, $p < .001$ and smoked, $\chi^2(1) = 9.53$, $p < .005$ than non-dual users. Additionally, dual users were significantly more likely to report residing with other smokers, $\chi^2(1) = 39.14$, $p < .001$ and vapers, $\chi^2(1) = 15.81$, $p < .001$ compared to non-dual users. Interestingly, no significant association was observed between dual use and having children in the home, $\chi^2(1) = .000$, $p > .05$.

Results of a Chi square of independence (with Yates' continuity correction) indicated that First Responders who endorsed current smoking behaviors were significantly more likely to report residing with other smokers, $\chi^2(1) = 101.35$, $p < .001$, having friends who smoked, $\chi^2(1) = 38.81$, $p < .001$, and having friends who vaped, $\chi^2(1) = 4.61$, $p < .05$ compared to non-smokers. No significant difference was found regarding the presence of children in the home, $\chi^2(1) = .12$, $p > .05$ and having other residents in the home who vaped $\chi^2(1) = 1.14$, $p > .05$., when comparing smokers to non-smokers. For additional comparisons of current vapers, current smokers, and dual users across psychosocial variables, see Table 2.

Discussion

Over the past few years, a significant number of studies have documented the negative health effects associated with ENDS and cigarette use. Despite this, the rate of ENDS utilization has continued to rise across the United States (Cantrell *et al.*, 2018; Kasza *et al,* 2017; Rass *et*

al., 2015). However, little is known about the rates and effects of vaping among First Responders. First Responders are a population that is at a higher risk for ENDS, cigarette, and/or dual use, as they encounter a significant level of occupational stress, tend to be male, single, and are at a greater vulnerability for mental health diagnoses -- all risk factors for increased substance use, including smoking (Ansell *et al.*, 2008; SAMHSA, 2018; and Schafer, Sutter, & Gibbons, 2015). Results from our current study found that 31% of First Responders currently vaped, 22.2% were current smokers, and 11% were current dual users. These rates are all significantly higher than those reported in the general population (CDC, 2018; CDC, 2019; and Kava et al., 2020). These rates support the need for targeted interventions that prevent and reduce vaping among First Responders.

This study also examined the rate of stealth vaping and smoking, the act of vaping or smoking in areas in which these behaviors are prohibited. Research by Yingst *et. al.* (2018) indicated that 46.8% of the general population engaged in stealth vaping within their workplace. For First Responders, their workplace often includes the building in which they start and end a shift, the location in which they might take a break, as well as the vehicle they tend to spend a significant amount of time within (ambulance, patrol car, or fire truck). Of those who endorsed vaping in our sample, 38.0% endorsed stealth vaping, or non-adherence to the workplace rules some of the time and 31.0% endorsed stealth vaping within their work vehicles. Of First Responders who engaged in smoking behaviors, 15.5% engaged in stealth smoking within their workplace and 7.4% smoked in their work vehicles. These findings indicate that First Responders were less likely than the general population to engage in stealth vaping and smoking within their workplace and work vehicles. However, a significant percentage of First

Responders engaged in stealth vaping or smoking, even when the consequences can be detrimental. First Responders are often surrounded by patients who are ill or injured and many may experience negative side effects from secondhand vapers and smoke. Of note is that only 23.0% of First Responders reported that vaping was prohibited by anyone, anywhere, or at any time in the workplace, while 55.4% and 8.2% reported vaping was allowed in certain locations, at certain times, or in designated areas within the workplace and work vehicle, respectively. Additionally, 7.4% and 3.5% of First Responders reported that their agency had no rules about vaping in the workplace or work vehicle, respectively, while 11.8% and 13.7% reported uncertainty regarding workplace and work vehicle restrictions for vaping. Collectively, these results highlight the importance of education and training about the health effects of vaping and secondhand vapors to First Responders as well as stricter implementation of guidelines and regulations regarding ENDS use within their workplace and vehicles.

Stress levels among First Responders were examined in this study by assessing felt occupational distress, presence of and number of mental health diagnoses, number of years on the job, as well as their report of vaping and cigarette response to COVID-19 and other recent environmental events. Results indicated a significant association between stress levels and vaping and dual use status among First Responders; those who reported greater overall stress levels were more likely to be vapers and dual users. Additionally, those who denied ENDS use within the last 30-days, reported significantly lower stress levels compared to those who reported current vaping, smoking, and dual use. First Responders who endorsed dual use also endorsed higher total stress levels compared to current smokers and vapers, although no significant differences in total stress were reported between current vapers and smokers.

Results further indicated that First Responders who reported everyday use or some days of vaping endorsed a significantly higher level of stress compared to those who denied vaping within the last 30-days. Together, these results suggest that First Responders may be candidates for stress management programs that may involve relaxation training, cognitive restructuring strategies, or other activities for managing stress without tobacco or e-cigarettes.

The significantly high rates of vaping and dual use in this study may reflect First Responders' perceptions of health risks associated with vaping. Overall, First Responders endorsed moderate health risk perceptions, although current vapers and dual users reported lower health risk perceptions than current smokers. First Responders who associated less risk with vaping and viewed vaping as a safer alternative to smoking were more likely to vape. In fact, 69.5% of First Responders perceived vaping as an effective method of smoking cessation. Additionally, First Responders who engaged in daily vaping behaviors reported lower health risk perceptions compared to those who vaped some days or denied use of ENDS within the last 30-days, suggesting that perceptions of risk may also influence frequency of vaping behaviors. Collectively, these results suggest that better health messaging may be warranted to inform First Responders about the health risks of vaping and its limitations as an effective method of smoking cessation. Behavioral and pharmacological interventions for tobacco cessation should also be made available by agencies and companies to First Responders and their family members who are ready to quit smoking/vaping.

In addition to stress and health perception levels, several significant demographic variables were identified to be associated with vaping among First Responders. Among these factors was age, with younger individuals (18-35 years) endorsing a higher rate of vaping then

those who were older. Further, individuals who were single (single, divorced, or widowed), were significantly more likely to endorse vaping habits and dual use compared to those who reported being married. Likewise, First Responders who reported lower socioeconomic status and lower educational levels were significantly more likely to endorse vaping habits and dual use compared to those with higher socioeconomic status and education levels. These risk factors are similar to those within the general population and indicate those First Responders who are at greatest risk for engaging in vaping and smoking and should be targeted for intervention.

Lastly, the relationship between psychosocial variables and vaping, smoking, and dual use was examined. Results indicated that First Responders who endorsed current ENDS use were significantly more likely to report residing with individuals who smoked and vaped, as well as having a significantly higher number of friends who vaped. Similarly, First Responders who engaged in dual use behaviors were more likely to report having friends who vaped and smoked. Dual users were also significantly more likely to report residing with other smokers and vapers, demonstrating the influence of the First Responders' social network on their smoking and vaping behaviors. As the First Responder community has a strong bond between its members, often leading to intimate social circles, and greater periods of time, during and out of work, spent together, it may be beneficial for First Responders to engage in peer-support groups. As a unique group, First Responders often can relate to the same stressors, experiences, and challenges that may impact their smoking and vaping as well other lifestyle behaviors. Therefore, peer-support groups or other behavioral interventions should address the issue of peer pressure and teach refusal skills (i.e., refusal of offers of cigarettes or e-cigarettes),

as well as offer positive coping skills, such as identifying alternative opportunities that allow for socialization around non-tobacco related activities, for maximum effectiveness.

Limitations and Directions for Future Research

This study addressed many of the gaps that are seen within the ENDS literature, specifically with regards to stealth vaping within the First Responder population, as few studies have been conducted on this topic. However, there were several limitations inherent in the current study. First, while self-reports of smoking have been shown to be valid, self-reported validity for vaping behaviors has yet to be determined (Wong, Shields, Leatherdale, Malaison, & Hammond, 2012). Additionally, First Responders may have been reluctant to disclose information they perceived to be harmful to themselves professionally, and in such their responses may be biased or under-reported, specifically regarding endorsement of stealth vaping behaviors. Future research may look to include less face-valid questions regarding stealth vaping and smoking behaviors. Another limitation of this study was its inclusion of only those individuals within the First Responder community of fire, police, and medical personnel; it did not include other groups who are often included in First Responder reports such as search and rescue team members. This may have resulted in rates of smoking/vaping outcomes that differed from those obtained in prior research which included these participant categories. Future studies can look to be more comprehensive in their participant inclusion.

