The Intersection between Mining Contaminants and Hunting in Northeastern Ontario Communities

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Abstract

There is a plethora of research circulating in the academic word related to Indigenous hunters and how industrial development is affecting their traditional lifestyles; of particular concern are the toxic exposures derived from these industrial activities as well as the effects these are having on animal and human health. However, relatively little research exists on the ways in which non-Indigenous hunters are being impacted by and perceive the environmental risks posed by industrial activities (i.e., mining contaminants). The purpose of this study was two-fold: to investigate whether there is a relationship between hunting practices of non-Indigenous hunters and their health status and personal wellbeing as well as examining how the perception of environmental risk associated with mining contaminants might affect the hunting practices, health and wellbeing of non-Indigenous hunters living in northeastern Ontario communities. The study involved survey questionnaires that were distributed in four northeastern Ontario communities (Onaping Falls, Porcupine, Wawa, and Hearst) where a total of 390 hunters, non-hunters, and former hunters voluntarily participated. Findings from this study indicated a few relationships between hunting practice variables (discarding/giving away animals and hunting near mine or tailings sites) and general health, physical health, and physical health readiness variables but no relationships with personal wellbeing. Furthermore, significant associations were found between two hunting practice variables (hunting near mine tailings and discarding/giving away hunted animals) and the two risk perception variables. In addition, worrying about mining contaminants was significantly associated with reduced levels of mental health and personal wellbeing. Despite the significant associations, few hunters took actions as a result of their concern or worry over mining contaminants although it must be noted that only a minority of hunters always or very frequently hunted near mine or tailings sites. Either hunters

did not perceive the risks as being high or they merely have a high risk tolerance. Further research is required to delve deeper into the issues explored in this research study.

Abstrait

Il y a une multitude de recherches qui circulent le monde académique concernant les chasseurs autochtones et comment le développement industriel affecte leurs modes de vie traditionnels; les expositions toxiques dérivées de ces activités industrielles et leurs effets sur la santé animale et humaine sont particulièrement concernant. Cependant, relativement peu de recherches existent sur les façons dont les chasseurs non-autochtones sont touchés et perçoivent les risques environnementaux posés par les activités industrielles (c.-à-d., Les contaminants miniers). Le but de cette étude était: d'examiner s'il existe une relation entre les pratiques de chasse des chasseurs non-autochtones et leur état de santé et leur bien-être, et examiner comment la perception des risques environnementaux associés aux contaminants miniers pourrait affecter les pratiques de chasse, la santé et le bien-être des chasseurs non-autochtones vivant dans les communautés du nord-est de l'Ontario. L'étude comportait des questionnaires qui ont été distribués dans quatre communautés du nord-est de l'Ontario (Onaping Falls, Porcupine, Wawa et Hearst) où un total de 390 chasseurs, non-chasseurs et anciens chasseurs ont participé de façon volontaire. Les résultats de cette étude indiquent quelques relations entre les variables de la pratique de la chasse (rejeter / donner des animaux et chasser près des sites de mines ou de résidus) et la santé générale et la santé physique mais il n'avait pas de relation avec le bien-être. De plus, des relations significatifs ont été trouvés entre deux variables de la pratique de la chasse (chasse près des résidus miniers et rejeter / donner des animaux chassés) et les deux variables de perception du risque. De plus, s'inquiéter des contaminants miniers était significativement associé à des niveaux réduits de santé mentale et de bien-être. Malgré les associations importantes, peu de chasseurs ont agi en raison de leur inquiétude à l'égard des contaminants miniers, mais il faut noter qu' une minorité de chasseurs chasse toujours ou très fréquemment près des sites miniers

ou des locations à résidus. Soit que les chasseurs ne percevaient pas les risques comme étant élevés, ou ils ont une tolérance élevée au risque. D'autres recherches seraient nécessaires pour approfondir les questions explorées dans cette étude de recherche.

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Table of Contents

List of Tables

List of Figures

List of Appendices

Chapter 1 : Introduction

Mining and Hunting Activity

Mining has played an instrumental role in the Canadian economy for centuries. In Ontario alone, there are 43 active mines that produce 21% of Canada's current mineral production and contribute approximately 10.7 billion dollars to the Canadian economy (Ontario Prospectors Association, 2015). Although profitable, mines are at the epicenter of a number of environmental concerns across Canada. Based on Beck's (1992, 2013) risk society theory we are being faced with a larger number and different types of environmental risks as a result of industrial and scientific advancements. As a society, we no longer have the ability to contain these risks due to their long-lasting consequences and the vast impacts spanning across geographic boundaries (Beck, 1992; Mythen, 2004). Particularly concerning is the accumulation of heavy metals in soils which are affecting entire ecosystems, starting at the soil and groundwater levels and climbing up the food chain (Canadian Institute for Health Information, 2006). In some situations, these high metal concentrations are leading to serious health conditions in mining communities (Environmental Law Alliance Worldwide, 2014), which are already fraught with a variety of health issues such as cardiovascular illnesses, cancers, and mental health problems often leading to suicide (Canadian Institute for Health Information, 2006, Stough-Hunter & Donnermeyer, 2010).

Researchers have been documenting the effects of mining contaminants on Indigenous communities for years. Of particular concern has been the effect that these contaminants may have on country foods (foods harvested off of the land). Since consuming and harvesting country foods are important aspects of Indigenous people's physical, mental, and spiritual health, as well as the continuation of traditional cultural norms, the potential for possible contamination

of their main food sources places them at high risk of developing serious health problems (Dunk, 2002; Golden, Fernald, Brashares, Rasolofoniaina, & Kremen, 2011; Manore & Miner, 2006; Pufall, Jones, McEwen, Lyall, Peregrine, & Edge, 2010). For example, empirical studies have found that exposure to mining contaminants are linked to increases in birth defects, cancer, and kidney disease to name a few (Craft et al., 2004). One of the main problems is that the relationship between hunting and health is very complex and not always direct, particularly in Indigenous communities where unhealthy habits (i.e., smoking and drinking alcohol) are already contributing to poor health. In addition, health status is not always effectively reported and analyzed due to the antagonism and distrust held by Indigenous people with regards to non-Indigenous governments and academics, which significantly limits screening procedures and proper health assessments of illnesses (Craft et al., 2004). For this reason, researchers who study the relationships between mining contaminants and the risks they pose on Indigenous populations must always consider how population health dynamics and historic antagonist relationships might play a role in health outcomes.

Although hunting is often perceived as an Indigenous activity, it is also important to many non-Indigenous and Indigenous hunters not living on a reservation, however their participation is under-reported in academic literature (Ferrara & Lanoue, 2004; Gray, Duwors, Villeneuve, Boyd, & Legg, 2003; Manore & Miner, 2006; Mitchell, 2001). That being said, research has found that many hunters across Canada find that engaging in recreational hunting activities is a healthy way to stay connected with oneself, others, and the environment (Gray et al., 2003; Manore & Miner, 2006; Wisher, 1999). Hunting lies at the core of the values, individual identity and way of life of those who participate in this activity. Whether or not mining contaminants are having the same effects on hunters from non-Indigenous communities

as they do on hunters from Indigenous communities is important to know in order to reach population health goals across Canadian provinces, which include improvements in the overall health of all populations as well as decreasing the health inequities within these populations (Health Canada, 2001). If hunters are subject to greater health risks than the rest of the population due to their encounters with toxic mining residues, these risks must be assessed, analyzed and ameliorated in order to attain good health at the community level as well as at the national level.

Environmental contamination stemming from toxic mine residues has the potential to negatively impact outdoor enthusiasts who engage in activities such as hunting and fishing. With that being said, there is already a great deal of research devoted to the importance of fishing and what happens when fish contamination starts impacting human health (Doyle, Blais & White, 2012; Gray et al., 2003; King & Furgal, 2014). However, there is a gap that exists in the research literature with regards to hunting in non-Indigenous communities. Current peer reviewed research does not examine the hunting and health relationships of non-Indigenous or Indigenous populations living off of reservations. For this reason, very little is known in terms of the importance placed on hunting practices by these hunters and what happens when their hunting lands are transformed and contaminated by toxic residues from industrial activities like mining.

