Policing and Cancer: The need for further research

by

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Abstract

It is becoming increasingly apparent that people who work in certain professions are more likely to develop cancer than other professionals – some examples being firefighters, farmers, auto workers, and hair dressers. The purpose of this paper is to inspire research about whether policing might be yet another profession of concern. While there is a scarcity of research establishing a relationship between policing and cancer, there are aspects of police work that should give strong reason for concern. This paper argues that when considering such matters as shift work, Post-Traumatic Stress Disorder (PTSD), diet, dehydration, working lifestyle, exposure to carcinogens, air pollution, exposure to UVA/UVB rays, radar, and the single event factor, there is a prima facie case to be made that a relationship between police work and cancer is likely. Accordingly, it is a matter that deserves serious research attention.

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Introduction

It is becoming increasingly apparent that people who work in certain professions are more likely to develop cancer than other professionals (Chen & Osman, 2012). The case of firefighters is one excellent example. With firefighters, not only has it been established that they are more likely to develop cancer than the average person, at least one Canadian province now automatically presumes that if a firefighter is diagnosed with certain types of cancer, including non-Hodgkin's lymphoma, bladder, brain, colorectal, kidney, lung, testicular, and leukemia, it is caused by the nature of their employment (Hynes, 2011). Other examples include farmers (Sauve et al, 2016), auto workers (McHale, Zhang, & Smith, 2012), and hair dressers (Ros et al, 2012).

The purpose of this paper is to inspire research about whether policing might also be added to the list of professions likely to experience higher rates of cancer. While there is a scarcity of research establishing a relationship between policing and cancer, there are aspects to police work that should give strong reason for concern. Specifically, as discussed in this paper, elements including shift work, Post-Traumatic Stress Disorder (PTSD), diet, dehydration, working lifestyle, exposure to carcinogens, air pollution, exposure to UVA/UVB rays, radar, and the single event factor suggest there is a prima facie case to be made that a relationship between police work and cancer is likely. Accordingly, it is a matter that deserves serious research attention. In the interim, enough is known already to suggest that law enforcement agencies should proceed with an abundance of care and caution for officers; at very least, taking steps to ensure that a premium is placed on early screening for cancer.

Studies Reviewing Police Officers and Cancer

It is evident there is a lack of research on the prevalence of cancer among police officers. In a recent review of such research, Wirth et al (2012) were only able to refer to 14 studies. Another six studies were located outside of Wirth's review though three of these focused exclusively on post-September 11, 2001 New York City first responders. Even with minimal research studies, the review showed some alarming results. For example, one of the studies reviewed found that police officers were more likely than the general public to be diagnosed with testicular, cervical, colon cancer, melanoma, leukemia and lymphoma, though not all achieved statistical significance (van Netten, Brands, Hoption, Spinelli, & Sheps, 2003). Additionally, five of the studies reviewed reported a statistically significant increase in prostate or testicular cancer (Bouchardy et al, 2002; Zeegers, Friesema, Goldbohm, & van den Brandt, 2004; van Netten, Brands, Hoption, Spinelli, & Sheps, 2003; Davis & Mostoffi, 1993;) five noted an increase in kidney cancer (Forastiere et al, 1994; Bouchardy et al, 2002; Kleinman et al, 2015; Gu, Burchfield, Andrew & Violanti, 2011; Violanti, Vena, & Petralia, 1998) and four studies noted increases in thyroid, lymphoma, and skin cancers (Wirth et al, 2012). Further, of the two studies Wirth reviewed that included female officers in their study cohorts, one noted an elevated number of cervical cancer cases (van Netten, Brands, Hoption, Spinelli, & Sheps, 2003) and another study noted an elevated number of female breast cancer (Kleinman et al, 2015). Finally, eight of the studies reviewed found a higher than average mortality rate amongst the police officers who were diagnosed with cancer (Vena, Violanti, Marshall, & Fiedler, 1986; Violanti & Vena, 1998; Rosenstock, Demers, Heyer, & Barnhart, 1990; Forastiere et

al, 1994; Feuer & Rosenman, 1986; Kleinman et al, 2015; Li et al, 2016; & Moline et al, 2009).

That said, it is not clear that the studies fully encapsulated the relationship between policing and cancer. To begin with, only nine of the studies reviewed related to cohorts employed in policing beyond 2000 (Gu, Burchfield, Andrew & Violanti, 2011; van Netten, Brands, Hoption, Spinelli, & Sheps, 2003; Wirth et al, 2013; Sauve, Lavoue, & Parent, 2016; Davis & Mostoffi, 1993; Kleinman et al, 2015; Li et al, 2016; Moline et al, 2009; Sritharan et al, 2017), and three of those studies focused on the effects of the World Trade Centre attacks on law enforcement cancer rates (Kleinman et al, 2015; Li et al, 2016; & Moline et al, 2009). Secondly, as noted, only two of the studies reviewed by Wirth and three of the post September 11, 2001 studies included women, which is significant as the number of women in policing has increased dramatically (Royal Canadian Mounted Police, 2016). Thirdly, most of the studies reviewed involved a comparison of police officers to the general population (Vena & Marshall, 1986; Violanti, Vena, & Petralia, 1998; Gu, Burchfield, Andrew & Violanti, 2011; Demers, Heyer, & Rosenstock, 1992, Morton & Marjanovic, 1984; van Netten, Brands, Hoption, Spinelli, & Sheps, 2003). This comparison is skewed to the extent that police officers as a group, and at time of recruitment, are generally healthier than other members of the population. All else being equal, comparisons to the general population should be adjoined with an expectation of *lower*, *not equal or higher,* incidents of cancer among police officers. This issue will be discussed more in the next section of this paper.

One final and significant concern that needs to be addressed regarding the research done to date is the fact that it is focused on working police officers and fails to assess those

officers after their service. In this regard, the average age of police officers in Canada is 41 (Statistics Canada, 2009), yet cancer is most commonly diagnosed in people over 50 years of age (Canadian Cancer Society, 2015). Further, many police officers do not stay in policing for their entire careers, but instead leave early due to burnout, stress, and/or poor performance (Anshel, 2000). Notably, for example, approximately 31% of police officers who left policing in 2015/2016 were for reasons other than retirement (Statistics Canada, 2016). This is particularly true for First Nations police services where 33% of those officers who left their respective forces had less than 10 years of service (Statistics Canada, 2017). The statistics are significantly smaller for other Canadian police services who had an average of 15.6% of their officers leaving prior to 10 years of service (Statistics Canada, 2017). The assessment of cancer rates needs to be made not only on working police officers, but on former and retired officers, and with respect to the reality that cancer, if it is likely to appear at all, is most likely to show itself later in the officer's life. Until this is accomplished, we should expect that any reported rates of cancer among police officers are likely to be underestimated.