Additionally, this study examined the rates of product use among all personnel within the First Responder categories, including not only career personnel, but those who volunteer their services; however, studies have shown no significant differences in smoking rates

between volunteer and employed First Responders (Haddock *et al.* 2011). Lastly, in examining stress levels, this study utilized perceived level of stress, as well as current environmental (COVID-19 and protests and riots) stress, which may have affected the relationship between current results and prior or future results. This study sets the stage for future research examining risk factors, stress, and health perceptions associated with vaping among those who are most vulnerable.

References

Agency for Toxic Substances and Disease Registry (ATSDR). (2007). *Acrolein*. Retrieved from https://www. atsdr.cdc.gov/toxfaqs/tfacts124.pdf

Alexander, D. A., & Klein, S. (2009). First responders after disasters: A review of stress reactions, at-risk, vulnerability, and resilience factors. *Prehospital and Disaster Medicine, 24,* 87–94. http://dx.doi.org/10 .1017/S1049023X00006610

Allen, G. J., Flanigan, S. S., LeBlanc, M., Vallarino, J., MacNaughton, P., Stewart, J. H., Christiani, C. (2016). Flavoring chemicals in e-cigarettes: Diacetyl, 2,3-pentanedione, and ccetoin in a sample of 51 products, including fruit-, candy-, and cocktail-flavored e-cigarettes. *Environmental Health Perspectives, 124*(6), 733-739. doi: 10.1289/ehp.1510185

Al-Yousef, A.N.M, Awada, W., & Michailidou, E. (2019). Fitness characteristics of Jordanian emergency medical technicians. *Advanced Journal of Emergency Medicine.* 3(4): e41. Doi: 10.22114/ajem.v0i0.160

American Lung Association. (2020). Smokefree air laws. *American Lung Association.* https://www.lung.org/policy-advocacy/tobacco/smokefree-environments/smokefree-air-laws

American Psychiatric Association. (2013). *Diagnostic and statistical manual of mental disorders: DSM–5* (5th ed.). Washington, DC: Author.

Ansell, E. B., Gu, P., Tuit, K., & Sinha, R. (2012). Effects of cumulative stress and impulsivity on smoking status. *Human Psychopharmacology,* 27(2); 200–208. http://dx.doi.org/10.1002/hup.1269

Avdija, A.S. (2013). Stress and law enforcement: testing the relationship between law enforcement work stress and health-related issues. *Health Psychology & Behavioral Medicine*. 2(1): 100-110. Doi:10.1080/21642850.2013.878657

Behar, R. Z., Luo, W. T., Lin, S. C., Wang, Y. H., Valle, J.,…&. Talbot., P. (2016). Distribution, quantification and toxicity of cinnamaldehyde in electronic cigarette refill fluids and aerosols. *Tobacco Control, 25*(2):ii94–ii102. doi: 10.1136/tobacco- control-2016-053224

Beillon, L.M., Suserud, B., Karlberg, I., & Herlitz, J. (2009). Does ambulance use differ between geographic areas? A survey of ambulance use in sparsely and densely populated areas. *American Journal of Emergency Medicine.* (27): 202-211. Doi: 10.1016/j.ajem.2008.01.012

Bekki, K., Uchiyama, S., Ohta, K., Inaba, Y., Nakagome, H., Kunugita, N. (2014). Carbonyl compounds generated from electronic cigarettes. *International Journal of Environmental Research and Public Health, 11*(11), 11192-11200. doi: 10.3390/ijerph111111192

Biggs, Q.M., Fullerton, C.S., Reeves, J.J., Grieger, T.A., Reissman, D., & Ursano, R.J. (2010). Acutue stress disorder, depression, and tobacco use in disatster workers following 9/11. *American Journal of Orthopsychiatry.* 80(4): 586-592. Doi: 10.1111/j.1939-0025.2010.0.1063.x

Bohac, D. L., Hewett, M. J., Kapphahn, K. I., Grimsrud, D. T., Apte, M. G., & Gundel, L. A. (2010). Change in indoor particle levels after a smoking ban in Minnesota bars and restaurants. *American Journal of Preventive Medicine, 39*(6), S3-S9. doi: 10.1016/j.amepre.2010.09.012

Brikmanis, K., Petersen, A., & Doran, N. (2017) E-cigarette, perceptions, and cigarettes smoking intentions in a community of young adults nondaily cigarette smokers. *Psychology of Addictive Behaviors*. 31(3) 336-342. Doi: 10.1037/adb0000257

Brose, L. S., Hitchman, S. C., Brown, J., West, R., & McNeill, A. (2015b). Is the use of electronic cigarettes while smoking associated with smoking cessation attempts, cessation and reduced cigarette consumption? A survey with a 1-year follow-up. *Addiction, 110*(7), 1160-1168. doi: 10.1111/add.12917

Brown, E.S. & Green, A.I. (2018) Tobacco use, medical illness, and service utilization. *Journal of Dual Diagnosis* 14(1). Doi: 10.1080/15504.263.2017.1406230

Bullen, C., Howe, C., Laugesen, M., McRobbie, H., Parag, V., William, J., & Walker, N. (2013). Electronic cigarettes for smoking cessation: a randomized controlled trial. *Lancet*. 382(9905): 1629-1637. Doi: 10.1016/S0140-6736(13)61842-5

Campaign for Tobacco Free Kids (2019). Smoke-free laws encourage smokers to quit and discourage youth from starting. *Tobacco Free Kids*. https://www.tobaccofreekids.org/assets/factsheets/0198.pdf

Cantrell, H., Huang, J., Greenberg., Willett, J., Hair, E., & Vallone, D. (2018). History and current trends in the electronic cigarette retail marketplace in the united states: 2010-2016. *Nicotine &Tobacco Research* 1-5. Doi: 10.1093/ntr/nty214

Carnevale, R., Sciarretta, S., Violi, F., Nocella, C., Loffredo, L., Perri, L.,…& Frati, G. (2016). Acute impact of tobacco vs electronic cigarette smoking on oxidative stress and vascular function. *Chest, 150*(3), 606-612. doi: 10.1016/j.chest.2016.04.012

Center for Disease Control and Prevention (2018). Current cigarette smoking among U.S. adults aged 18 years and older. *U.S. Department of Health and Human Services.* [Accessed March 11, 2020].

Center for Disease Control and Prevention (2019). Smoking and Tobacco Use – About electronic cigarettes (E-Cigarettes). *Office on Smoking and Health, National Center for Chronic Disease Prevention and Health Promotion*. [Accessed December 25th, 2019]

Center for Disease Control and Prevention. (2018). Smoking and Tobacco Use – Current cigarettes smoking among adults in the United States. *Office on Smoking and Health, National Center for Chronic Disease Prevention and Health Promotion.* [Accessed December 25th, 2019].