Research Study

The aim of this research study therefore, was to investigate the important aspects of the intersection between hunting, health, and mining contaminants. Due to the wealth of information that already exists with regards to fishing, it was decided that this activity would not be included in this study. Two research questions were developed. The first question asks, “is there a

relationship between hunting practices, including the consuming of hunted foods, of non-Indigenous hunters and their health status and personal wellbeing?" This question focuses on hunting and health relationships. The second research question delves deeper into the hunting and health relationship and tries to understand what happens when a potential health risk (i.e., heavy metal exposure) is introduced into a small, rural mining community. This question asks, "how does the perception of environmental risk associated with mining contaminants produced by mining activity affect the hunting practices, health and wellbeing of non-Indigenous hunters living in northeastern Ontario communities?" Together, these two questions address basic hunting and health relationships and then examine more complicated aspects of these relationships by considering perception of environmental risk related to hunting.

In order to proceed, it is important to provide definitions of the health and wellbeing concepts used in this research study. To begin, physical health is defined "as a state of wellbeing when all internal and external body parts, organs, tissues and cells can function properly as they are supposed to function" ("Physical Health Definition," 2018, para. 1). According to the World Health Organization (WHO), mental health is, "…a state of wellbeing in which every individual realizes his or her own potential, can cope with the normal stresses of life, can work productively and fruitfully, and is able to make a contribution to her or his community" (World Health Organization, 2014). Personal wellbeing refers to "good mental states, including all of the various evaluations, positive and negative, that people make of their lives and the affective reactions of people to their experiences" (OECD, 2013, p. 10).

Anticipated relationships between hunting practices, health and wellbeing, as well as environmental risk can be illustrated in two conceptual maps. The first conceptual map corresponds to research question one and focuses on the possible relationships of hunting

practices with health and wellbeing. It presumes that if a hunter never hunts within 10 km of a mine or tailings site, and if he or she is regularly consuming the animals that are hunted, spending a great deal of time hunting in the outdoors, and has been hunting for many years, he or she will continue to receive health and personal wellbeing benefits that are attributable to performing regular outdoor activities such as hunting and consequently, he or she will have a high level of health and wellbeing (see Figure 1.1). On the contrary, if a hunter always or very frequently hunts within 10 km of a mine or tailings site, and if he or she always or very frequently consumes animals that are hunted near a mine or tailings site, hunts more than 50 days in a season (more days = greater potential of exposure), and if he or she is aged 51 years or older (likely has been hunting longer than someone younger) then he or she will likely experience lower levels of physical health.

The second conceptual map corresponds to research question two and looks at environmental risk rather than hunting practices (see Figure 1.2). It assumes that if a hunter is not concerned about consuming animals shot near mine or tailings sites and if he or she is never worried that there are mining contaminants in the animals that he or she hunts and eats, then he or she will continue to hunt which will bring about high levels of health and personal wellbeing. On the contrary, if a hunter is always concerned about consuming animals shot near mine or tailings sites and if he or she is always worried that there are mining contaminants in the animals that he or she hunts and eats, one's concern and worry could result in a lower level of health and wellbeing.

Importance of Study

Findings from this study can potentially aid in developing our knowledge of non-Indigenous and Indigenous hunters living away from traditional lands who are often not studied,

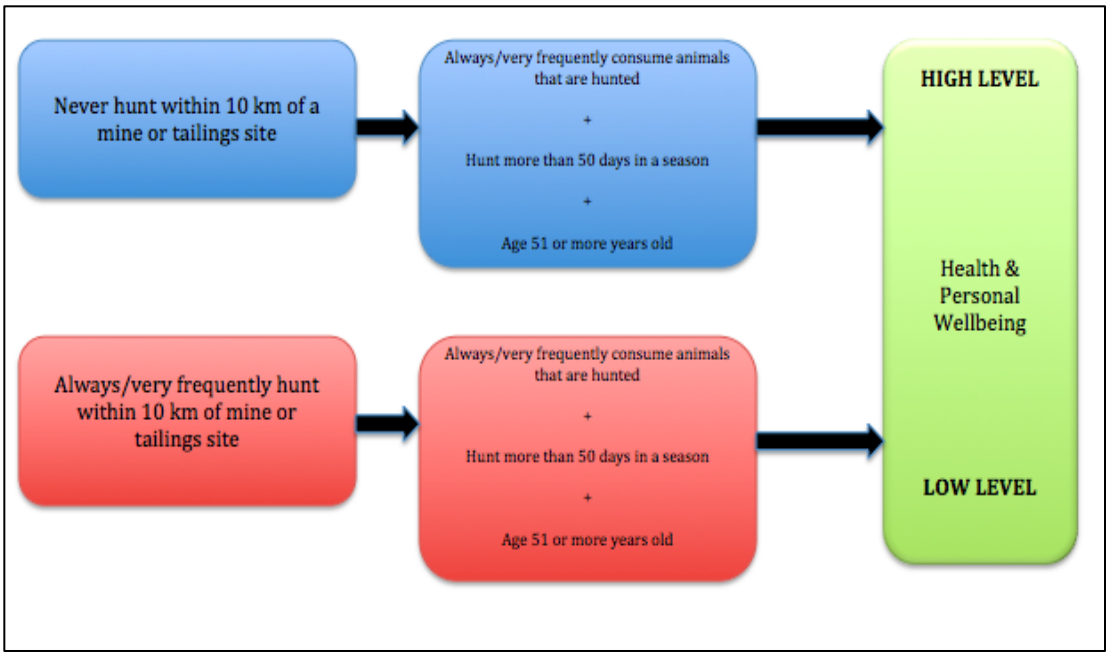

Figure 1.1. Conceptual map of the theoretical relationships between hunting practices, risk perception and health and wellbeing.

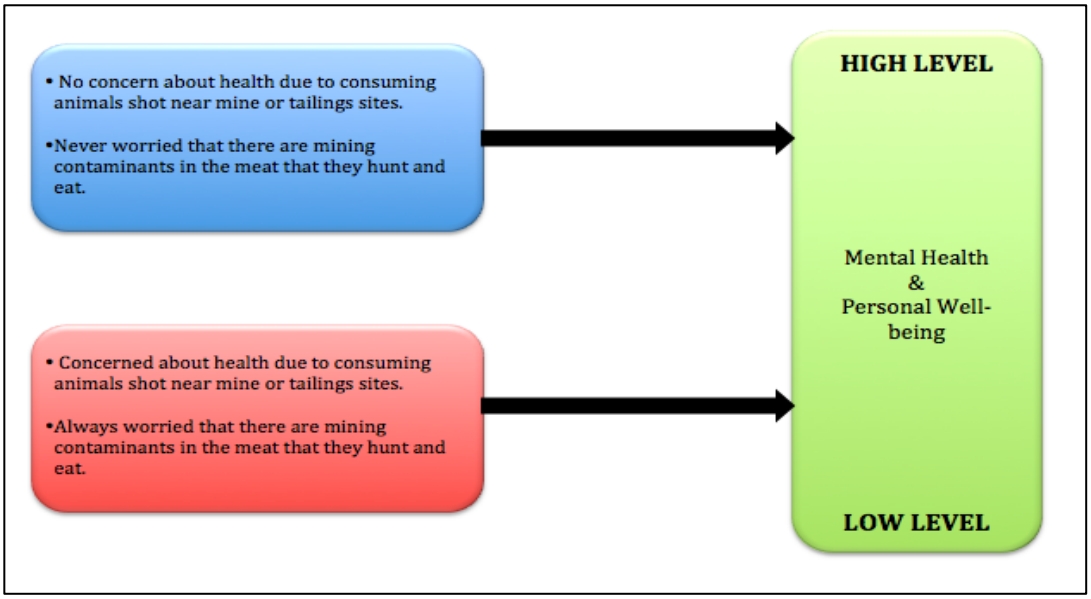

Figure 1.2. Conceptual map of the theoretical relationships between hunting practices, risk perception and mental health and personal wellbeing.