Comparing police officers to the general population

Police officers, at least in theory, should be healthier than other individuals in the general population. Police officers are recruited and screened for health and wellness prior to hiring. Police applicants are subjected to physical exams that measure heart and lung function, blood-sugar levels, hearing, vision, mental health, and physical fitness levels (Royal Canadian Mounted Police, 2017). Applicants to the RCMP must provide immunization certification for tetanus, diphtheria, pertussis, measles, mumps, rubella and Hepatitis B, which is a known cancer-related infection (Canadian Cancer Society, 2018).

Applicants must receive tuberculosis screening showing they do not have an active strain (Royal Canadian Mounted Police, 2017). Applicants also must submit blood and urine tests that screen for abnormalities and harbingers of disease (What to expect during the Police Officer Medical Evaluation, 2012). Additional tests include a chest x-ray, dental, eye, and hearing exams. Dental exams, although they may appear superficial, are an excellent indicator of health as research has indicated that poor oral health can lead to major health complications, including cancer. Some research has even suggested that poor oral hygiene could be the primary cause of oral cancer (Oji & Chukwuneke, 2012). In addition to the medical screening, applicants must complete the Minnesota Multiphasic Personality Inventory (MMPI), which is a psychological screening test.

The Toronto Police also require their applicants to undergo a rigorous and comprehensive medical assessment (Ministry of Community Safety and Correctional Services, 2009). Applicants can be disqualified from the screening process for conditions associated to cardiac disease, peripheral vascular disease, cerebral vascular disease, nervous system, and respiratory, renal and endocrine conditions (Ministry of Community Safety and Correctional Services, 2009). A candidate can be disqualified from the Ontario Provincial Police if they have cerebral vascular disease, nervous system disorders, chronic respiratory diseases, renal and/or endocrine disorders (Ministry of Community Safety and Correctional Services, 2015). Thus, just being accepted by a Canadian law enforcement agency improves the likelihood of a healthier individual when compared to the general population.

Part of the policing assessment for most Canadian police forces also includes a physical abilities test. In the RCMP, the Physical Abilities Requirement Evaluation (PARE),

assesses the applicant's cardiovascular abilities, strength, and resiliency. The PARE requires a candidate to physically exert themselves in a timed exam that simulates a confrontation with a suspect, interspersed with chasing and subduing the suspect (Royal Canadian Mounted Police, 2016). After a very physically taxing scenario, the candidate is then required to carry a 100-pound bag approximately 100 feet, which simulates carrying a person after the occurrence (Royal Canadian Mounted Police, 2015). Similar to the PARE, Ontario officers also have to do a Physical Readiness Evaluation for Police (PREP) exam, which involves a timed pursuit/restraint circuit involving fence scaling, stair climbing, and push-pull machines. The PREP exam also requires the ability to pull a mannequin weighing 170 pounds a distance of 15 metres. The PREP also includes a timed aerobic shuttle run (Applicant Testing, 2016).

Anyone not sufficiently fit and healthy to perform the rigors of the policing profession are not selected to advance to the training academy. The training academy further eliminates those who are not in sufficiently adequate health to withstand the training rigors of the police academy. Thus, only the physically healthiest and mentally hardiest graduate to become a police officer in Canada.

The assessment to ensure police officers are healthy does not stop after graduation from the academy. RCMP officers also perform the PARE every three years to ensure continued strength and fitness. Further, the majority of police officers undergo a periodic health assessment (PHA) every three years. Specialty units, such as Emergency Response Team and Forensic Identification Section officers may be required to undergo PHA assessments every year. This health assessment monitors cholesterol, triglycerides, resting glucose, urine, Hepatitis B immunity status, and tuberculosis exposure. The PHA also tests

white blood cell counts, platelet levels, and hemoglobin (RCMP form 3935e, 2016). These blood tests can aid in diagnosing some forms of cancer, including lymphoma (Asco Cancer.Net, 2017).

Any comparison of police officers to the general population should also be attentive to the Healthy Worker Effect. This is the phenomenon in which people who are employed are generally healthier and have lower morbidity rates than those who are not working. This is believed to result from greater access to medical treatment for employed people compared to the unemployed and because those who are ill are generally excluded from the workforce (Last, 2014). Again, given that police officers are gainfully employed, have very good access to the Canadian medical system, and are routinely screened for physical health indicators, we should expect them to have better health than the general population.

Reasons for Concern

As suggested above, police officers as a population should, theoretically, have lower rates of cancer than the general population given the health pre-screening examinations, ongoing medical examinations, and the Healthy Worker Effect. They are, in short, a healthy group of people. However, the indications from research thus far suggests that they have rates of cancer which are at least similar and in some cases higher than the general population – and that is ignoring the problem of the research not being focused on the health of police in later life. This leads to the question of why? Why do police officers have similar or higher rates of cancer to the general population? Is there something inherent in police work or the lifestyles of police officers that contributes to higher than expected rates of cancer? The next section of this paper looks at various aspects of police work to highlight

reasons for concern. One such aspect is shift work – something most every police officer will have experienced for some period of time in their career.

Shift Work

Research has shown a clear link between cancer and shift work (Hansen & Stevens, 2012; Itani & Kaneita, 2016; Schernhammer et al., 2006). The International Agency on Research on Cancer labeled shift work as probably carcinogenic in 2007 (Costa, 2010). The suprachiasmatic nucleus, which is comprised of approximately 20,000 nerve cells, is responsible for the body's circadian rhythm (Costa, 2010). The circadian rhythm regulates the body's natural rhythms (Loef et al, 2016), including when we wake up and go to sleep. Shift work can interrupt the circadian rhythm (Boggild & Knutsson, 1999; Costa, 2010), which disrupts cell division and metabolism, which are two biological processes associated with cancer (Papagiannakopoulos et al, 2016). Another study found a link between rotating night shifts and cancer, which was increased with more time spent on rotating shifts (Schernhammer et al, 2001). Not only can shift work damage the body by interrupting the circadian rhythm but it can also make the body more susceptible to contracting infections and increasing the length and impact they have on the body (van Drongelen et al, 2011). A study by Li et al found that working night shifts increased breast cancer morbidity at increasing percentages depending on the length of night shift work with an 8.8% increase in breast cancer for those who worked over 20 years of night shifts (Li et al, 2015). This is particularly relevant given that a very limited number of studies reviewing cancer rates for police officers included female officers as part of their study samples.