Coleman, B.N., Rostron, B., Johnson, S.E., Ambrose, B.K., Pearson, J., Stanton, C.A., Wang, B., Delnevo, C., Bansal-Travers, M., Kimmel, H.L., Goniewicz, M.L., Niaura, R., Abrams, D., Conway, K.P., Borek, N., Compton, W.M., & Hyland, A. (2017). Electronic cigarette use among US adults in the population assessment of tobacco and health (PATH) study, 2013-2014. *Tobacco Control* 26(E2): 117-126. 10.1136/tobaccocontrol-2016-053462

Cummins, S.E., Zhu, S., Tedeschi, G.J., Gamst, A.C., & Myers, M.G. (2014). Use of e-cigarettes by individuals with mental health conditions. *Tobacco Control*. 23(3):iii48 – iii53. Doi: 10.1136/tobaccocontrol-2013-051511

Czogala, J., Goniewicz, m.J., Fidelus, B., Zielinska-Danch, W., Travers, M.J., & Sobczak, A. (2014). Secondhand exposure to vapors from electronic cigarettes. *Nicotine & Tobacco Research* 16(6): 655-662. Doi: 101093/ntr/ntt203

Deloye, S.H., Brassard, P., Prairie, J., Larouche, D., Jauvin, N., Poirier, P., Tremblay, A. & Corbeil, P. (2015). Prevalence of risk factors for cardiovascular disease in paramedics. *International Archives of Occupational and Environmental Health.* 88(7). Doi:10.1007/s00420-015-1028-z

Dunbar, Z.R., Giovino, G., Wei, B., O'Connor, R.J., Goniewicz, M.L., & Travers, M.J. (2020). Use of electronic cigarettes in smoke-free spaces by smokers: results from the 2014-2015 population assessment on tobacco and health study. *Internation Journal od Environmental Research and Public Health* (17). Doi: 10.3390/ijerph17030978

Dvorsky, M.R. & Langberg, J.M. (2019) Cigarette and E-cigarette use and social perceptions over the transition to college: the role of ADHD symptoms. *Psychology of Addictive Behaviors*. 33(3): 318-330. Doi: 10.1037/adb0000450

First Responder Center for Excellence. Presumptive Legislation for firefighters Cancers: Occupational Cancer Legislation. https://www.firstrespondercenter.org/cancer/toolsresources/presumptive-legislation-firefighter-cancer-state/

Garner, N., Baker, J., & Hagelgans, D. (2016). The private traumas of first responders. The *Journal of Individual Psychology.* 72(3): 168-185.

General Services Administration (2008). Protecting Federal Employees and the public from exposure to tobacco smoke in the federal workplace. *Federal Register. The Daily Journal of the United States Government*. 73 FR 78360. https://www.federalregister.gov/documents/2008/12/22/E8-30377/protecting-federal-employees-and-the-public-from-exposure-to-tobacco-smoke-in-the-federal-workplace

Goniewicz, M.L., Smith, D.M., Edwards, K.C., Blount, B.C., Caldwell, K.L., Feng, J., Wang, L., Christensen, C., Ambrose, B., Borek, N., Bemmel, D.V., Konkel, K., Erives, G., Stanton, C.A., Lambert, E., Kimmel, H., Hatsukami, D., Hecht, S. S., Niaura, R.S., Travers, M., Lawrence, C., & Hyland, A.J. (2018). Comparison of nicotine and toxicant exposure in users of electronic cigarettes and combustible cigarettes. *JAMA Network- Public Health* 1(8): e185937. Doi: 10.1001/jamanetworkopen.2018.5937

Haddock, C.K., Jitnarin, N., Poston, W.S.C., Tuley, B., Jahnke, S.A. (2011). Tobacco use among firefighter in the central United States. *American Journal of Industrial Medicine 54(9): 697-706. Doi: 10.1000/ajim.20972*

Hajec, P., Phillips-Waller, A., Przulj, D., Pesola, F., Smith, K. M., Bisal, N.,…McRobbie, H. J. (2019). A randomized trial of e-cigarettes versus nicotine-replacement therapy. *New England Journal of Medicine, 380*, 629-637. doi: 10.1056/NEJMoa1808779

Hartley, J.M., Violanti,J.M., Sarkisian, K., Fekedulegn, D., Mnatsakanova, A., Andrew, M. E., & Burchfiel, C. M. (2014). Association between police-specific stressors and sleep quality: Influence of coping and depressive symptoms. *Journal of Law Enforcement Leadership Ethics* 1(1): 31-48.

Hartley, T.A., Burchfiel, C.M., Fekedulegn, D., Andrew, M.E., Violanti, J.M. (2011). Health Disparities in police officers: Comparisons to the U.S. general population. *International Journal of Emergency Mental Health*. 13(4): 221-220. Doi:

Hefner, K.R., Sollazzo, A., Mullaney, S., Coker, K.L., & Sofuolgu, M. (2019). E-cigarettes, alcohol use, and mental health: Use and perception of e-cigarettes among college students, by alcohol use and mental health status. Journal of *Addictive Behavior*. (91): 12-20. Doi:10.1016/j.addbeh.2018.10.040

Hu, N., Han, X., Lane, E.K., Gao, F., Zhang, Y., & Ren, J. (2013). Cardia-specific overexpression of metallothionein rescue against cigarette smoking exposure-induces myocardial contractile and mitochondrial damage. *PLoS ONE* 8(2): e57151. Doi: 10.1371/journal.pone.0027151

Huang, J., Kim, Y., Vera, L., & Emery, S. L. (2016). Electronic cigarettes among priority populations: Role of smoking cessation and tobacco control policies. *American journal of Preventative Medicine, 50*(2), 199-209. doi: 10.1016/j.amepre.2015.06.032

Jahnke, S.A., Haddock, C.K., Jitnarin, N., Kaipust, C.M., Hollerbach, B.S., & Poston, W.S.C., (2019). The prevalence and health impacts of frequent work discrimination and harassment among women firefighters in the US fire service. *BioMed Research International*. Doi: https://doi.org/10.1155/2019/6740207

Jahnke, S.A., Poston, W.S., Haddock, C.K., Jitnarin, N., Hyder, M.L., & Horvath, C. (2012). The health of women if the US fire service. *BMC Women's Health.* Doi: 10.1186/1472-6874-12-39

Jitnarin, N., Poston, W., Haddock, C.K., Jahnke, S.A., & Day, R.S. (2015). Tobacco use pattern among a national firefighter cohort. *Nicotine & Tobacco Research*. 17(1); 66-73. Doi: 10.1093/ntr/ntu131

Jitnarin, N., Poston, W.S.C., Haddock, C.K., & Jahnke, S.A. (2019) Tobacco use among women firefighters. *Women's Health Issues*. 29(5); 432-439. Doi: 10.1016/j.whi.2019.05.006

Kasza, K.A., Ambrose, B.K., Conway, K.P., Borek, N., Taylor, K., Goniewicz, M.L., Cummings, K.M., Sharma, E., Pearson, J.L., Green, V.R., Kaufman, A.R., Bansal- Travers, M., Travers, M.J., Kwan, J., Tworek, C., Cheng, Y.-C., Yang, L., Pharris- Ciurej, N., van Bemmel, D.M., Backinger, C.L., Compton, W.M., Hyland, A.J. (2017). Tobacco-product use by adults and youths in the United States in 2013 and 2014. The *New England Journal of Medicine* 376, 342–353. http://dx.doi.org/10.1056/NEJMsa1607538.

King, B. A., Patel, R., Nguyen, K. H., & Dube, S. R. (2015). Trends in awareness and use electronic cigarettes among US adults, 2010-2013. *Nicotine and Tobacco Research: Official Journal of the Society of Research on Nicotine and Tobacco,17*(2), 219-227. doi: 10.1093/ntr/ntu191

Kleim, B. & Westphal, M. (2011). Mental health in first responders: A review and recommendation for prevention and intervention strategies. *Traumatology.* 17(4): 17-24. Doi: 10.1177/1534765611429079.

Koch, B. (2010). The psychological impact on police officers of being first responders to completed suicides. *Journal of Police and Criminal Psychology,25,* 90–98. http://dx.doi.org/10.1007/s11896-010-9070-y

Kreiss, K., Gomaa, A., Kullman, G., Fedan, K., Simoes, E. J., & Enright, P. L. (2002). Clinical bronchiolitis obliterans in workers at a microwave-popcorn plant. *New England Journal of Medicine, 347*(5), 330-338. doi: 10.1056/NEJMoa020300

Kronenberg, M., Osofsky, H.J., Osofsky, J.D., Many, M., Hardy, M. &Arey, J. (2008). First responder culture: Implications for mental health professionals providing services following a natural disaster. *Psychiatric Annals.* 38(2): 114-118. Doi: 10.3928/00485713-20080201-05

Lanza, A., Roysircar, G., & Rodgers, S. (2018). First responder mental healthcare: Evidence-based prevention, postvention, and treatment. *Professional Psychology: Research and Practice, 49*(3), 193-204. Doi: http://dx.doi.org.portal.lib.fit.edu/10.1037/pro0000192

Law, M. L., & Wald, N. J. (2003). Environmental tobacco smoke and ischemic heart disease. *Progress in Cardiovascular Diseases*, (46) 31–38.