and the complex relationships between hunting, health, and environmentally degrading industrial activities. In the future, the results of this study may be helpful in forming a coalition between Indigenous and non-Indigenous hunters in their defence of hunting, which hunters feel is often under siege (Manore & Miner, 2006). Furthermore, this study can also provide health institutions with information regarding the hunting-health relationship and whether there is a need for physiological health assessments (i.e., blood tests, hair sampling, and urinalyses which can actually determine metal concentrations) in mining communities where exposures are high enough to anticipate negative health impacts from hunting practices. This study may inform mining industries of the possible importance of maintaining hunting practices for people in nearby communities. Since aspects of current environmental risk assessments, such as deciding who may be harmed and how often, usually focus on Indigenous hunting regimes, they may not adequately consider non-Indigenous hunters' health and wellbeing. Therefore, the results of this study may be relevant to policy makers who make decisions regarding mine tailings rules and regulations as well as environmental supervisors who oversee mine tailings assessments, when deciding who will be harmed by a hazard.

Chapter 2 : Literature Review

This chapter critically reviews literature that exists on exposure to mining contaminants and what this means for people who live, hunt, and consume animals in non-Indigenous communities in northeastern Ontario. Note that, a contaminant is described by the Canadian Government's Environmental Protection Act as, "any solid, liquid, gas, odour, heat, sound, vibration, radiation or combination of any of them resulting directly or indirectly from human activities that causes or may cause an adverse effect" (Ontario Ministry of the Environment, 2011, "What is a contaminant", para. 1). In this study, we are particularly concerned with contaminants from mining residues (i.e., heavy metals).

This literature review synthesizes research on: Indigenous people and hunting; perceived importance of hunting; benefits of hunting; benefits of consuming hunted animals; how the mining industry poses a risk to the quality of hunted food in Canada; the human health risks associated with exposure to trace elements from gold, copper and nickel mines; and environmental risk perception. Underlying each of these sections of the literature review is the notion that the relationship between hunting and health is complex and not direct and therefore, population health dynamics are taken into account throughout the review. In 1997, the Federal, Provincial, and Territorial Advisory Committee on Population Health (ACPH) of Canada defined population health as, "…the health of a population as measured by health status indicators and as influenced by social, economic and physical environments, personal health practices, individual capacity and coping skills, human biology, early childhood development, and health services" (Government of Canada, 2012, para. 2). The aim of population health is to improve the health of a population and decrease health status inequities based on key determinants of health which can include: social, economic, and physical environments; early childhood development; personal

health practices; individual capacity and coping skills; human biology; and health services (Health Canada, 2001). Obviously, mining contaminants, which can have serious impacts on human health can decrease overall population health and make it difficult to achieve its aims.

Indigenous People and Hunting

Research concerning the meaning of hunting has proliferated in the past few decades with a particular focus on Indigenous communities. Many researchers now have a better understanding of the importance of hunting practices to Indigenous people (Herrmann et al., 2014; Hipwell, Mamen, Weitzner, & Whiteman, 2002; King & Furgal, 2014; Samson & Pretty, 2006). It is evident from the literature that hunting and gathering foods from the land plays a fundamental role in sustaining Indigenous people's socialization, health and wellbeing. For Indigenous people, hunting and the land itself are believed to form the basis for their economic, social, and religious practices (Samson & Pretty, 2006). Indigenous peoples' relationship with the land and their hunting regimes in the 1900s led to the exploitation of natural resources such as timber, energy, and minerals (Samson, 2003a). What remained were barren lands that were often contaminated by toxic residues. The Canadian government's attempts at assimilating Indigenous populations into local villages was not an effective method of 'taking care' of these displaced people as was evidenced by the Innu of Labrador whose way of living and lifestyles were so tied to the land that in the absence of this relationship, their physical and mental health, as well as their personal wellbeing significantly declined (Samson & Pretty, 2006). Most Innu had trouble finding adequate full-time employment and have had to rely on social assistance or welfare payments in order to support their families long-term (Samson & Pretty, 2006). This type of displacement situation leaves these people with few opportunities for self-reliance and self-determined lives, both of which are important to their culture and individual health (Samson,

2003a). A focus on the economic value of land, timber, reservoirs for hydro-electricity, ore deposits, and the need to protect wildlife blinded policy makers in this region to the negative effects that these developments were having on the traditional lifestyles of Indigenous people (Samson, 2003a).

A growing body of literature is now devoted to the effects that current industrial activities (e.g., contaminants from mining) can have on Indigenous hunters' health in such communities (Dewailly & Nieboer, 2013; Furgal & Rochette, 2007; King & Furgal, 2014; Pufall et al., 2011). Indigenous people who hunt and fish are unequally exposed to health risks since they come into contact with contaminants from industrial procedures such as mining. Researchers often study the effects of mining contaminants on these populations with the hopes of uncovering ways to help these populations enhance their health at the micro and macro levels in order to achieve the national population health goals of improving the health of the population and decreasing health status inequities (Health Canada, 2001). Within the Indigenous health literature, three empirical studies exist on the aforementioned mining contaminant issues that are of direct pertinence to this study. The first study by Furgal and Rochette (2007) looked at environmental contaminants and found that once Nunavik residents became aware of environmental contaminants, 25% of them reported changing their diet which resulted in a potential loss of some benefits attributed to a traditional (uncontaminated) Inuit diet and lifestyle. The second study performed by Pufall et al. (2011) involved community-based research which found that the Inuit people of Nain, Nunatsiavut had major concerns about human expansion in the North, mining operations, chemical contamination and the effect that these contaminants would have on animals and the food harvested from these animals. The third foundational study was that of Dewailly & Nieboer (2013), which found that Oujé-Bougoumou Cree residents, who were believed to be exposed to

high levels of mine tailing residues, were not at risk of developing related internal health conditions. These studies serve as a basic foundation on which further studies on mining contaminants and hunting can be based. In addition to these studies, a review by McAuley and Knopper (2011) examined research studies on Indigenous communities and/or reservations from the Northwest Territories to Newfoundland and Labrador, which looked at exposure to industrial contaminants and perceptions of Indigenous health. Ultimately, the studies all focus on Indigenous communities or reservations in remote regions of Canada; they do not focus on Indigenous people who live off of reservations and on non-traditional territories.

Perceived Importance of Hunting – Why People Hunt

Hunting is and always has been part of Canadian culture (Dunk, 2002; Manore & Miner, 2006). Ever since the onset of urbanization and industrialization, people have had to expend less time and energy working to meet their immediate needs for survival (Manore & Miner, 2006). As a result, opportunities were afforded by free time to participate in activities for enjoyment. For some people, this spare time meant hunting for recreational purposes rather than for sustenance. For others, it meant fishing, hiking, bird watching, or just getting active outside. Many Canadians who hunted perceived it as a social activity whereby groups of families and friends would get together in an outdoor setting and experience nature firsthand (Manore & Miner, 2006).

It is evident in the hunting literature that hunting was, and continues to be, not just about the kill (Dunk, 2002). Common across this literature is the feeling of excitement, experience, companionship of others, self-fulfillment, spiritual renewal and reconnection with the natural world while hunting (Dunk, 2002; Good, 1997; Pufall et al., 2011). There are reports of hunters feeling humbled by their ability to stalk and capture an animal, proving to themselves and to

others that they did not have to rely on grocery stores in order to survive (Dunk, 2002). In much of the Indigenous hunting literature, hunting and consuming personally harvested country food is reported to foster passionate expressions of self-identity, elicit discussions of ethical behaviours and relationships to nature, and strengthen Indigenous rights and recognition (King & Furgal, 2014; Manore & Miner, 2006; Pufall et al., 2011).