Some studies have also shown that shift work is positively associated to weight gain and obesity (Grundy et al, 2017; van Drongelen et al, 2011; Costa, 2010; Proper, 2016)

while others indicated no association (McGlynn et al, 2015). There is indication that night shift workers may eat an inferior diet (van Drongelen et al, 2011; Boggild & Knutsson, 1999; Costa, 2010), engage in less exercise, smoke more (Boggild & Knutsson, 1999; Costa, 2010) and drink more alcohol (Boggild & Knutsson, 1999), which are all activities associated to cancer (Canadian Cancer Society, n.d.). Another concern is that shift work may increase the likelihood of developing diabetes (van Drongelen et al, 2011; Proper et al, 2016) and cardiovascular disease (Boggild & Knutsson, 1999) though the research is unclear as to whether the relationship is correlative or causal.

Policing is a 24/7 profession in most communities, with many police officers working two 12-hour days shifts followed by two 12-hour night shifts. Although not all officers work general duty, the vast majority are required to work some form of altered shifts, extended hours, on-call shifts, with many experiencing call outs in the middle of the night to attend calls for service. According to the 2005 General Social Survey, 66% of those in protective service occupations worked shift work (General Social Survey, 2005). Females were less likely than men to work shift work, however, 41% of women worked rotating shifts versus 34 % of men (General Social Survey, 2005). While it is difficult to know exactly how many police officers work shift work, it is safe to assume that nearly all police officers will have worked a significant amount of shift work and/or irregular hours in their career. In any case, one study found that out of almost 4,500 police officers surveyed, 42% were currently working a rotating shift while only 14% were working on a fixed shift schedule (Duxbury & Higgins, 2012). This same study suggested that working shift work is associated to issues at home, which can increase stress (Duxbury & Higgins, 2012).

Stress

Research has shown that extended increase in the hormone cortisol can lead to reduced immune system, which could reduce one's ability to fight disease, including cancer (Kiecolt-Glaser, McGuire, Robles, & Glaser, 2002; Anshel, 2000; Anderson, Lintzenberger, & Plecas, 2002). One study showed that the presence of ATF3, a hormone related to stress, facilitated breast cancer metastasis and was related to reduced survival rates (Wolford et al, 2013). Other studies have shown that stress can result in weakened immune systems (Franke, Cox, Schultz & Andersen, 1997), which, in theory, could be positively related to higher rates of cancer. There is also evidence that psychological stress can increase behaviors, which can increase cancer risk, including smoking, overeating, and drinking alcohol (National Cancer Institute, 2012; Cancer Research Centre UK, 2016).

Police work is often hours of the mundane punctuated by moments of extremely high stress and sheer chaos. Studies have shown that police work can be "one of the most stressful occupations in the world" (Anshel 2000 citing Dantzer, 1987 and Loo, 1984). Police officers are exposed to both physical stress (Anderson, Litzenberger, & Plecas, 2002; Bonneau and Brown, 1995) and mental stress (Anshel, 2000; Duxbury & Higgins, 2012; Brown & Grover, 1998). One study found that 97% of the survey participants, including psychologists and police officers, thought it was emotionally demanding to be a police officer and 76.5% of survey participants thought police work was physically difficult (Andersen & Papazoglou, 2016). One of the greatest stressors in policing is suggested to be the competing interests of high demand and low control (Anderson, Litzenberger, & Plecas, 2002). The effect of this teeter-totter between mind-numbing boredom and hair-raising fear cannot be healthy for the human body. Additional stressors include the antagonistic

relationship that exists or is perceived to exist between the police officer and the communities they serve (Anshel, 2000). Other stressors are more central to the organization police officers work for and can be caused by feelings that the organization does not support the officer (Anshel, 2000).

Arnsten's study in 1998 identified that this type of extreme stress was associated with increased arousal, alertness, and memory caused by a swift increase in hormones, including epinephrine, dopamine, and norepinephrine (Arnsten, 1998). A 2002 study by Anderson, Lintzenberger, and Plecas showed that police officers' heart rates were highest at the beginning of shift and slowly declined throughout their shift (Anderson, Lintzenberger, & Plecas, 2002). Their heart rates remained higher than resting heartrate throughout the entire shift (Anderson, Lintzenberger, & Plecas, 2002). Importantly, the study also showed that while officers' heart rates increased during stressful activities, they did not return to the normal above-resting heart rate until approximately 30 to 60 minutes after the incident (Anderson, Lintzenberger, & Plecas, 2002). Other studies have shown that stress increases issues with fatigue, depression, reduced mental well-being, and suicidal ideations (Panagioti, Gooding, & Tarrier, 2009; Totterdell & Holman, 2003).

There are other factors of police work that contribute to an overall stressful experience. In 2016, Statistics Canada noted that 2016 was a fifth consecutive year of police strength decline leaving fewer officers to conduct a similar number of increasingly more difficult and labor-intensive calls for service (Statistics Canada, 2016). There were only 190 officers per 100,000 Canadians (Statistics Canada, 2016), which does not take into account the number of officers who were injured and performing administrative duties only, off duty sick, on parental leave, or on a leave without pay. Almost 65% of the surveyed police

officers in Duxbury and Higgins' study spent time off-shift dealing with work-related e-mails and those in command positions volunteered an average of 10 plus hours per week to their organization (Duxbury & Higgins, 2012).

Stress, however, does not only come from the profession. A large amount of time is spent every week dealing with family issues, including childcare and elder care (Duxbury & Higgins, 2012), which adds to the stress already encountered by police officers. Of particular concern, however, was the potential that police officers were unaware of the effect stressful incidents has on their physical health (Andersen & Papazoglou, 2016). Overall, there is little doubt that policing, as a profession, is physically and psychologically stressful. While there is some debate over the link between stress and cancer (Li et al, 2016), there remains research that shows a link exists.