Malik, A., Chaudhry, A., Karamat, A., Arif, N., Cheema, M.A., Rauf, A. (2010). Cigarette smoking and health care professional at Mayo Hospital, Lahore, Pakistan. *Journal of the Pakistan Medical Association.*60(6): 509 -512.

Manzoli, L., Flacco, M. E., Fiore, M., La Vecchia, C., Marzuillo, C., Gualano, M. R., Liguori, G., Cicolini, G., Capasso, L., Boccia, S., Siliquini, R., Rociardi, M., & Villari, P. (2015). Electronic cigarettes efficacy and safety at 12 months: Cohort study. *PLoS One, 10*(6), 10129443. doi: 10.1371/journal.pone.0129443

Marin, H. A. & Diaz-Toro, E. C. (2011). Reduced exposure to secondhand smoke at casinos in Puerto Rico after the implementation of a workplace smoking ban in 2007: A pre-post design. Puerto Rico Health Sciences Journal, 30(4), 182-187.

McConnell, R., Barrington-Trimis, J. L., Wang, K., Urman, R., Hong, H., Unger, J.,…&Berhane, K. (2017). Electronic cigarette use and respiratory symptoms in adolescents. *American Journal of Respiratory and Critical Care Medicine, 195*(8), 1043-1049. Doi: 10.1164/rccm.201604-0804OC

McCreary, D.R., & Thompson, M.M. (2006). Development of two reliable and valid measures of stressors in policing: The Operational and Organizational Police Stress Questionnaires. *International Journal of Stress Management, 13*, 494-518.

McKee, S. A., Sinha, R., Weinberger, A. H., Sofuoglu, M., Harrison, E. L. R., Lavery, M., & Wanzer, J. (2011). Stress decreases the ability to resist smoking and potentiates smoking intensity and reward. *Journal of Psychopharmacology, 25,* 490 –502. http://dx.doi.org/10.1177/0269881110376694

Moheimani, R. S., Bhetraratana, M., Yin, F., Gombein, J., Araujo, J. A., & Middlekauff, H. R. (2017). Increased cardiac sympathetic activity and oxidative stress in habitual electronic cigarette users: Implications for cardiovascular risk. *JAMA Cardiology, 2*(3), 278-284. doi: 10.1001/jamacardio.2016.5303.

Moller, T.P., Erboll, A.K., Tolstrup, J.S., Ostergaard, D., Viereck, S., Overton, J., Folke, F., & Lippert, F. (2015). *Journal of Trauma, Resuscutation, and Emergency Medicide.*23(88). Doi: 10.1186/s13049-015-0169-0

National EMS Safety Council (NEMSSC). (2017). Guide for developing an EMS agency safety program. *National Association of Emergency Medical Technicians.* http://www.naemt.org/docs/default-source/ems-health-and-safety-documents/nemssc/ems-safety-program-guide-10-11-17.pdf

National Health Interview Survey. (2016). Percentage of adults who ever used an e-cigarette and percentage who currently use e-cigarettes, by age group. *Morbidity and Mortality Weekly Report*(66), 892. doi: 10.15585/mmwr.mm6633a6

National Institute for Occupational Safety and Health (NIOSH). (2016). *Exposures to flavoring chemicals: How and where exposures may occur*. Retrieved from https://www.cdc.gov/niosh/topics/ flavorings/exposure.html

National Institute of Mental Health. (2017). Post-traumatic stress disorder (PTSD). Retrieved from https://www.nimh.nih.gov/health/statistics/ post-traumatic-stress-disorder-ptsd.shtml

National Toxicology Program (NTP). (2007). *Study of glycidol in genetically modified haploinsufficient p16^{Ink4a}/p19^{Arf} mice*. Retrieved from https://ntp.niehs.nih.gov/ntp/htdocs/gmm_rpts/gmm13. pdf

New York State Department of Health. (2000). No smoking policy. *Bureau of Emergency Medical Services*. https://www.health.ny.gov/professionals/ems/policy/00-07.htm

Pang, R.D., Goldenson, N.I., Kirkpatrick, M., Barrington-Trimis, J.L., Cho, J., & Leventhal, A.M. (2020). Sex differences in the appeal of flavored E-cigarettes among young adult E-cigarette users. *Psychology of Addictive behaviors*. Doi: http://dx.doi.org/10.1037/adb0000548

Park, S.H., Lee, L., Shearston, J.A., & Weitzman, M. (2017). Patterns of electronic cigarette use and level of psychological distress. *PLOSone*: 12(3): e0173625. Doi:10.1371/journal.pone.0173625

Patel, R.R. & Schmidt, H. (2017). Should employers be permitted not to hire smokers? A review of US legal provisions. *International Journal of Health Policy and Management* 6(12); 701-706. Doi: 10.1517/ijhpm.2017.33

Pepper, J. K., & Brewer, N. T. (2013). Electronic nicotine delivery system (electronic cigarette) awareness, use, reactions and beliefs: A systematic review. *Tobacco Control*. 23(5): 375-384. doi:10.1136/tobaccocontrol-2013-051122

Pepper, J.K., Robisl, K.M., Emery, S.L., & Brewer, N.T. (2014). Reasons for starting and stopping electronic cigarette us. *International Journal of Environmental Research and Public Health* 11(10): 10345-10361/ Doi: 10.3390/ijerph111010345.

Peters RJ, Meshack A, Lin M-T, Hill M, & Abughosh S. (2013). The social norms and beliefs of teenage male electronic cigarette use. Journal of Ethn Substance Abuse. 12(4):300–307. doi:10.1080/15332640.2013.819310

Pirrallo, R.G., Levine, R., & Dickison, P.D. (2005). Behavioral health risks factors of united states emergency medical technicians: The LEADS project. *Prehospital and Disaster Medicine.*20(4): 235-242. Doi: 10.1017/S1049023X00002594

Pokherl, P., & Herzog, T.A. (2014). Reasons for quitting cigarette smoking and electronic cigarettes use for cessation help. *Psychology of Addictive Behaviors* 29(1); 114-121. Doi: http://dx.doi.org/10.1037/adb0000025

Poston, W.S.C., Haddock, C.K., Jitnarin, N., & Janhke, S.A. (2012). A national qualitative study of tobacco use among career firefightersd and department health personnel. *Nicotine and Tocacco Research.* 14(6): 734-741.

Ramakrishnan, J., Majgi, S.M., Premarajan, K.C., Lakshminarayanan, S., Thangaraji, T., & Chinnakali, P. (2013). High prevalence of cardiovascular risk factors among policemen in Puducherry, South Indian. *Journal of Cardiovascular Disease Research*. 4(2): 112-115. Doi: 10.1016/j.jcdr.2013.05/002

Rass, O., Pacek, L.R., Johnson, P.S., & Johnson, M.W. (2015). Characterizing use patterns and perceptions of relative harm in dual users pf electronic tobacco cigarettes. *Experimental and Clinical Psychopharmacology*. 23(6): 494-503.

Romijnders, K.A.G.J., Osch, L., Vries, H., & Reinskje, T. (2018). Perceptions and reasons regarding e-cigarette use among users and non-users: A narrative literature review. *International Journal of Environmental Research and Public Health.* 15(6): 1190. Doi: 10.3390.ijerph15061190.