Although the majority of the reviewed literature related to hunting focuses on Indigenous peoples, there is some evidence in Dunk's (2002) court-appeal paper that non-Indigenous hunters experience the same sort of fulfillment when they hunt. During the spring bear hunt court appeal in 2002, when asked, the Indigenous community and the non-Indigenous community both reported similar levels of meaning associated with hunting (Dunk, 2002). The non-Indigenous community in this case felt as strongly about the importance of hunting to their way of life as did the Indigenous community. This finding suggests that it is quite possible that hunting is of equal importance to both Indigenous and non-Indigenous hunters in Canada. Another piece of literature that speaks about hunting in general and not specifically with regards to Indigenous communities is that by Stough-Hunter and Donnermeyer (2010). This ethnographic study in Applalachia, U.S., reports findings on the 'rural man'. For the men in the study, hunting and fishing are important aspects of masculinity and if one does not identify as a hunter or fisherman, then he is probably 'gay' according to the majority of the respondents that were interviewed (Stough-Hunter & Donnermeyer, 2010). These preconceived notions of how to 'do' gender enable researchers to see the deeply rooted gender norms that help to shape the typical social relationships of hunters and fishermen in rural mining communities. In other words, rural men are expected to hunt and fish if they are truly (men) and failure to do so results in stigmatization from the rest of the community. This expectation illustrates how social factors play into the

structuring of a community and ultimately affects how it functions. Such strong norms underlying a society make achieving population health goals difficult since citizens' values are often deeply rooted.

For some men, hunting has also been used as a measure of health. Stough-Hunter and Donnermeyer's (2010) study revealed that rural men of an Appalachian community believed that if one is still able to hunt then he is most likely healthy. This belief is problematic however since the activity of hunting is by no means a key determinant of health. This type of ideology lends itself to fewer visits to the doctor and more deaths related to diagnosing serious illnesses too late (Stough-Hunter & Donnermeyer, 2010; Halverson et al., 2004). Stough–Hunter and Donnermeyer (2010) reported that the Appalachian men in their study felt that going to the doctor was not perceived as masculine but should they have to go, their doctor should be someone that they can relate to; someone that hunts and fishes. The researchers concluded that the study participants lacked proper health literacy, interest in health outcomes, and involvement in community health services. This deficiency in awareness could be a result of exclusion from overarching health decisions at the national level, which is a mistake of the government. Employing mechanisms of public involvement in health, which would highlight the proper means of assessing health (rather than using hunting as an indicator) and the importance of maintaining good health, might act as a means of attaining population health goals in these populations. Therefore, community members should be included in meetings and decisions regarding how to improve health scores in their particular community. These meetings would be a good opportunity to make community members aware of the risks that are prevalent within their vicinities and it would also help to inform policy makers and stakeholders of the concerns of community members as well as the foundational norms and values that are fundamental to

their ways of life. No single approach to assessing health and wellbeing will be suitable for all communities, especially rural ones that do not necessarily follow typical norms, and therefore, conversations with community members should be encouraged.

Although there is a lack of pertinent research to state with certainty, it is possible that if non-Indigenous people are hunting as often and with as much importance placed on the activity as Indigenous hunters, it is likely that they also face unequal health burdens as a result of their continual exposure to mining contaminants. When this exposure to mining contaminants is combined with poor attendance at doctors' appointments and preconceived notions of health indicators (i.e., ability to hunt and fish), it makes for potentially fatal health outcomes. According to population health data, these unequal health burdens is something that should be addressed in order to maintain and/or improve the health and wellbeing of entire populations and effectively reduce inequities in health status among these groups (Health Canada, 2001).

The Benefits of Hunting

Hunting communities are generally smaller, rural communities that face a higher number of economic and socio-demographic challenges which tends to result in lower levels of overall health than their urban counterparts (Canadian Institute for Health Information, 2006; Stough-Hunter & Donnermeyer, 2010). Age, economic difficulties and geographic isolation are believed to account for most of the health vulnerabilities in rural areas and small towns in developed countries (Canadian Institute for Health Information, 2006; Matthews & Gallo, 2011). Socio-demographic statistics regarding rural communities reveal that people from these areas are less educated, have higher rates of unemployment, and lower incomes than people in urban centers (Canadian Institute for Health Information, 2006). Researchers have found that people living in rural areas tend to have higher rates of health problems including cardiovascular illnesses,

cancers, and mental health problems that lead to suicide (Canadian Institute for Health Information, 2006). There seems to be consensus in the empirical literature that the cause of the lower health scores for people in these rural or smaller communities are related to lifestyle risk factors (i.e., smoking, alcohol and substance abuse, and low levels of engagement in physical activities), physical environmental factors (i.e., living near toxic mine sites), as well as poor access to and utilization of health centers (Canadian Institute for Health Information, 2006; Stough-Hunter & Donnermeyer, 2010). Together, all of these challenges make reaching population health goals set by Health Canada challenging to meet. Different strategies must be applied at these rural levels than what would be applied in urban centers because of the increased vulnerability of these people. Despite these health challenges, people in rural communities have found that hunting can be beneficial to health and the remainder of this section will explain why.

Researchers agree that hunting promotes an active lifestyle that can help to achieve population health goals and improve health inequities. Modernity is characterized by sedentary lifestyles in all aspects of daily life, including during leisure time, which has led to widespread chronic diseases (O'Keefe, Vogel, Lavie, & Cordain, 2011; Samson & Pretty, 2006). Hunting can be physically demanding; catching animals involves a certain level of physical ability as long as the majority of this activity is not done using motorized transport (King & Furgal, 2014; Samson & Pretty, 2006). For example, hunting can be extremely physical if hunters are cutting their own trails using axes and handsaws, if they are tracking animals on foot while carrying heavy hunting gear, and walking on rugged and uneven terrain while climbing hills. According to a meta-analysis performed by O'Keefe et al. (2011), human bodies are genetically engineered for the hunter-gatherer lifestyles of our ancestors. Humans thrive when they endure regular physical activity but become ridden with disease and debility when they do not (O'Keefe et al.,

2011). Although many people in modern societies exercise regularly in indoor gyms, some researchers believe that the same people would receive additional benefits from exercising outdoors (O'Keefe et al., 2011). Increased vitamin D, memory function and attention span are all attributable to regular outdoor exercise (O'Keefe et al., 2011). Therefore, hunting is a good way to exercise and attain these additional health benefits. In addition, Gray et al. (2003) reported that the majority of Canadian hunters were over the age of 55. Given that physical activity generally declines over time, hunting is a good way for these older age groups to remain active, physically fit, and free of debilitating illnesses related to inactivity. It is evident from the Indigenous assimilation literature that active lifestyles are important in maintaining physical health.