Post-Traumatic Stress Disorder

Although only in its infancy, research into Post-traumatic Stress Disorder (PTSD) and Operational Stress Injuries (OSI) has improved knowledge in the areas of trauma and its effect on the human mind and body. PTSD is an injury to the brain caused by a trauma that is greater than the individual's ability to cope (van der Kolk, 2014). PTSD can include one exposure to death or injury, but can also include repeated and/or extreme exposure to traumatic events throughout a person's profession, such as policing (US Department of Veterans Affairs, 2013). Most people are aware of the mental health implications as a result of PTSD, however, very few understand that trauma can also cause biological changes. Research has shown that trauma exposure can lead to physiological changes in the brain that can lead to behavior issues, including violence and anti-social behavior (Black, Woodworth, and Tremblay, 2012; van der Kolk, 2014). Some of the research has been

contradictory, however, other research is indicating that psychiatric disorders, such as PTSD, are associated with immune system dysregulation, chronic inflammation, and the physical disorders generally associated with those medical conditions (Miller, Driscoll, Smith, & Ramaswamy, 2017). The relationship between cancer and chronic inflammation is not yet fully understood, however, much research has shown that chronic inflammation may contribute to cell damage which can promote cancer growth (Nesi, Nobili, Cai, Caini, & Santi, 2015; Kiecolt-Glaser, McGuire, Robles, & Glaser, 2002). Up to 20% of cancers are believed to have started from chronic inflammation and/or infection (Nesi, Nobili, Cai, Caini, & Santi, 2015). Additionally, PTSD is commonly linked to depression (Smith-Marek, Durtschi, Brown & Dharnidharka, 2016) which has been shown to have a positive association with higher overall rates of cancer and a statistically significant increase in breast cancer risk (Gross, Gallo, & Eaton, 2009).

Research has shown that police officers had higher rates of depression and PTSD than the general population (Violanti et al, 2006). In fact, PTSD amongst American police officers is estimated to be between 7 to 19% compared to the general population rate of approximately 3.5% (Yuan et al, 2011). One of the most common traumatic events experienced by police officers that can cause PTSD is the exposure to gruesome and horrific scenes, such as motor vehicle crashes, murder scenes, and investigations involving harm to children (Faust & Vander Van, 2014). At the same time the situation is not getting any better because while homicides and other violent crimes and incidents remain high, the number of police officers available to deal with them has continually declined (Statistics Canada, 2016). Hence, each officer, on average, is increasingly likely to be exposed to events that place them at risk of PTSD.

Diet

Healthy nutrition is vital to maintaining a healthy body as it may assist with dealing with stress and help fight off disease (Martinussen, Richardsen & Burke, 2007). Some estimates even suggest that a proper diet and corresponding active lifestyle can help prevent up to 30 to 40% of all cancers (Divisi et al, 2006). One study identified that a pro-inflammatory diet was associated with a higher risk of cancer deaths (Deng et al, 2016). The World Health Organization noted that processed meats, which are made with sodium nitrates as a preservative, form carcinogenic chemical compounds (Kluger, 2015) increasing the risk of cancer for those who consume them.

A diet lacking in fruits and vegetables is one of the five leading behavior risks associated with cancer (World Health Organization, 2017). Vegetables, particularly leafy green vegetables, contain antioxidants that help in the prevention of cancer as they inhibit the reproduction of cancer cells (Mutanen, Niku & Oikarinen, 2011). Police officers are noted to have poor coping mechanisms for stress and sometimes turn to alcohol, drugs, poor diet (Anshel, 2000) cigarettes, and physical isolation to cope (Burke, 1994).

Maintaining a healthy lifestyle can be difficult when working 12 hour rotating shifts that, for some officers, are predominantly spent driving in a vehicle (Plecas, McCormick & Cohen, 2010). The nature of policing, and general duty policing in particular, is not conducive to a healthy diet while at work. In a 2009 study of Surrey RCMP officers, it was noted that approximately 28% of officers on shift ate unhealthy snacks during their shifts (McCormick, Cohen, & Plecas, 2011). Unhealthy snacks were defined as “fast food snack wraps, chips, or beef jerky” (McCormick, Cohen, & Plecas, 2011, p. 2). Processed meats, including beef jerky, were declared a Group 1 carcinogen by the World Health Organization

in October, 2015 (World Health Organization, 2015). As little as 50 grams of processed meat per day can increase the risk of colorectal cancer by as much as 18% (World Health Organization, 2015). This is particularly relevant as many of these foods are high in salt and saturated fat, which are, as noted above, influential in the promotion of cancer. Additionally, the prevalence of poor eating habits increased during the shift week. For example, 14% of officers ate unhealthy snacks during their first shift, however, this number increased to approximately 33% during the last night shift (McCormick, Cohen, & Plecas, 2011). Additionally, officers ate more unhealthy snacks during night shifts than during day shift (McCormick, Cohen, & Plecas, 2011).

Dehydration

Bladder cancer is one of the most common forms of cancer in Canada (Canadian Cancer Society, n.d.). It generally occurs in older people, particularly those over 65 years of age (Canadian Cancer Society, n.d.). It is currently unknown whether dehydration, or not drinking enough fluids, is a causal factor for cancer (Canadian Cancer Society, n.d.). The greatest known risk factor for bladder cancer is smoking (Canadian Cancer Society, n.d.). Holding your urine is believed to be a causal factor in bladder infections (Rettner, 2017). Past research has indicated that frequent bladder infections and/or chronic bladder irritation increases the likelihood of being diagnosed with bladder cancer later in life (Cancer Research UK, 2015; Canadian Cancer Society, n.d.). Other studies, however, indicate that bladder infections can have a negative correlation to bladder cancer diagnoses (Vermeulen et al, 2015). Evidently, more study is required in this area. If holding your urine causes more bladder infections, which in turn may lead to higher rates of bladder cancer, then police officers who do not drink sufficient water and/or do not utilize the

washroom enough, could be placing themselves at higher risk. This could explain the studies showing an increase in bladder cancer for police officers (Forastiere et al, 1994; Bouchardy et al, 2002).