Rose, J.E., Salley, A., Behm, F.M., Bates, J.E., & Westman, E.C. (2010). Reinforcing effects of nicotine and non-nicotine components of cigarette smoke. *Psychopharmacology*. 210(1): 1-12. Doi: 10.1007/s00213-010-1810-2

Rose, J.E., Salley, A., Behm, F.M., Bates., J.E., & Westman, E.C. (2010). Reinforcing effects of nicotine and non-nicotine components of cigarette smoke. *Psychopharmacology*, 210(1): 1-12. Doi: 10.1007/s00213-010-1810-2

Rush, J. W., Denniss, S. G., & Graham, G. A. (2005). Vascular nitric oxide and oxidative stress: determinants of endothelial adaptations to cardiovascular disease and to physical activity. *Canadian Journal of Applied Physiology, 30*(4), 442-474. doi: 10.1139/h05-133

Schafer, K., Sutter, R., & Gibbons, S. (2015). Characteristics of Individuals and Employment among first responders. *U.S. Department of Labor.*

Schoenborn, C. A., & Gindi, R. M, (2015). E-cigarette use among adults: United States, 2014. *NCHS Data Brief, 217*, 1-8.

Schulenberg, J. E., Johnston, L. D., O'Malley, P. M., Bachman, J. G., Miech, R. A. & Patrick, M. E. (2017). Monitoring the future national survey results on drug use, 1975–2016: Volume II, College students and adults ages 19–55. *Institute for Social Research, The University of Michigan.*

Sharapova, S. R., Singh, T., Agaku, I. T., Kennedy, S. M., & King, B. A. (2018). Patterns of e-cigarette use frequency – National adult tobacco survey, 2012-2014. *American Journal of Preventative Medicine, 54*(2), 284-288. doi: 10.1016/j.amepre.2017.09.015

Shi, Y., Pierce, J. P., White, M., Vijayaraghavan, M., Compton, W., Conway, K., Hartman, A.M, & Messer, K. (2017). E-cigarette use and smoking reduction or cessation in the 2010/2011 TUS-CPS longitudinal cohort. *BMC Public Health, 16*(1), 1105. doi: 10.1186/s12889-016-3770-x

Siegel, M.B., Tanwar, K.L., & Wood, K.S. (2011). Electronic cigarettes as a smoking-cessation tool results from an online survey. *American Journal of Preventive Medicine.* 40(4); 472-475. Doi: https://doi.org/10.1016/j.amepre.2010.12.006

Sinha, R. (2008). Chronic stress, drug use, and vulnerability to addiction. *Annals of the New York Academy of Sciences.* 1141: 105-130. Doi: 10.1196/annals.1441.030

Smith, D.R., Devine, S., Leggat, P.A., & Ishitake, T. (2005). Alcohol and tobacco consumption among police officers. *Kurume Medical* Journal. 52 (1-2); 63-5. Doi:10.2739/kurumemedj.52.63

Soneji, S., Barrington-Trimis, J. L., Wills, T. A., Leventhal, A. M., Unger, J. B., Gibson, L. A., Sargent, J. D. (2017). Association between initial use of e-cigarettes and subsequent cigarette smoking among adolescents and young adults: A systematic review and meta-analysis. *Journal of the American Medical Association Pediatrics, 171,* 788–797. http://dx.doi.org/10.1001/jamapediatrics.2017.1488

Spears, C.A., Jones, D.M., Weaver, S.R., Pechacek, T.F., & Eriksen, M.P. (2017). Use of electronic nicotine delivery systems among adults with mental health conditions, 2015. *International Journal of Environmental Research and Public Health*. 14(1): 10. Doi: 10.3390/ijerph14010010.

Spears, C.A., Jones, D.M., Weaver, S.R., Yang, B., Pechacek, T.F., & Eriksen, M.P. (2019). Electronic nicotine delivery systems (ENDS) use in relation to mental health conditions, past-month serious psychological distress, and cigarette smoking status, 2017. *Addition.* 114(2): 315-325. Doi: 10.1111/add.14464.

Stellman, S.D., Boffetta, P., &Garfinkel, L. (1988). Smoking habits of 800,000 American men and women in relation to their occupations. *American journal of Industrial Medicine*. 13; 43-58.

Substance Abuse and Mental Health Services Administration (SAMHSA). (2018) First responders: Behavioral health concerns, emergency response, and trauma. *Disaster Technical Assistance Center Supplement Research Bulletin.* May 2018.

Tan, A.S.L.., Rees, V.W., Rodgers, J., Agudile, E., Sokol, N.A., Yie, K., & Sanders-Jackson, A. (2018) Effects of exposure to anti-vaping public service announcements among current smokers and dual users of cigarettes and electronic nicotine delivery systems. *Drug and Alcohol Dependence.* 188; 251-258. Doi: 10.1016/j.drugalcdep.2018.04.013

Thornburg, J., Malloy, Q., Cho, S., Studabaker, W., & Lee, Y.O. (2015). Exhaled electronic cigarette emissions: What's your secondhand exposure? *RTI Press: Research Brief*. Doi: http://dx.doi.org/10.3768/rtipress.2015.rb.0008.1503

Trinity EMS, Inc. (2016) Policies & procedures handbook. *Trinity EMS*. https://trinityems.com/wp-content/uploads/2018/11/2018-Handbook-11-14-2018-PDF.pdf

Truth initiative, Inspiring tobacco-free lives (2019). E-Cigarettes: facts, stats, and regulation. [Accessed December 25, 2019]

Tyc, V. L., Lensing, S., Vukadinovich, C. M., & Hovell, M. F. (2013). Smoking restrictions in the homes of children with cancer. *American Journal of Health Behavior, 37*(4), 440-448. doi: 10.5993/AJHB.37.4.2

U.S. Department of Health and Human Services (USDHHS). (2016). *E-cigarette use among youth and young adults: A report of the surgeon general*. Atlanta, GA: U.S. Department of Health and Human Services, Centers for Disease Control and Prevention, National Center for Chronic Disease Prevention and Health Promotion, Office on Smoking and Health.

USDHHS. (2016). *E-cigarette use among youth and young adults: A report of the surgeon general*. Atlanta, GA: U.S. Department of Health and Human Services, Centers for Disease Control and Prevention, National Center for Chronic Disease Prevention and Health Promotion, Office on Smoking and Health.

Vardavas, C. I., Anagnostopoulos, N., Kougias, M., Evangelopoulou, V., Connolly, G. N., & Behrakis, P. K. (2012). Short-term pulmonary effects of using an electronic cigarette: impact on respiratory flow resistance, impedance, and exhaled nitric oxide. *Chest, 141*(6), 1400-1406. doi: 10.1378/chest.11-2443

Varughese, S., Teschke, K., Brauser, M., Chow, Y., van Netten, C., & Kennedy, S. M. (2005). Effects of theatrical smokes and fogs on respiratory health in the entertainment industry. *American Journal of Industrial Medicine, 47*(5), 411-418. doi: 10.1002/ajim.20151

Wang, L., Zhan, Y., Li, Q., Zeng, D. D., Leischow, S. J. (2015). An examination of electronic cigarette content on social media: Analysis of e-cigarette flavor content on reddit. *International Journal of Environmental Research and Public Health ,12*(11), 14916-14935. doi: 10.3390/ijerph121114916

Wieslander, G., Norback, D., & Lindgren, T. (2001). Experimental exposure to propylene glycol mist in aviation emergency training: Acute ocular and respiratory effects. *Occupational and Environmental Medicine, 58*(10):649–655. doi: 10.1136/oem.58.10.649

Wong, S.L., Shields, M., Leatherdale, S., Malaison, E., & Hammond, D. (2012). Assessment of validity of self-reported smoking status. *Health Reports* 23(1).