Hunting can also be advantageous to the mental health of individuals, which is helpful given the tendencies of hunting communities to be fraught with mental health illnesses. Research conducted on Innu populations in Labrador determined that regular outdoor activity, as opposed to sedentary lifestyles, decreased an individual's risk of depression, drinking, suicide, solvent abuse, sexual abuse, loss of self-esteem and feelings of uselessness (O'Keefe et al., 2011; Samson, 2003b; Samson, Wilson & Mazower, 1999). The Innu almost unanimously spoke of hunting as a fulfilling exercise that was therapeutic for their mental health (Samson & Pretty, 2006). Similar mental health declines were reported in Australia, Botswana, and Mongolia when Indigenous populations were moved off of their lands, disconnected from their hunting routines, and placed in modern societies by governments hoping to assimilate them as a means of gaining their lands which were high in natural resources (Gall et al., 2015; Humphrey & Sneath, 1999; Olmsted, 2004; McKnight, 2002; Trudgen, 2000). In addition, a meta-analysis performed by O'Keefe et al. (2011), revealed that regular outdoor activities like hunting could improve an

individual's mood and reduce his or her likelihood of emotional stress. One of the main reasons why there are tensions between Indigenous people on reservations and governments and why many Indigenous reservations are fraught with poor living conditions and the misery that comes with living a life full of solvent abuse, alcohol abuse, sexual abuse, and depression is due in part to the fact that these people who once had free reign of the land and experienced freedom to explore and connect with lands minimally altered by humans, are now confined to a relatively small area (Samson & Pretty, 2006). Since these villages are now the sites of many horrific tragedies (i.e., suicides of loved ones); living in them increases the feeling of loss, especially for those generations old enough to remember life in the country and who compare this life to the poor life in the new 'villages' (Samson & Pretty, 2006). While some of the Canadian government's attempts at ameliorating health problems within Indigenous villages are welcomed, an issue among Indigenous people is that the governments are not recognizing their need to be connected to the lands and their need to hunt for their foods; without this connection, their poor health is not likely to improve as the land and hunting are such important aspects of who they are as individuals and as communities. They require the autonomy and freedom to hunt when they want to hunt and to rest when they want to rest, which is unlike the rigid work schedules that define modern civilizations (Samson & Pretty, 2006). In the absence of their freedom, their mental health is compromised. Although the situation is different for non-Indigenous hunters living in modern societies since they are accustomed to the norms and regulations of modern societies, it is not correct to assume that barriers posed by industrial activities that potentially affect their hunting activities do not affect their mental health as well. This assumption is something that needs to be explored in more detail; a more inclusive approach that includes non-Indigenous hunters needs to be taken with regards to hunters' mental

health so that baseline health assessments can be created that are continually monitored with the tong-term aim of improving mental health outcomes.

Another important benefit attributable to hunting is an increase in personal wellbeing (Dunk, 2002). Particularly in rural communities that lack community services, hunting can act as a means of socialization and a means of achieving better population health (Mactaggart, McDermott, Tynan, & Gericke, 2016). According to the Ontario Federation of Anglers and Hunters (OFAH), hunting is fundamental to hunters' feelings of self-worth, expression, freedom and personal adventure (Dunk, 2002). Many hunters use their hunting experiences in order to identify themselves in the world with their loved ones, friends, and community members (Dunk, 2002; Stough-Hunter & Donnermeyer, 2010). Many male hunters also use hunting as a means of fulfilling their gender role and proving to others that they are 'manly'; actively participating in hunting makes them feel like they fit in with other men (Stough-Hunter & Donnermeyer, 2010). Hunters experience the life cycle firsthand, which can help them develop a nature-oriented worldview, an understanding of life processes, and an appreciation for measures taken to preserve our natural environment (Dunk, 2002). Hunters are exposed to the notion of survival and death, the power of nature, and the actions required by humans in order to sustain wildlife populations and our natural environment (Dunk, 2002). This exposure increases concern for local environments, making people more likely to take measures to improve and/or advocate for environmental improvements, which ultimately increases peoples' satisfaction with their local environment. In addition, hunting is usually done as a group, which helps to build strong community ties and relationships, which some people lack in their daily lives, particularly in small, rural communities (Manore & Miner, 2006).

The Benefits of Consuming Hunted Animals

In recent years, researchers and policy makers have advocated the benefits of hunting and consuming hunted foods procured from local environments (King & Furgal, 2014). Eating hunted foods was generally seen as a healthy option and thus, adopting a diet similar to Indigenous communities in northern Canada was encouraged (King & Furgal, 2014). Studies have shown that the average hunted food diet has higher protein (especially x-3 fatty acids), fat, vitamins (e.g., vitamin C and selenium), iron nutrient value and energy availability than the equivalent foods at conventional grocery stores which can be high in carbohydrates and saturated fats and low in essential nutrients (Golden et al*.,* 2011; King & Furgal, 2014; McGrath-Hanna et al., 2003). Studies have shown that obesity rates have risen sharply within recent decades and do not seem to be slowing (Cancer Care Ontario, 2015; Kopelman, 2000; Vanasse, Demers, Hemiari, & Courteau, 2006). Over 18% of Ontario adults over the age of 18 years were considered to be obese in 2012 based on Canadian obesity guidelines compared with only 4% of the Ontario population aged 18 years or older who were considered obese in 1985 (Cancer Care Ontario, 2015). It is believed that the cause in rising obesity rates is an imbalance between caloric intake and activity level, which defines modern societies (Vanasse et al., 2006). Unfortunately, obesity is leading to chronic health illnesses (i.e., significantly increased cancer rates) within the Canadian population and lends itself to disability, lost days at work, restricted activity days, and mobility limitations which results in enormous costs to the healthcare system making it hard to find finances for projects aimed at improving community health (Cancer Care Ontario, 2015; Vanasse et al., 2006).

A study that surveyed six Indigenous communities in the 1990s found that the transition in diet to grocery store-bought foods led to a diet low in fruits, vegetables and dairy products,

and high in sugar; a diet which did not meet the recommended daily doses of calcium, magnesium, folate, vitamin C, and vitamin A (Lawn et al., 2002). Consequently, many Indigenous people who have been assimilated into modern society have experienced weight gain and health problems due to their exposure to different and non-traditional diets (Samson & Pretty, 2006). Unsurprisingly, common among these health issues are rising obesity rates, diabetes and cardiovascular complications (Kuhnlein, Receveur, Soueida, & Egeland, 2004; Thouez et al., 1990). Case in point, Cree and Inuit populations from Northern Quebec have undergone extreme political, economic, structural, and cultural transformations in the last twenty to thirty years, which has resulted in an increased dependence on external sources of supplies and foods rather than their healthier and more traditional ones (Thouez et al., 1990). The results of these transformations have been discouraging given their decreased health following the aforementioned changes.

Not only do studies show that hunted food diets are a healthy alternative to many store-bought foods, but consumers of a hunted food diet also believe this to be true. For example, in a study performed on the Inuit of Labrador, participants were asked about their perceptions of consuming hunted food (Pufall et al., 2011). Participants reported that eating harvested foods was good for their health because they knew that their foods were not contaminated with genetically modified organisms (GMOs) that are often used by food processing companies in modern societies (Pufall et al., 2011). The harvested foods were valued by the Inuit due to their perceived freshness, variety, healthfulness, and superior taste (Pufall et al., 2011). The Inuit also felt safer eating hunted meat because they knew that there were no additives, hormones, or antibiotics in the meat. These people regarded the consumption of hunted and harvested foods as fundamental to their physical, mental and spiritual health (Pufall et al., 2011).

Although hunted and harvested foods were advocated in the past, recently, researchers have become concerned with contamination in the food chain as a result of environmental land-use change and what effect this might have on the health of hunters or harvesters who are consuming these foods (King & Furgal, 2014). Small and large animals accumulate heavy metals from industrial residues into their systems via ingestion, inhalation, grooming, skin absorption, and placenta transfer during pregnancy (Gall et al., 2015). Typically, levels of metal accumulation in animals are measured via tissue samples from the stomach, liver, kidneys, lungs, femurs, hair, teeth, and blood samples (Gall et al., 2015). The exposure and resultant concentrations held within an animal's body depends on factors such as the type of species, diet, season, sex, age, and the metal that is being considered (Gall et al., 2015).

Another important factor in determining metal accumulation and exposure in animals is their foraging range as small animals (who generally have small foraging ranges) and those large animals foraging closer to a polluted site will be at the highest risk of toxic metal contamination. Reglero et al. (2009) found higher levels of lead in animals that repeatedly foraged near mining areas than those who foraged at other non-polluted sites as well. Something of great importance to humans is that animal diets that are rich in heavy metals lead to accumulation of metal in the tissue, especially when the metals are not essential elements of diets and/or when their concentrations are well above acceptable exposure guidelines. Since tissue is typically the part of the animal that is consumed by humans, hunters should be concerned when they hunt animals near polluted mine or tailings sites as this is a precursor to developing severe health conditions.