Police officers spend a significant amount of time in their vehicles every shift (Plecas, McCormick, & Cohen, 2011). Not only is this concerning given the amount of time spent sitting every workday, it is also concerning because it can lead to poor diet and hydration habits. One study found that police officers drank an alarmingly low amount of fluids, and even less water, in each shift (McCormick, Cohen, & Plecas, 2011). Officers drank on average only two drinks per 12-hour shift and, of those two drinks, officers who were between 40 to 49 years of age, only 27% of those drinks were water (McCormick, Cohen, & Plecas, 2011). The vast majority of the drinks for the older officers were coffee with 76% (McCormick, Cohen, & Plecas, 2011). This is particularly concerning given that the strain on the body could be more damaging to older officers than younger ones. In approximately 77% of shifts, the officers did not drink more than one glass of water (McCormick, Cohen, & Plecas, 2011). Working in a police vehicle can be counterproductive to healthy drinking habits as, not only may access to fresh water be limited, particularly during night shifts and in more remote locations, but access to washrooms can also be limited. Thus, although officers may wish to drink more water, the fear that they may be stuck at a file for extended periods of time without access to a washroom could prevent officers from drinking as much as they should. This could be reflected in the finding that Surrey general duty police officers only spent approximately nine minutes in a 12-hour shift taking a washroom break (Plecas, McCormick & Cohen, 2010).

As noted above, four studies of police officer cancer rates found a statistically significant increase in bladder cancer and/or bladder cancer mortality (Vena, Violanti, Vena, & Petralia, 1998; Forastiere et al, 1994; Bouchardy et al, 2002; Davis & Mostofi, 1993) and five found increased rates and/or mortality rates of colon cancer (Vena, Violanti, Vena, & Petralia, 1998; Violanti, Vena, & Petralia, 1998; van Netten, Brends, Hoption, Spinelli, & Sheps, 2003; Bouchardy et al, 2002; Forastiere et al, 1994). If the above studies are accurate for police officers throughout Canada, there could be a cause and effect relationship from the lack of proper hydration and/or increased concentration of harmful chemicals in the bladder and colon from a reduction of voiding activities. The exact cause of bladder cancer is unknown, however, approximately 90% of people who are diagnosed with bladder cancer are over 55 years old (McIntosh, 2018). Not all of the studies reviewed indicated the age of the officers who were diagnosed with bladder cancer, however, given that all were actively serving members of a police force, there is a high likelihood that the majority, if not all, of the officers diagnosed were under 55 years of age.

Unhealthy Working Lifestyle

An unhealthy lifestyle can lead to significant negative health consequences (Farhud, 2015; Lee & Ashforth, 1996; Udo, Mun, Buckman, Vaschillo, Vaschillo, & Bates, 2013; Canadian Cancer Society, 2018). Failure to participate in an active lifestyle is one of the five leading behavioral risks associated to cancer (World Health Organization, 2017). Lack of exercise can also increase the chances of being overweight, which is also a risk factor for cancer (Wicki & Hagmann, 2011; Canadian Cancer Society, nd).

Almost all types of policing, from general duty to surveillance to major crime, requires that a significant amount of time is spent sitting. In a 2009 study of 171 Surrey

RCMP officers, the officers were found to spend approximately 48% of a 12-hour shift sitting in their police vehicles (Plecas, McCormick & Cohen, 2010). Of that time, 59% of it was spent utilizing the Mobile Data Terminal, which was noted to result in poor ergonomics and was bad for the back given its requirement that the officer sit in a twisted position (Plecas, McCormick & Cohen, 2010). A related study noted that while officers were allowed to take 90 minutes of breaks in a 12-hour shift, on average, officers only took a little over half of the allotted time (Cohen, Plecas, & McCormick, 2011). Additionally, it was noted that older officers took fewer breaks than the younger officers (Cohen, Plecas, & McCormick, 2011), though given the strains on the body, the older officers probably should have been taking more breaks than their younger counterparts. Another study showed that police officers have higher body mass index scores (Violanti et al, 2006).

Exposure to Carcinogens

A strong link has been drawn between the profession of firefighting and certain types of cancer (Dow, Kunz, Garis & Thomas, 2015; Tsai et al, 2015; Glass, Pircher, Del Monaco, Vander Hoorn, & Sim, 2016; Zuo et al, 2014; Daniels et al, 2014; Daniels et al, 2014; Glass, Del Monaco, Pircher, Vander Hoorn, & Sim, 2016). Not only are firefighters exposed to carcinogens through burning of housing exteriors, there are also multitudes of carcinogens in household interior materials such as flooring, furniture, and electronics (Korst, 2012). The link is so strong that since 2011, firefighters in BC who are diagnosed with leukemia, non-Hodgkin's lymphoma, bladder, brain, colorectal, kidney, lung, testicular or ureter cancer, the cancer is automatically presumed to have been caused by the nature of their employment (Hynes, 2011). As part of their jobs, firefighters attend calls involving burning buildings, furniture, and vehicles. All these things are known to have carcinogens

that the firefighters then either inhale or absorb through their unprotected skin (Tsai et al, 2015).

This is relevant to this current paper as police officers are also often dispatched to calls for service involving fires and, more specifically, arsons. Statistics regarding how many fires police officers attend in Canada each year were not available. However, statistics for the number of fires attended in Canada by firefighters was available. In 2014, there were 38,844 total fire incidents in Canada with vehicle fires comprising 6,056 of those fires (Statistics Canada, 2017). One hundred seventy people died as a result of fire deaths in 2014, which are deaths police officers would have attended (Statistics Canada, 2017). In 2014, 1,909, or 16%, of all structural fires by act or omission were caused by incendiary devices, which includes arson (Statistics Canada, 2017). Police officers would have attended each of these investigations as they involve a criminal component. The National Work Injury/Disease Statistic Program (NWISP) registered only 1,388 claims of lost work time for Canadian law enforcement personnel due to exposure to harmful substances and only 59 claims of lost work due to exposure to fire and/or explosions (NWISP, 2017). Although these figures suggest that police officer exposure to carcinogens is likely minimal, these figures only record if an officer lost time at work, reported that loss through the NWISP, and the loss was directly attributable to the officer's profession. Given the number of clandestine marihuana grow operations, synthetic drug manufacturing plants, house, forest, and vehicle fires that police officers attend, I would suggest these numbers exceedingly underestimate the true carcinogen exposure and injury police officers face.