Yingst, J. M., Veldheer, S., Hammett, E., Hrabovsky, S., & Foulds, J. (2017). Should electronic cigarette use be covered by clean indoor air laws? *Tobacco Control, 26*(E1), e16-e18. doi: 10.1136/tobaccocontrol-2016-053074

Yingst, J.M., Lester, C., Veldheer, S., Allen, S., Du, Ping., & Foulds, J. (2018). E-cigarette users commonly stealth vape in places where e-cigarette use is prohibited. *Tobacco Control*. 28(5); 493-497. Doi: 10.1136/tobaccocontrol-2018-054432

Zhu, A., Zhuang, Y., Wong, S., & Cummins, S. E. (2017). E-cigarette use and associated changes in population smoking cessation: evidence from US current population surveys. *The British Medical Journal, 358*, j3262. Doi: https://doi.org/10.1136/bmj.j3262

Zhu, S.-H., Gamst, A., Lee, M., Cummins, S., Yin, L., & Zoref, L. (2013). The use and perception of electronic cigarettes and snus among the U.S. population. *PLoS One,* 8(10): e79332. doi:10.1371/journal.pone.0079332

Appendix A: Letter of Information and Informed Consent

Primary Investigator:

Shifra L. Gross, M.A., M.S

Department of Psychology, Florida Institute of Technology

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Co-Investigator:

Vida L. Tyc, PhD.

Department of Psychology, Florida Institute of Technology

Purpose of the Study

The purpose of this study is to learn more about vaping among First Responders - law enforcement, fire fighters, and emergency medical technicians (EMT)/ paramedics – and gain information about First Responders' perceptions and reasons for e-cigarette use. E-cigarettes are electronic smoking devices that do not involve burning tobacco, but instead produce an aerosol vapor that is inhaled. Whether you use or do not use e-cigarettes, we will ask you about your opinions and perceptions regarding e-cigarettes. Additionally, you will be asked about policies and regulations regarding vaping and e-cigarette use at your workplace and within your work vehicle. This information will help us determine rates for vaping behaviors among First Responders and patterns of use.

Eligibility

In order to participate, you must be 18 years of age or older, able to read and write English fluently, and have previously worked or currently work/volunteer as a Law Enforcement officer, Firefighter, and/or EMT/Paramedic.

Procedures of the Study

If you are eligible to participate in the study, you will be asked to complete an online survey. The survey will consist of questions regarding your past and current smoking and vaping behaviors, the rules and policies about smoking and vaping in your workplace and work vehicle, yourmedical and mental health history, as well as your experience working in your respective field. You will be able to adjust any of your responses by pressing the “Back” button to return to the previously completed page. We estimate that the questionnaire will take approximately 15-20 minutes to complete.

Compensation

At the end of the survey, you will be given the choice to provide your email address to be entered into a drawing to win one $100 gift card.

Potential Risks and Benefits

The risks of participating in this study are minimal and unlikely. However, you will be asked questions about your smoking and vaping behaviors as well as your field experience which you may find stressful. You may choose not to respond to any question that makes you

uncomfortable and are free to discontinue your participation at any point during the study. While unlikely, there is a risk of loss of privacy. We will keep your study information private and confidential and all data will be de-identified and kept in a database that only researchers have access to. There will be no direct benefits to you by taking part in this study. However, the information obtained from this study may be used to help other smokers and vapers in the future.

Discontinuation of the Study

Participation in this study is voluntary. You are under no obligation to participate in this study, and you are free to discontinue the study at any time without consequences to you. There is no penalty for not participating. You may refuse to answer any questions that we ask you. If you decide to withdraw from the study, the information provided by you will not be retained.

Confidentiality

All responses obtained from you will be kept confidential. No identifying information will be collected during this survey. All data collected will be entered into a HIPAA-compliant database and stored on a password-protected server located in the Department of Psychology at Florida Institute of Technology. Only authorized researchers will have access to this information.

Questions?

Any questions about study participation may be directed to Shifra L. Gross (Principal Investigator) at sisaacs2017@my.fit.edu.

This study has been reviewed and approved by the Institutional Review Board. If you have any ethical questions or concerns about the study, these may be directed to:

Dr. Jignya Patel, Chair for the Institutional Review Board

Institutional Review Board Office, School of Psychology

150 W University Blvd

Melbourne, Florida, 32901

(P): 321-674-8104

(E): jpatel@fit.edu

Consent

In order to keep your information confidential, your name or signature is not required. Please indicate your choice below. Should you choose to participate, you will be directed automatically to the survey.

- o I have read the information presented above about a study being conducted by Shifra L. Gross (Principal Investigator) of the School of Psychology at Florida Institute of Technology. I am 18 years or older, and I understand that I may withdraw from the study at any time. I agree to participate in this study.

- o I have read the information presented about this study and I do not wish to participate.

Appendix B: Survey Questions

Qualifying information:

1. Are you 18 years of age or older?
    - Yes
    - No
2. Do you currently or have you previously worked or volunteered as a First Responder (i.e., Law Enforcement, Firefighter, and/or Paramedic/Emergency Medical Technician [EMT])?
    - Yes
    - No

Demographics

3. What is your current age?
    - _____
4. What gender do you identify with?
    - Female
    - Male
    - Transwoman (MTF) Deg
    - Transman (FTM)
    - Gender Fluid
    - Other: _____
5. What is your race?
    - White/Caucasian

- Black/African American
- Asian
- American Indian/Alaskan Native
- Hawaiian Native/Other Pacific Islander
- Biracial/Multiracial
- Other: _____

6. What is your ethnicity?
    - Hispanic/Latino
    - Non-Hispanic/Latino
7. What state do you currently reside in?
    - _____
8. What is your current relationship status?
    - Single
    - Married
    - Divorced
    - Widowed
9. Are you currently living with your partner?
    - Yes
    - No
    - N/A (No spouse /partner)
10. How many children < 18 years of age are currently living in your home?
    - 0

- 1-2
- ≥3

11. What is your approximate individual total annual income (before taxes)?
    - $0-$19,000
    - $20,000-$39,000
    - $40,000-$59,000
    - $60,000-$79,000
    - $80,000-$99,000
    - $100,000-$119,000
    - $120,000 and over
12. What is your highest level of education completed?
    - I did not graduate high school
    - High school diploma
    - GED/ Technical Degree/Certificate
    - Associate Degree
    - Bachelor's Degree
    - Master's Degree
    - Doctoral Degree

Employment

13. In which of the following careers have you previously or currently work or volunteer?

    (*Please select all that apply)*.

- Law Enforcement
- Firefighter
- Paramedic/Emergency Medical Technician

14. What is your current occupational status?
    - Employed full-time
    - Employed part-time
    - Unemployed
    - On disability
    - Retired
15. How long have you worked/ volunteered as a First Responder?
    - < 1 year
    - 1-5 years
    - 5-10 years
    - > 10 years

Stress Index:

16. Please select *all that apply* related to your experience working/volunteering as a First Responder
    - I have felt as though different rules apply to different people (e.g., favoritism)
    - I have felt as though I have to prove myself to the organization
    - I have felt as though I lacked appropriate training
    - I have felt as though I lacked the resources to accomplish my duties
    - I have felt as though feedback from leaders focused on the negative

- I have felt a lack of understanding from family and friends about my work
- None apply to me

17. Please select *all that apply* related to your experience working/volunteering as a First Responder
    - I have taken on extra shifts due to staff shortages
    - I have felt distress over dealing with a supervisor
    - I have received negative comments from the public
    - I have spent more time at work than with my family or friends.
    - I have obtained occupational -related health issues (i.e., back pain, head injuries)
    - None apply to me
18. Please *select all that apply* related to your experience working/volunteering as a First Responder
    - I have been seriously injured
    - I have been present when a fellow colleague or partner was seriously injured or killed
    - I have received serious threats towards self or a loved one due to work as a First Responder
    - I have been threatened with a gun or other weapon while on the job
    - I have responded to a scene involving family, friend, or others known to the crew
    - I was diagnosed with a mental health condition as a consequence of my time as a First Responder (e.g., anxiety, depression, PTSD, acute stress disorder, etc.)
    - None apply to me

19. Have you ever been informed by a health professional that you have any of the following mental health conditions? (*Please select all that apply*).
    - Anxiety
    - Bipolar Disorder (including mania)
    - Depression (including dysthymia)
    - Obsessive Compulsive Disorder
    - Post-Traumatic Stress Disorder
    - Personality Disorder
    - Schizophrenia
    - Sleep disorder (e.g., insomnia)
    - Neurocognitive Disorder
    - Alcohol abuse
    - Drug abuse
    - Other: _____
    - I have not been informed of any mental health diagnoses