How the Mining Industry Poses a Risk to the Quality of the Environment and Hunted Food in Canada

There is increasing literature on the presence of environmental contaminants in hunted foods (King & Furgal, 2014). This contamination is a result of industrial processes like mining,

which involves toxic waste. Simply put, the mining process involves the removal of overburden, and often toxic, minerals in order to access desired ore deposits (Environmental Law Alliance Worldwide, 2014; Hilson, 2002). In order to access the desired ore deposit, many loads of waste rock, littered with high levels of toxic substances, must be removed (Environmental Law Alliance Worldwide, 2014). This toxic waste rock is often piled on mining sites, used as backfill in open pits or piped to tailings ponds for long-term storage (Environmental Law Alliance Worldwide, 2014). These waste sites have the potential to produce toxic dust and acid mine drainage which contaminates water courses and can lead to a decrease in the quality and growth of vegetation, soil qualities and ultimately, the health of living organisms that depend on them (Environmental Law Alliance Worldwide, 2014; Hilson, 2002; Sumi, Thomsen, & Rogers, 2001). One of the major routes of contamination is from airborne particles carrying toxic heavy metals to sites away from the direct deposit of the waste rock. Elevated concentrations of heavy metals in soils and plants adjacent to mine sites have been reported across the world (Zhuang, Zou, Li, & Li, 2009). Some of the toxic elements are particularly concerning because they have the potential to affect human health (Csavina et al., 2014).

Industrial developments like mining have been found to affect the quality and availability of traditional foods used by Indigenous populations (McAuley & Knopper, 2011). Many researchers like Donaldson et al. (2010) have focused their empirical studies of environmental contaminants and human health on communities in the Canadian Arctic that are at a high risk of contamination due to the bioaccumulation of polychlorinated biphenyls (PCBs) in this region. For instance, the Inuit Health Survey which focused on hunting, fishing and resource collection made the troubling discovery that despite the obvious contamination, traditional hunting activities were too important to the Inuit people that concern over environmental contaminants

did not lead to the rejection of their catch (Furgal & Rochette, 2007). What this means is that the benefits of engaging in the hunter-gatherer lifestyles outweighed the risk of environmental contaminants. One can tell how deeply rooted this lifestyle is when educating the population of the risks did not impact their participation in traditional activities. This commitment to traditional activities is an example of barriers encountered by the government when trying to improve health and decrease health inequities. Although much of the literature focuses on contamination to aquatic animals and systems, some information is available regarding terrestrial animals that could be hunted as food (McAuley & Knopper, 2011; Peplow & Edmonds, 2005). For example, an empirical study performed by Peplow & Edmonds (2005) looked at the effects of mine waste contamination at multiple levels of biological organization and found that bears in the Okanogan County, Washington, USA region were exposed to an arsenic level that was 18 times the average for arsenic based on an analysis of the hair of bears not exposed to arsenic. That being said, due to a lack of knowledge regarding the duration of exposure as well as species specific responses to arsenic, the calculation of risk to wildlife and eventually humans, remains unknown. It is hard to develop measures aimed at improving population health when the full extent of the risks are not known. Of particular importance to this study is the lack of research conducted beyond the Canadian Arctic and other remote, northern Indigenous communities that have looked at how contaminants from the mining processes can affect the health of hunted animal populations and consequently, the health of those who consume these animals.

Human Health Risks Associated With Exposure to Trace Elements Derived from Gold, Copper and Nickel Mines

Gold, copper and nickel mining, the types of mining that take place in northeastern Ontario, can result in elevated levels of arsenic, mercury, copper and nickel in waste rock and water. Heavy metals such as these are highly toxic and reactive even at low concentrations and

once they have entered the ecosystem, it is very difficult to mitigate their negative effects (Ensley, 2000; Sánchez, 2008; Wuana & Okieimen, 2011). Although some of these metals are essential to the diets of animals and humans at very low doses, mining residues contain high concentrations, which are above regular limits of animal and human health exposure based on guidelines produced by health organizations such as the Institute of Medicine (2001). Something to keep in mind however is that non-essential metals are more likely to accumulate in animal and human systems than essential nutrients because the essential nutrient metals are already regulated and the body tends to naturally excrete excess levels of these (i.e., zinc and copper are essential nutrients at low doses). Therefore, heavy metals like arsenic, nickel, copper, and mercury, which at very high levels lead to accumulation in animal tissues, are the metals that require the most attention and remediation work if we are to reach population health goals outlined by the Population and Public Health Branch of Canada in 2001.

In terms of humans, exposure to toxic elements like arsenic, mercury, copper, and nickel through consumption of contaminated food, water, soil, or air can lead to serious human health problems (Abdul, Jayasinghe, Chandana, Jayasumana, & Silva, 2015). It is possible that humans eating animals or fish that have been exposed, via plants, water, and other animals if they are carnivores, to high levels of these contaminants are at risk of developing serious health conditions (D. Fortin, personal communication, May 9, 2016). According to the International Council of Mining and Metals (ICMM), "beyond work related illness, few endeavours attempt to prevent diseases that affect the wider community or to consider the community's broader wellbeing" (Mining, Minerals and Sustainable Development Project, 2002, p. 20). In other words, mines do not focus on addressing health illnesses attributable to mine residue exposures.

Abdul et al. (2015) studied the key effects of inorganic arsenic exposure on major organ systems and found that arsenic can negatively impact various human organ systems throughout the body leading to major human health problems if exposure exceeds 2.0 μg/kg-bw/day (see Appendix A). If mine tailing residues are not carefully controlled, there is potential that humans and animals could suffer the consequences of chronic or acute arsenic exposure. Arsenic is particularly concerning due to the small size of its particulate, which travels freely in the air and is easily inhaled by those who come into contact with it.

Another element, mercury, is also of great concern. Mercury is a naturally occurring heavy metal that may enter the environment in various ways including through anthropogenic activities like mining (Holmes, James, & Levy, 2009). Methyl-mercury (MeHg) is the most stable form of mercury and is the one that raises the most concerns for human health because it is a neurotoxin. Mercury is easily absorbed by plants and it is particularly worrisome for those consuming foods from higher levels of the food chain because of its tendency to bio-accumulate (Holmes et al., 2009; Yeganeh et al., 2013). Mercury is often a concern for humans eating fish, particularly predatory fish, due to the increased rate of bioaccumulation. That being said, much is already known regarding hazardous interrelationships between fishing, mercury, and human health (Tkatcheva et al., 2004; Kuzyk, Burgess, Stow, & Fox, 2003; Payne et al., 2001). Recognized target organs for mercury include the kidneys, central nervous system, and the thyroid glands (Holmes et al., 2009). For this reason, it is recommended that humans do not ingest organs of animals shot near mine or tailing sites (Gall et al., 2015). Continual ingestion of trace amounts of mercury can lead to major health problems (see Appendix A). Humans have an upper daily mercury limit of 50 μg/L blood or 100 μg/L urine (Holmes et al., 2009).

Copper is an essential trace metal that humans require in their regular diet (da Silva & Williams, 2001). A daily intake of 900 μg per day is the recommendation for adults with an upper limit of 10 mg per day (Institute of Medicine, 2001). Copper toxicity is rare, unless large amounts of copper salts are ingested, due to the human body's natural ability to excrete excess amounts (Institute of Medicine, 2001). In altered environmental conditions (i.e., mine contaminants) however, the risk of exposure to high levels of copper is significantly increased because exposure levels are simply too high for the body to keep up with the toxin. This increase was observed in a study of people living near an abandoned copper-sulphide mine in Libiola, Italy where residents were experiencing the negative health effects of chronic copper exposure (Zotti et al., 2014). It was evident from this study that the intake of high levels of copper can result in adverse human health problems (see Appendix A).