In one week alone in July, 2017, the RCMP deployed approximately 340 officers from BC and Alberta to aid in the battle against the BC wildfires. Officers evacuated towns due to proximity to the dangerous wildfires, but the officers then stayed in the burning communities to protect life and property. The RCMP's commitment to the wildfires lasted approximately 3 months with fluctuating numbers of officers being deployed every week. Police officers, generally, are not supplied with the protective self-contained breathing apparatus that firefighters are provided nor are they provided with equipment to prevent absorption through unprotected skin. Police officers also do not have the education regarding carcinogens in burning materials as firefighters are provided. Each officer in the BC wildfires was outfitted with a breathing mask, which was not a self-contained breathing apparatus. The numbers have not been released, however, many officers returned home with sore throats, headaches, and other symptoms of exposure. In 2016, officers in Alberta suffered similar experiences with the Fort McMurray wildfires. Police officer exposure to carcinogens through fires and catastrophic events will be explored later in this paper in the section titled The Power of a Single Incident.

Not only are police officers subjected to many fires, they are exposed to other carcinogens as a result of their occupation. Many marihuana grow operations involve the use of pesticides and other chemicals to promote the indoor growth of marihuana plants (Peel Region, 2012). Police officers are also exposed to a wide variety of caustic and carcinogenic substances through their attendance at methamphetamine labs (McFadden, Kub, & Fitzgerald, 2006). Although police have learned a great deal about the dangerous effect these chemicals can have, often it is the first responder who is exposed to these chemicals and generally does not have the protective equipment provided to officers in the

specialized units such as the ClanLab Team and the Green Team who are responsible for dismantling illegal clandestine methamphetamine and marihuana grow operations. Many times, the first responder does not realize they are entering into a property that contains hazardous chemicals until they are already exposed. In a study of Washington State Poison Centre, between 1999 and 2004, 93% of all health care facility usage was for law enforcement personnel (Thrasher et al, 2010). Police officers who are exposed to methamphetamine laboratories during response activities had a seven to 15 times greater risk of becoming ill than those exposed to labs in the set-up, in-transit, or former lab stages (Thrasher et al, 2010). Exposure symptoms included headaches, nausea, vomiting, cough, eye, nose and skin irritation, dizziness, and difficulty breathing (Thrasher et al, 2010). The long-term effects of those exposures was not noted and, likely, was unknown.

Exposure to Air Pollution

In 2013, the International Agency for Research on Cancer/the World Health Organization (WHO) announced that it was classifying outdoor air pollution as a human carcinogen (International Agency for Research on Cancer, 2013). The WHO noted a particular increase in the risk for lung cancer based on studies of millions of people across Europe, North America, and Asia (WHO News, October 24, 2013). There was also, according to the WHO, limited epidemiological evidence to suggest that some occupations with high exposure to traffic have higher rates of bladder cancer (WHO News, 2013). Of particular concern was the association between air pollution and lung cancer. The evidence suggested there may be a connection between the damage to the DNA that repairs damage caused by exposure to air pollution (WHO News, 2013).

Police officers who work outdoors are exposed to levels of outdoor air pollution, including benzene, three to five times greater than the general public with traffic and motorcycle officers being at the greatest risk of exposure. (Pilidis et al, 2009). In Pilidis et al's study in 2009, they estimated that the police officers had a 1% increased risk of cancer. With air pollution a known human carcinogen, the exposure police officers face in the course of their duties could increase their potential for lung and bladder cancer. This, however, is only true for those officers who spend extended periods of time outdoors and/or in their vehicles. Of particular concern would be traffic control officers, police service dog officers, bicycle patrol officers, and foot patrol officers, many of whom spend large proportions of their shifts outside. As per the study by Plecas, McCormick and Cohen, Surrey RCMP general duty officers spent approximately 50% of a 12-hour shift inside their vehicles (Plecas, McCormick & Cohen, 2010). On average, an officer would spend approximately 24 hours in a vehicle exposed to potentially harmful and carcinogenic air pollution over a four-day shift. The potential for exposure to pollution, a class one carcinogen, is very high.

Alcohol Consumption

The International Agency for Cancer Research has classified ethanol as a human carcinogen (World Cancer Research Fund, 2007). High prevalence of excessive alcohol consumption is correlated to higher morbidity rates from all causes, including cancer (Xi et al, 2017). Alcohol consumption is also a known cause of liver cirrhosis (World Cancer Research Fund, 2007). In particular, alcohol consumption is a causal factor in cancers of the "oropharynx, larynx, esophagus, liver, colon, rectum, and female breast" (Connor, 2016, p. 223; World Cancer Research Fund, 2007). Even light to moderate drinking can increase the

likelihood of a cancer diagnosis (Shield et al, 2017). Allen et al's study in 2009 identified that consumption of less than 20 grams of alcohol per week resulted in a 5% decrease in total cancer than those who drank 70 to 140 g of alcohol per week. Those who drank more alcohol had a 13% increased risk of developing breast cancer (Allen et al, 2009). Shield et al (2017) identified that approximately 8% of all new cancer cases in France were attributable to alcohol consumption.

Although there is conflicting evidence of alcohol use and abuse rates for police officers, anecdotally, police officers have higher rates of alcohol use and abuse than the general population. While there are studies which suggest that there is no difference between alcohol consumption of police officers versus the general population (Lindsay, 2008), other studies suggest police officers drink more alcohol than the general population. One study estimated that police officers drink double that of the general population (Kirschman, 2006). Another study, completed by Richmond et al in 1998, identified that 48% of male Australian police officers and 40% of female Australian police officers self-reported drinking excessively or engaging in binge-drinking behavior (Richmond et al, 1998). Another study, conducted in 2009, reported an average of almost 20% of male and female officers who had "scores indicating lifetime adverse consequences from alcohol" (Ballenger et al, 2009, p. 25). Surprisingly, in contrast to the general population where females consume less daily alcohol than males, in this study, female officers had almost equal numbers of daily alcohol use as their male counterparts (Ballenger et al, 2009). These studies are particularly significant given the lack of studies on cancer and female officers. If police officers drink more alcohol than the general population and have higher rates of binge drinking and alcohol is a known carcinogen, this could be evidence to suggest that

police officers have higher rates of cancer than would be expected from their profession otherwise.