Smoking Status and History

20. Have you smoked at least 100 cigarettes in your entire life? (5 packs = 100 Cigarettes)
    - Yes
    - No
21. Have you smoked cigarettes <u>within the last 30 days</u>?
    - Every day
    - Some days

- Never

22. How many of individuals residing in your current home smoke cigarettes (excluding yourself)?
    - 0
    - 1-2
    - 3 or more
23. How many of your close friends currently smoke cigarettes?
    - 0
    - 1 - 2
    - 3 or more
24. Do you feel that your smoking habits have changed since/ due to the start of COVID-19?
    - No, my smoking habits have not changed since COVID-19
    - Yes, I started smoking cigarettes since the start of COVID-19
    - Yes, I smoke more since COVID-19
    - Yes, I smoke less since COVID-19
25. Do you feel that your smoking habits have changed since the start of recent events (i.e., riots and protests)?
    - No, my smoking habits have not changed since the start of recent events
    - Yes, I started smoking cigarettes since the start of recent events
    - Yes, I smoke more since the start of recent events
    - Yes, I smoke less since the start of recent events
26. Do you feel that you smoke to manage/cope with stress?

- Yes
- No
- N/A, I do not smoke

Vaping Status and History:

27. Have you ever used an electronic nicotine delivery system (ENDS) product including electronic cigarettes, e-cigarettes, e-cigs, vapes, vape pens, or electronic vapor product even once in your lifetime?
    - Yes
    - No
    - No, but I currently smoke cigarettes
28. Have you used an electronic nicotine delivery system (ENDS) product including electronic cigarettes, e-cigarettes, e-cigs, vapes, vape pens, or other electronic vapor product within the last 30 days?
    - Yes, Every day
    - Yes, Some days
    - No, I have not used any of these products in the last 30 days
29. How many individuals residing in your current home vape or use an electronic cigarette (excluding yourself)?
    - 0
    - 1-2
    - 3 or more
30. How many of your close friends currently vape/use electronic cigarettes?

- 0
- 1 or 2
- 3 or more

31. If you use or have ever used e-cigarettes/vapes, how old were you when you first tried e-cigarettes/vaped?
    - _____
    - N/A; I do not use or have ever used e-cigarettes/vapes
32. If you use or have ever used e-cigarettes/vapes, how much nicotine is typically in your e-liquid?
    - None, my e-cigarettes/vapes do not contain any nicotine
    - My e-cigarettes contain nicotine; Nicotine amount: _____
    - Not sure
    - N/A; I do not use or have ever used e-cigarettes/vapes
33. If you use or have ever used e-cigarettes/vapes, have you ever used an e-cigarette pen/vape to inhale other products, such as CBD oil?
    - Yes
    - No
    - N/A; I do not use or have ever used e-cigarettes/vapes
34. Do you feel your vaping habits/use of e-cigarettes have changed since/ due to the start of COVID-19?
    - No, my vaping habits have not changed since COVID-19
    - Yes, I started using e-cigarettes since the start of COVID-19

- Yes, I vape more since COVID-19
- Yes, I vape less since COVID-19

35. Do you feel your vaping habits/use of e-cigarettes have changed since the start of recent events (i.e. riots and protests)?
    - No, my vaping habits have not changed since the start of recent events
    - Yes, I started vaping/using e-cigarettes since the start of recent events
    - Yes, I vape more since the start of recent events
    - Yes, I vape less since the start of recent events
36. Do you feel that you vape/ use e-cigarettes to manage/cope with stress?
    - Yes
    - No
    - N/A, I do not vape or use e-cigarettes

Risk Perceptions Associated with ENDS use

Regardless of whether you vape or smoke. please complete the following items

37. Using e-cigarettes/electronic vapor products is harmful to one's health.
    - Strongly Agree
    - Agree
    - Disagree
    - Strongly Disagree
38. E-cigarettes/electronic vapor products are a safer alternative to combustible cigarettes.
    - Strongly Agree
    - Agree

- Disagree
- Strongly Disagree

39. Breathing vapors from e-cigarettes is less harmful than breathing cigarette smoke.

- Strongly Agree
- Agree
- Disagree
- Strongly Disagree

40. Using e-cigarettes/electronic vapor products around adults is harmful to their health.

- Strongly Agree
- Agree
- Disagree
- Strongly Disagree

41. Using e-cigarettes/electronic vapor products around infants/children is harmful to their health.

- Strongly Agree
- Agree
- Disagree
- Strongly Disagree

42. Inhaling vapor from e-cigarettes/electronic vapor products can harm the health of adults and children.

- Strongly Agree
- Agree

- Disagree
- Strongly Disagree

43. Breathing air in a room where people vaped yesterday can harm the health of adults and children.
    - Strongly Agree
    - Agree
    - Disagree
    - Strongly Disagree
44. Breathing air in a vehicle where people vaped can harm the health of adults and children.
    - Strongly Agree
    - Agree
    - Disagree
    - Strongly Disagree
45. Please choose one of the following that you believe is true: Use of e-cigarettes or electronic vapor products is:
    - Less harmful to the user than regular cigarettes
    - As harmful to the user as regular cigarettes
    - More harmful to the user than regular cigarettes

46. Please choose one of the following that you believe is true: Use of e-cigarettes or electronic vapor products around others is:

    - Less harmful to adults and children around the user than regular cigarettes
    - As harmful to adults and children around the user as regular cigarettes
    - More harmful to adults and children around the user than regular cigarettes

Smoking Cessation:

47. E-cigarettes/electronic vapor products could help me/others quit smoking regular cigarettes (i .e. are an effective method of smoking cessation).

    - Strongly Agree
    - Agree
    - Disagree
    - Strongly Disagree

48. E-cigarettes/electronic vapor products could help me/others reduce the number of cigarettes smoked.

    - Strongly Agree
    - Agree
    - Disagree
    - Strongly Disagree

Stealth Vaping:

49. Which best describes the rules regarding use of e-cigarettes/vaping in your workplace?

    - Vaping is forbidden by anyone, anywhere, or at any time at work

- Vaping is only allowed in some locations, at certain times, or in designated areas at work
- There are no rules about vaping; Vaping is allowed anywhere and at any time
- I am unsure what the vaping rules and policies are at my workplace

50. Which best describes the rules regarding use of e-cigarettes/vaping <u>in your work vehicle (patrol vehicle/firetruck/ambulance)</u>
    - Vaping is forbidden by anyone, anywhere, or at any time in the work vehicle
    - Vaping is permitted in the work vehicle only sometimes or in certain situations (i.e. when patients or non-employees are not present or when the windows are open and/or fans are on)
    - There are no rules about vaping; Vaping is allowed anywhere and at any time
    - I am unsure what the vaping rules and policies are in the work vehicle
51. Which best describes your adherence to your workplace rules about e-cigarettes/vaping <u>in the workplace</u>:
    - I adhere to all rules regarding e-cigarettes/vaping while in the workplace
    - I adhere to the rules regarding e-cigarettes/vaping some of the time or when others are around
    - There are no rules regarding e-cigarettes/vaping at my workplace
    - N/A; I do not use e-cigarettes or vape
52. Which best describes your adherence to your workplace rules about e-cigarettes/vaping <u>in your work vehicle</u>:
    - I adhere to all rules regarding e-cigarettes/vaping while in my work vehicle

- I adhere to the rules regarding e-cigarettes/vaping some of the time or when others are around
- There are no rules regarding e-cigarettes/vaping in the work vehicle
- N/A; I do not use e-cigarettes or vape

53. Do you use an e-cigarette/vape pen product <u>while at work?</u>

- Every day
- Some days
- Never
- N/A; I do not use e-cigarettes or vape

54. Do you use an e-cigarette/vape pen product <u>within your work vehicle?</u>

- Every day
- Somedays
- Never
- N/A; I do not use e-cigarettes or vape

Stealth Smoking:

55. Which best describes the rules about use of cigarettes <u>in your workplace</u>?

- Smoking is forbidden by anyone, anywhere, or at any time in the workplace
- Smoking is only allowed in some locations, at certain times, or in designated areas at work
- There are no rules about smoking; Smoking is allowed anywhere and at any time
- I am unsure what the smoking rules and policies are at my workplace

56. Which best describes the rules about use of cigarettes in the work vehicle (patrol vehicle/firetruck/ambulance)
    - Smoking is forbidden by anyone, anywhere, or at any time in the work vehicle
    - Smoking is permitted in the work vehicle only sometimes or in certain situations (i.e. when patients or non-employees are not present or when the windows are open and/or the fans are on)
    - There are no rules about smoking; Smoking is allowed anywhere and at any time
    - I am unsure what the smoking rules and policies are in the work vehicle
57. Which best describes your adherence to your workplace rules about use of cigarettes in the workplace:
    - I adhere to all rules regarding smoking while at the workplace
    - I adhere to the rules regarding smoking some of the time or when others are around
    - There are no rules regarding smoking at my workplace
    - N/A; I do not smoke
58. Which best describes your adherence to your workplace rules about use of cigarettes in your work vehicle:
    - I adhere to all rules regarding smoking while in my work vehicle
    - I adhere to rules regarding smoking some of the time or when others are around
    - There are no rules regarding smoking in the work vehicle
    - N/A; I do not smoke
59. Do you smoke cigarettes while at work?

- Every day
- Some days
- Never
- N/A; I do not smoke

60. Do you smoke cigarettes <u>within your work vehicle?</u>

- Every day
- Somedays
- Never
- N/A; I do not smoke

If you would like to be entered into a drawing to win one $100 gift card, please provide your email address below: _____

Table 1

Demographic Variables by Smoking/Vaping/ Dual Use Status

Variables	Total Sample (*N* = 757) *M (SD)*	Current Smokers (*N* = 168) *M (SD)*	Current Vapers (*N* = 234) *M (SD)*	Duals Users (*N* = 83) *M (SD)*	*F*
Age	33.59 (10.90)	34.59 (9.89)	29.73 (8.5)	31.91 (9.49)	
Risk Perception	26.62 (3.94)	28.24 (3.97)	31.65 (3.61)	31.71 (3.63)	59.56***
Felt/Perceived Stress	15.48 (6.34)	17.91 (5.92)	17.87 (6.83)	20.25 (6.90)	53.91***
	N (%)	*N (%)*	*N (%)*	*N (%)*	X^2
Gender					0.13
Male	359 (47.5%)	67 (40.1%)	108 (46.4%)	38 (46.3%)	
Female	397 (52.5%)	100 (59.9%)	125 (53.6%)	44 (53.7%)	
Race					566.74***
White/Caucasian	706 (93.6%)	157 (93.5%)	221 (94.4%)	77 (92.8%)	
Other	51 (6.7%)	11 (6.5%)	13 (5.6%)	6 (7.2%)	
Ethnicity					
Non-Hispanic/Latino	708 (94.7%)	158 (94.6%)	222 (96.5%)	80 (97.6%)	
Hispanic/Latino	40 (5.3%)	9 (5.4%)	8 (3.5%)	2 (2.4%)	
Income (Individual)					23.74***
$0 - $59,000	499 (66.3%)	122 (72.6%)	185 (79.1%)	64 (77.1%)	
$60,000 and higher	254 (33.7%)	46 (27.4%)	49 (20.9%)	19 (22.9%)	
Level of Education					1.27
Did not graduate high school, High School Diploma, GED/technical Degree/Certificate	363 (48.0%)	97 (57.7%)	140 (59.8%)	52 (62.7%)	
Associate Degree – Doctoral Degree	394 (52.0%)	71 (42.3%)	94 (40.2%)	31 (37.3%)	
Relationship Status[+]					19.78***
Single	341 (45.2%)	76 (45.2%)	132 (56.4%)	45 (54.2%)	
Married	338 (44.8%)	70 (41.7%)	76 (32.5%)	27 (32.5%)	
Divorced	72 (9.5%)	20 (11.9%)	25 (10.7%)	10 (12.0%)	
Widowed	4 (0.5%)	2 (1.2%)	1 (0.4%)	1 (1.2%)	
Occupation					
Law Enforcement	105 (13.9%)	15 (8.9%)	9 (3.8%)	2 (2.4%)	
Firefighters	268 (35.4%)	66 (39.9%)	73 (31.2%)	34 (41.0%)	

Paramedics/ Emergency Medical Technicians	659 (87.1%)	156 (92.9%)	218 (93.2%)	77 (92.8%)
Occupational Status				
Employed Full-Time	627 (82.9%)	143 (85.1%)	195 (83.3%)	71 (85.5%)
Employed Part-Time	84 (11.1%)	14 (8.3%)	28 (12.0%)	7 (8.4%)
Unemployed	22 (2.9%)	3 (1.8%)	7 (3.0%)	2 (2.4%)
On disability	12 (1.6%)	4 (2.4%)	3 (1.3%)	2 (2.4%)
Retired	11 (1.5%)	4 (2.4%)	1 (0.4%)	1 (1.2%)
Years Employed				
< 1 – 5 years	281 (37.2%)	51 (30.5%)	112 (47.9%)	35 (42.1)
5-10 years	208 (27.5%)	52 (31.2%)	75 (32.1%)	25 (30.2%)
> 10 years	267 (35.3%)	64 (38.3%)	47 (20.1%)	23 (27.7%)

* $p < .05$, ** $p < .01$ ***$p < .001$

[+]Chi square value for Relationship Status is based on a comparison of married vs. all others.

Table 2
Psychosocial Variables by Smoking/Vaping/ Dual Use Status

Variables	Total Sample (*N* = 757)	Current Smokers (*N* = 168)	Current Vapers (*N* = 234)	Duals Users (*N* = 83)	
	N (%)	*N (%)*	*N (%)*	*N (%)*	X^2
Do you live with your partner?					30.92***
Yes	455 (60.1%)	99 (58.9%)	126 (53.8%)	42 (50.6%)	
No	302 (39.9%)	69 (41.1%)	108 (46.2%)	41 (49.4%)	
Do children reside in your home?					19.34***
Yes	318 (42.0%)	73 (43.5%)	91 (38.9%)	35 (42.2%)	
No	439 (58.0%)	95 (56.5%)	143 (61.1%)	48 (57.8%)	
Do smokers (other than yourself) reside in your home?					252.27***
Yes	160 (21.1%)	83 (49.4%)	61 (26.1%)	40 (48.2%)	
No	597 (78.9%)	85 (50.6%)	173 (73.9%)	43 (51.8%)	
Do you have close friends who smoke?					162.75***
Yes	554 (73.2%)	155 (92.3%)	183 (78.2%)	73 (88.0%)	
No	203 (26.8%)	13 (7.7%)	51 (21.8%)	10 (12.0%)	
Smoking as a coping mechanism for Stress					141.25***
Yes	215 (28.4%)	146 (86.9%)	125 (53.4%)	74 (89.2%)	
No	542 (71.6%)	22 (13.1%)	109 (46.6%)	9 (10.8%)	
Do vapers (other than yourself) reside in your home?					252.27***
Yes	160 (21.1%)	41 (24.4%)	116 (49.6%)	32 (38.6%)	
No	597 (78.9%)	127 (75.6%)	118 (50.4%)	51 (61.4%)	

Do you have close friends who vape?					208.20***
Yes	577 (76.2%)	139 (82.7%)	221 (94.4%)	77 (92.8%)	
No	180 (23.8%)	29 (17.3%)	13 (5.6%)	6 (7.2%)	
Vaping as a coping mechanism for stress					151.81***
Yes	209 (27.6%)	69 (41.1%)	183 (78.2%)	60 (72.3%)	
No	548 (72.4%)	99 (58.9%)	51 (21.8%)	23 (27.7%)	

* $p < .05$, ** $p < .01$ ***$p < .001$

Note. All chi square comparisons are between current smokers, current vapers, and dual users