Lastly, another element of concern due to its tendency to be found in local mine residues is nickel. This element is an essential micronutrient at very low concentrations but it can become toxic at high concentrations (Yeganeh et al., 2013). If exposed to nickel for long periods of time or at very high concentrations, humans can develop nickel-related illnesses (see Appendix A). Of particular concern for human health are sulfidic and oxidic nickels due to their tendency to be carcinogenic, which have upper limits of 10 mg Ni/m^3 in humans (Yeganeh et al., 2013).

These are only a few of the metals that are worrisome to human health, however they are relevant to this study due to their presence in the mine residues of the mines adjacent to the communities studied. Having said this, it is evident from the literature reviewed that mine tailings pose a risk to human health when mining authorities do not carefully manage them. Arsenic, mercury, copper and nickel are only four of many toxic elements that may exist in toxic mine tailings that have the potential to lead to serious human health conditions.

Environmental Risk Perception

Based on Risk Perception Theory, most people have a basic understanding of what risk is however scholarly research and anecdotal evidence states that there is no universal conception of risk (Inouye, 2014). That being said, attempts have been made at creating a definition for operational purposes. According to the National Safety Council, an operational definition of risk is "a measure of the probability and severity of adverse effects" (as quoted in Inouye, 2014, p. 2). The National Safety Council indicates that a person's ability to assess risk is based on their risk perception and risk tolerance. The Campbell Institute, an environmental, health, and safety center of excellence located in the United States, defines risk perception as, "a person's ability to discern a certain amount of risk" (as quoted in Inouye, 2014, p. 2). Similarly, Janmaimool and Watanabe (2014) define risk perception as a judgment of the adverse consequences of a particular hazard by a person or group of people.

Although some people may be aware of risks, their risk tolerance might determine their level of action taken with regards to the risk. Risk tolerance is defined by the Campbell Institute as, "an individual's capacity to accept a certain amount of risk" (as quoted in Inouye, 2014, p. 2). There are many possible factors that might affect a person's risk perception and/or risk tolerance. A possible reason for high risk tolerance is a result of habitual engagement in high-risk behaviours (Weyman & Kelly, 1999). If an action is done repeatedly without any adverse consequences, people tend to think that the risk is no longer a concern. In addition, it is possible that a person can accurately assess risk but is willing to tolerate a higher level of risk. This would mean that the person has a high risk tolerance. According to Risk Perception Theory, there are factors affecting risk perception and tolerance, which fall under macro, meso, and micro-levels (Inouye, 2014). Macro-level factors account for broad social, cultural and

environmental differences, for example, the way supervisors or managers approach safety measures can have an effect on employees' risk perception. If managers ignore safety within the workplace, then employees may also ignore safety measures as a means of 'fitting in' with their co-workers and employer. Meso-level factors affecting individual risk perception and tolerance are related to peer or community pressures. For example, an empirical study by Davey, Wallace, Stenson and Freeman (2008) found that young drivers drive around railway crossing barriers because the perception of the community and peers was that this was acceptable behaviour. Lastly, micro-level factors include individuals' knowledge of a risky situation. Generally, those who are less informed about a risk are less likely to take a risk than those who are more knowledgeable, but this behaviour is not objective; it is based on an individual's own perception of knowledge, which is completely subjective (Huang et al., 2013). In other words, not all people perceive risks in the same way. Optimism bias, a person's tendency to believe the risk will not happen to them, also plays into macro-level factors (Weinstein, 1984). Aside from those mentioned, there are also sub-theories related to risk perception and risk tolerance that might explain the differences that exist in perception and tolerance of risks (see Table 2.1).

In terms of environmental risk perception, which is one of the foci of this study, much of the literature reiterates a number of factors affecting general risk perception and tolerance. Social and cultural factors such as age, gender, value systems, financial circumstances, education, and social norms as well as people's individual ways of thinking and past experiences may cause them to have differences in environmental risk perception (Cohen, Scribner, & Farley, 2000; Janmaimool & Watanabe, 2014; Krewski et al., 2006).

In general, women tend to have higher levels of risk awareness than men (Laferriere, Crighton, Baxter, Marsuta, & Ursutti, 2016). Interestingly, white men tend to perceive risks to

be lower than women and ethnic minorities. Brody, Zahran, Vedlits and Grover (2008) speculated that this difference is due in part to the fact that white men have the advantage in

Table 2.1.
Sub-theories Related to Risk Perception and Risk Tolerance Adapted from Inouye (2014)

Sub-Theories	Explanation of the Theory
Protection Motivation Theory	People are more likely to protect themselves when they can anticipate negative consequences from their actions. For example, people are more likely to take safety measures while hunting if they have already sustained a previous injury.
Risk Compensation/Homeostasis Theory	People tend to adjust their risk perception and tolerance based on the number of protection measures that are already in place. For example, hunters feel that they can speed while wearing a helmet on their recreational vehicles because they feel protected.
Situated Rationality Theory	There is a rational thought behind risk seeking behaviours; the reward of taking the risk outweighs the consequences of taking the risk. For example, the benefits gleaned from hunting can outweigh the risks of eating contaminated animals.
Habituated Action Theory	When a high-risk activity is done repeatedly without any adverse effects, people become desensitized to the risk. For example, hunters who have always eaten animals hunted near mine or tailings sites may continue when they see that they are still functioning 'normally'.
Social Action Theory	People take actions when they are peer pressured by peers or the community; it's permissible as long as everyone else does it. For example, when teenagers see other hunters drinking while driving recreational vehicles, they are more likely to perceive this as acceptable behaviour.
Social Control Theory	Being connected to an organization helps with conformity and can reduce high-risk behaviours. For example, being a part of a hunting organization helps hunters learn about risks while hunting and how to reduce the risks while hunting which ultimately raises hunters' risk awareness and decreases their risk tolerance.

society and feel a certain amount of control, which increases their ability to affect change. In addition, people of lower socio-economic status tend to perceive higher levels of risks than richer people because they lack the resources to properly understand the risk and/or take actions against them. However, their feelings of powerlessness and their inability to affect change can result in a failure to manage environmental threats effectively. Laferriere & Crighton's (2017) empirical research also highlighted the availability and clarity of information, trust in the information sources, perceptions of control and the ability to affect change as important factors influencing the likelihood of people to take protective actions against environmental risks. According to Lazarus & Folkman (1984), another thing to consider is that if a risk cannot be removed for whatever reason, some people may use denial as a means of coping with stress. The result is a lower perception of risk and a higher risk tolerance. Taken together, these factors explain how people cope, shedding light on individual capacities and coping skills, which are key determinants of health (Health Canada, 2001).

Empirical cases that support the above-mentioned factors related to environmental and health risk perception include a 2006 Canadian health risk perception survey which found that women are typically more concerned about environmental hazards than their male counterparts and that people aged 55 or older tended to take risks more seriously than their younger counterparts (Krewski et al., 2006). Krewski et al. (2006) also found that people with lower levels of education perceived risks to be a higher threat than those who are more educated. In addition, a study performed by Pufall et al. (2011), found that some Indigenous people did not want to know about any of the health hazards associated with eating hunted foods because they felt that if they knew of the danger then they would be reluctant to eat the foods that are such a fundamental part of their lives. Their perceptions of the contaminants were influenced by their

individual way of thinking as well as their inability to affect change, thus they used denial as a coping mechanism to develop a low risk perception and a high risk tolerance towards the risk. If these people received proper education regarding health risks and how to cope with them, it may eliminate needless worry. Furthermore, Jardine and Furgal (2007) performed a study regarding health perceptions of Indigenous communities situated in the Northwest Territories as well as Newfoundland and Labrador, Canada, which found that although participants seemed to understand the nature and magnitude of the risks posed by environmental contamination associated with continuing their traditional lifestyle (i.e., hunting and consuming animals shot near contaminated sites), their behaviours had not been adapted or changed following this health messaging. The reasons provided for ignoring the public service messaging were related to mistrust of the federal government, the belief that the government was merely creating fear-based messaging, and the belief that Indigenous Elders hold more reliable and reputable knowledge than outside agencies (Jardine & Furgal, 2007). However, researchers have argued that Elders do not always have sufficient knowledge and understanding of health information to be providing advice to their communities. This non-response to health messaging places Indigenous people in a particularly vulnerable position.