Exposure to Harmful UVA and UVB Rays

Exposure to the sun is associated with neoplasm development (Candido et al, 2014). Outdoor work, in particular, is associated with higher rates of melanoma (Young & Rushton, 2012). The incidence and mortality rates of melanoma, or skin cancer, have been increasing (Young & Rushton, 2012). A study in the British Journal of Cancer found that public administration and defense were industries of concern for cutaneous malignant melanoma with higher rates in males and an average of 17 years of lost life due to solar radiation received through occupational exposure (Rushton & Hutchings, 2017).

Police officers spend some of their shifts outside exposed to the elements, including the harmful effects of the sun. Multiple studies noted an elevated incidence of melanoma in police officers (Finkelstein, 1998; van Netten, Brands, Hoption, Spinelli, & Sheps, 2003; & Feuer & Rosenman). However, identifying exposure to harmful ultraviolet rays as a causal factor in melanoma in police officers is a very difficult argument to make given the dearth of information regarding police officer activities in Canada. Moreover, to date there have been no studies on the question of whether or not law enforcement personnel are likely to have higher rates of melanoma as a *direct result* of their occupational exposure to higher levels of harmful UVA and URB rays.

Still, there should be reason for concern, in that police are involved in a variety of duties requiring them to work with intermittent exposure to the sun. Additionally, some police officers work in the northern communities where harmful exposure is different than those working in the southern communities. Similarly, working on the west coast would

expose officers to different harmful effects than those working on the east coast or on the prairies. Adding to the difficulty is that many police officers change their duties within their chosen profession multiple times throughout their careers. Many more change the location of where they live and serve. Although there may be an increase in melanoma for police officers, identifying the root cause may be difficult without thorough and appropriate research taking into account the different variations of exposure throughout the life and career of the officers.

Radar

There has been much speculation as to the correlation between hand-held radar and testicular cancer in male police officers. A study conducted by Davis and Mostofi in 1993 identified six cases of testicular cancer in a cohort of 340 American police officers (Davis & Mostofi, 1993). Another study from 2016 noted that police officers had a higher risk of testicular cancer than those from a control cohort selected for similarities in three areas of risk for testicular cancer (Sauve, Lavoue, & Parent, 2016). The study was impressive in that it controlled for age, race, smoking, alcohol consumption, exercise, family history, education, and body-mass index (Sauve, Lavoue, & Parent, 2016). Given the increase in female officers over the past few decades, however, it is also important for future research to assess the effects radar has on female officers.

The Power of a Single Incident

How many exposures to carcinogens does it take to cause cancer? On September 11, 2001, nineteen terrorists hijacked and flew four airplanes into landmark American buildings, including two that were flown into the Twin Towers at the World Trade Centre (WTC) (Hoffman, 2014). In addition to many other first responders, 39,946 New York City

Police Department (NYPD) officers responded to the WTC sites (Kleinman et al, 2015). After September 11, 2001, the air was heavy with airborne pollutants, including asbestos, glass too small for the eye to see, and benzene carried in the form of jet fuel carried by the two airplanes that crashed into the WTC (Moline et al, 2009). One study assessing cancer rates of those officers who responded to the WTC after the terrorist attacks identified eight confirmed cases of multiple myeloma (MM) in first responders to the WTC disaster (Moline et al, 2009). This study was significant because four of the eight responders, who were predominantly law enforcement officers, were diagnosed with MM under the age of 45 years, when MM is generally diagnosed in the elderly with 71 years being the median age of diagnosis (Moline et al, 2009). Three of the four people diagnosed with MM were at Ground Zero on September 11, 2001, when the carcinogens would have been at their highest concentration (Moline et al, 2009). Although only eight people were identified with MM in this study, the authors noted that an additional eight diagnoses were reported to them since 2007; six of the eight cases were in first responders under the age of 50 (Molinet et al, 2009).

Another study conducted of these NYPD officers for five years prior to and 10 years after the WTC attacks showed that, even though the 39,946 officers had no previous significant history of work-related exposures to carcinogens, the officers had a 1.44 greater chance of being diagnosed with cancer than the NYPD officers serving in the five-year period prior to the WTC attacks (Kleinman et al, 2015). The highest increases were in brain cancer, which increased 3.27 times, kidney cancer, which increased 3 times, thyroid cancer, which increased 2.29 times, and non-Hodgkin's lymphoma, which increased 1.68 times (Kleinman et al, 2015). Although not conclusive, these studies show the powerful effects

one incident can have on the human body. Thankfully, incidents such as these are rare and extraordinary. But, what about the more mundane and routine aspects of police work?

Researchers believe the link between farmers and increased rates of prostate cancer is due to the use and exposure to organochlorines and organophosphates (Sauve et al, 2016), which are insecticides, herbicides, and pesticides. These same substances are often utilized in clandestine marihuana grow operations located in suburban homes and businesses (Martyny, Serrano, Schaeffer, & Van Dyke, 2013). Between 1997 and 2000, marihuana grow operations dismantled by the police went from 1,251 to 2,808 (Plecas et al). The number of marihuana grow operations in Ontario grew 250% between 2000 and 2002 (Martyny, Serrano, Schaeffer, & Van Dyke, 2013). In 2010, police officers in British Columbia alone dismantled 2,348 active marihuana grow operations (Diplock & Plecas, 2011 citing 2011 RCMP report). Although police attendance at marihuana grow operations may have declined in the past few years due to Health Canada's acceptance of marihuana grow operations, what about the officers who attended the high numbers of marihuana grow operations in the late 1990s through to 2016? How many exposures to carcinogenic chemicals was each officer exposed to when they attended clandestine marihuana grow operations? How many exposures are required before an officer gets cancer? How many years from exposure does it take before a diagnosis is made?

In 2011, the RCMP attended 48 synthetic drug labs in British Columbia (Morselli, Zhang, & Easton, 2016). British Columbia is now earning a reputation for being a world supplier of methamphetamine (Morselli, Zhang & Easton, 2016). Benzene, a known human carcinogen, is used in rubbers, dyes, detergents, and lubricants, but it is also used as a pesticide (American Cancer Society, 2016). Benzene is known to cause "acute myeloid

leukemia (AML) and myelodysplastic syndrome and a probable cause of other hematological malignancies, such as non-Hodgkin lymphoma" (McHale, Zhang & Smith, 2011, p. 240). Because "Cancers can be caused by DNA mutations (changes) that turn on oncogenes or turn off tumor suppressor genes" (American Cancer Society, 2015), AML can be caused in one incident through exposure to radiation and/or benzene (Nordqvist; 2017). The human DNA can change, causing leukemia cells to generate from normal bone marrow cells (American Cancer Society, 2015). How many times must a person be exposed prior to developing cancer?

Considerations for Future Research

Very little research has been conducted with respect to police officers and rates of cancer. Even fewer studies have been conducted in Canada, during the last decade, with male and female officers, and officers of multiple ethnic backgrounds. It must also be remembered that it has only been since 1974 that females have been allowed to join the RCMP and the Ontario Provincial Police (OPP), Canada's two largest police forces. In 1984, only 4% of RCMP officers were female (Statistics Canada, 2016). In 1995, only 13.6% of officers in the OPP were women (Ontario Provincial Police, 2017). Since that time, approximately 20% of the RCMP and 21% of the OPP is comprised of female officers (Royal Canadian Mounted Police, 2016; Ontario Provincial Police, 2017). With a significant percentage of females entering into policing as a profession, future research should also investigate the effect policing has on female officers. This is particularly relevant given that of the five studies located that expressly included female officers, two noted a statistical increase in cervical cancer (van Netten, Brands, Hoption, Spinelli, & Sheps, 2003) and elevated diagnoses of breast cancer (Kleinman et al, 2015).

Similarly, more research is required for people of non-Caucasian descent. Non-Caucasian officers make up approximately 10% of the approximately 18,462 officers in the RCMP (Royal Canadian Mounted Police, 2017). This is important as it is known that some cancers are more prevalent in people of specific ethnic backgrounds than others. For example, people of African heritage are more likely to develop prostate cancer than other ethnicities (Canadian Cancer Society, 2015).

Most research has focused on comparing cancer rates of police officers with those of the general population, without taking into account the Healthy Worker Effect, the periodic health assessments, and/or the fact that Canadian police officers are screened for health prior to entering into their respective police forces. Officers should not be compared to the general population. Rather, study cohorts should be structured with attention to the importance of age and the specifics and length of employment.

As it is, the majority of the studies researched cancer rates in those currently serving in a police force. Yet, less than 20% of officers are over the age of 50, an age when approximately 88% of cancers begin (Canadian Cancer Society, 2015). Additionally, many police officers leave policing prior to their ability to retire, either because they quit or had their employment terminated, so their cancer rates are completely unknown. In 2015 and 2016, 31% of officers who left their respective police departments were not eligible for retirement (Statistics Canada, 2016). Given this, a truly accurate study would control for the age of the participants as many officers could be leaving the police force prior to any diagnoses being made. Additionally, research would follow these officers after their retirement or after they have left policing for other reasons to identify the long-term health effects of a career in policing. Because they may not be diagnosed with cancer until after

they leave policing, there might not be an obvious and identifiable causal link between the career and the cancer diagnoses. As such, the true extent of the problem is likely to be grossly underestimated.

Research must also be attentive to the specifics and differences in careers for police officers. For example, nearly all recruits coming out of the RCMP training academy and the municipal training academies are put into general duty – but not all. A small percentage of graduating officers go directly into federal policing duties where there is a high likelihood they will not be placed on a four-shifts-on four-off rotating shift schedule. Additionally, there will be very few night shifts and very few dangerous encounters with armed suspects. Surveillance officers are generally not exposed to carcinogens, except those emitted from a vehicle, however, they spend extended hours sitting in a car, with minimal access to healthy food options, and even fewer opportunities to utilize a washroom. Forensic identification officers are exposed to harmful chemicals on a daily basis, as are firearms instructors. Future research should focus on the effects of police officer health as a result of the many different types of jobs within the policing realm. Perhaps by identifying which jobs within the police force are more likely to be associated with certain types of cancer, researchers will be able to identify which factors are more likely to have a causal relationship.

Some of the research, although it suggested that police officers do not have higher rates of cancer than the general population, indicate that police officers have higher mortality rates. None of the studies attempted to discover why there were higher rates of mortality for police officers. This would be one suggested area of research. Is the higher mortality rate because police officers are developing certain cancers younger than the

general population and, thus, are not screened for them in a timely fashion, allowing the tumors to grow and metastasize until they reach a level where they cannot be treated?

If research identifies that police officers are more susceptible to having cancer than their working public counterparts, further research is essential. Research would be beneficial to identifying which types of cancer police officers are more susceptible to, and to identifying what factors identified in the paper above contributed to increased cancer diagnoses. It would also shed light on whether or not survival rates could be higher if diagnoses were made sooner.

At this time, we just do not have the research to know the full extent of what the relationship between policing and cancer might be. We are not collecting data to facilitate this, and part of the problem is that police agencies do not keep sufficient records on officer health. Without appropriate record keeping there will never be sufficient evidence to properly establish the details of any association between cancer and police work. Most importantly, research must be designed to extend beyond the officer's career as many cancers have an incubation period in excess of five years, and otherwise are often not diagnosed until after retirement.

Conclusion

There is a clear and obvious need for further exploration on the nexus between policing and cancer. So little recent research has been done, particularly as it pertains to Canadian, female, and non-Caucasian officers. Hopefully, this paper will inspire others to look into the relationship between policing and cancer. Not only could such research save lives of hundreds of police officers throughout Canada, it could potentially save the government millions of dollars. If a link could be positively identified between policing as a

career and certain types of cancer, education and pre-screening could be implemented that could prevent some cancers and/or ensure cancers are detected earlier before they metastasize. Certain dietary choices are believed to reduce certain types of cancer, whereas, other dietary choices have an opposite effect. If police officers are more susceptible to certain forms of cancer, education could be tailored to teach them how to eat appropriately for their cancer risks.

The cost-savings to the Canadian taxpayer would be immeasurable, both in health care costs and lost work time due to illness. In 2009, the Public Health Agency of Canada estimated that cancer costs Canadian taxpayers approximately $4.4 billion dollars per year (Canadian Cancer, 2015). Further, the Canadian Cancer institute estimates that since 1988, approximately 179,000 lives have been saved through cancer prevention and control (Canadian Cancer Society). We are not currently in a position to reach presumptive status for a career in policing and a link to certain forms of cancer. However, further research could aid police officers in years to come, saving and enriching the lives of the law enforcement officers who risk their own lives to keep our communities safe.

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