Are there people who do take actions against risk? According to Laferriere and Crighton (2017), factors that lead to actions being taken to reduce environmental risks that may lead to human health issues include perceived control, income, and an increase in awareness of the risk. For instance, prior to having a baby, some mothers admitted that they were not as concerned about environmental risks than they were after their babies were born and they realized that they had a little one to protect (Laferriere & Crighton, 2017). Once their babies were born, they began taking risks more seriously and taking actions to reduce their exposure, some wishing that

they had done so earlier. Therefore, along with control, income, and education, sometimes it requires a change in a person's situation to put risks into perspective.

Without a doubt, risk perception is complex and can depend on a number of factors. It is important to assess risk perception and risk tolerance in order to understand and manage risks, particularly where health is involved.

Research Needed

The effects of toxic elements that can be found in mine tailings on human health have been studied across the world (Abdul et al., 2015; Csavina et al., 2014; Holmes et al., 2009; Institute of Medicine, 2001; Yeganeh et al., 2013; Zhuang et al., 2009; Zotti et al., 2014). Evidently, mining and other environmental contaminants in Indigenous hunted foods have been studied or reviewed to great depth in Canada (Dewailly & Nieboer, 2013; Furgal & Rochette, 2007; McAuley & Knopper, 2011; Pufall et al., 2011). Despite the abundance of literature, the answer to the question, "is Indigenous hunting still healthy?" is one that is hard to answer given the complex relationship between population health and hunting, as well as the various perspectives held by scientists on the benefits of hunting given recent environmental changes brought about by land use and climate change (King & Furgal, 2014). Researchers and policy makers once advocated the benefits of Indigenous hunting and lifestyles however, with the aforementioned environmental degradation affecting the lands used for hunting as well as the animals that are hunted, it is difficult to state whether or not this type of lifestyle remains advantageous to human health. Along these lines, no studies have looked directly at how non-Indigenous hunters are affected by and perceive the environmental risks posed by mining contaminants. As a result, very little is known about the value that non-Indigenous people place on hunting practices and how industrial developments like mining might be affecting their ability

to hunt and/or consume the foods that they harvest. In her article regarding survey research methods, Calder (1998) stated that one of the main reasons for conducting new research is that there is often a need for new and reliable data that has yet to have been collected and analyzed. For this reason, a comprehensive study is required that gathers this new data and looks specifically at the hunting practices, health status and personal wellbeing of non-Indigenous or Indigenous hunters living off of reservations who hunt near mines and tailings sites. In addition, since there is a lack of knowledge pertaining to the perception of risk and tolerance of non-Indigenous hunters and Indigenous hunters living in non-Indigenous communities who hunt near mine or tailings sites, it would be beneficial to investigate whether or not these populations are at risk of developing health conditions and how they are managing risks related to mining contaminants so that appropriate measures can be taken by authorities and individuals to eliminate the risk and/or educate populations about environmental risks so that exposure can be minimized.

Chapter 3 : Design and Methodology

The research questions that this study sought to answer were: "is there a relationship between hunting practices, including the consuming of hunted foods, of non-Indigenous hunters and their health status and personal wellbeing?" and "how does the perception of environmental risk associated with mining contaminants produced by mining activity affect the hunting practices, health and wellbeing of non-Indigenous hunters living in northeastern Ontario communities?" In order to answer the research questions, a survey research design was adopted, which allows for a broad range of data to be collected from a large number of respondents (Neuman, 2011). The study used non-probability sampling methods (purposive sampling and convenience sampling) to purposely seek out hunters, non-hunters, and former hunters that were interested in voluntarily participating in the research. The instrument used to collect the data was a paper questionnaire, which was comprised mainly of closed-ended questions and a few open-ended questions when an explanation was helpful in understanding a participant's actions (i.e., environmental risk perception). The quantitative data collected in this study generated numerical data that could be synthesized into usable statistics. Statistical analysis is appropriate in this case as a relatively large sample size (n = 390) was involved with relatively simple numerical data (Gratton & Jones, 2004).

Study Location

Four communities in northeastern Ontario were selected for this study (see Figure 3.1). Three of these communities are active mining communities: Onaping Falls (population of 3,456), Porcupine (population of 4,716), and Wawa (population of 2,610) (Statistics Canada, 2017a, b, d, e). In addition, the community of Hearst (population of 3,835) was used in order to increase the number of hunters who do not hunt near mine tailings sites, as there are presently no mines in

Hearst (Statistics Canada, 2017c). The four communities in this study were carefully selected based on the researcher's knowledge of their economies and their residents' engagement in outdoor recreational activities like hunting, their proximity to the researcher, time constraints, and funding availability.

Figure 3.1. Map of northeastern Ontario showing the location of the four study locations.

Sampling Strategy

Participants in each of the communities were selected using nonprobability, purposive (i.e., purposively seeking hunters, non-hunters, and former hunters) and convenience-sampling methods where they were able to self-select themselves into the survey based on their interest in the topic (Neuman, 2011). The advantage of using a self-selecting sample was that those participating had a vested interest in the topic and thus had a greater willingness to provide accurate answers. Participation was limited to interested non-Indigenous hunters, former

hunters, and non-hunters who were 18 years or older. Indigenous hunters, former hunters, and non-hunters, 18 years or older who were not currently living on a reserve or who had not lived on a reserve in the previous five years were also allowed to participate. The reason the researcher allowed Indigenous people living off of reservations to participate was due to the fact that the majority of the research that was found regarding Indigenous hunting and contaminants was specific to remote, Indigenous reservations (Dewailly & Nieboer, 2013; Furgal & Rochette, 2007; McAuley & Knopper, 2011; Pufall et al., 2011). Little research was found on Indigenous hunters not living on reserves who hunted near mines.

In addition, people with an Indigenous identity were allowed to participate as they account for a small percentage of the population in the four study communities. In Onaping Falls, only 415 people identified as 'Aboriginal' in the 2016 census, accounting for 12.4% of the population (Statistics Canada, 2017a, b). Furthermore, there is no reservation in Onaping Falls or its periphery. Next, in Porcupine, 475 people identified as 'Aboriginal' in the 2016 census, which accounts for 10.3% of the total population (Statistics Canada, 2017d). The closest reservation is approximately 70 km away in Matheson, Ontario. This means that most Indigenous people have a non-reservation identity. Furthermore, in Wawa, only 350 people identified as 'Aboriginal' in the 2016 census, which accounts for 13.3% of the population (Statistics Canada, 2017e). There is an Indigenous reservation near Wawa called 'Michipicoten First Nation' which is self-governing, however those living on the reservation were not allowed to participate in the study. Lastly, in Hearst, only 285 people reported having an Indigenous identity, which accounts for 7.8% of the total population (Statistics Canada, 2017c). There is also no Indigenous reservation in the immediate vicinity of Hearst, which means that the potential for Indigenous representation in this study community is very small. Given these statistics, it is

unlikely that many Indigenous people participated in the study since the percentage of the population with Indigenous identities is below 15% in each of the four communities.

Recruitment and Data Collection

Data collection occurred in the winter and spring of 2017 in each of the respective communities where interested persons visited a table at prominent locations (i.e., grocery or convenience store, Tim Hortons) and completed a survey. Data was collected for one to three days, generally on a weekend, except for the community of Hearst, which required a longer sampling time frame. In an attempt to optimize participation and response rates as well as avoid sampling biases, recruitment flyers were distributed with the help of local residents in each of the communities one week prior to data collection (see Appendix B), which specified that the researcher would be looking for hunters and non-hunters to participate in a hunting and health study in order to draw in participants who might not be at the survey location otherwise.

In Onaping Falls, the table was set up in front of a local gas station and the target sample size (n = 100) was achieved after two days of data collection. In Porcupine, the table was set up in front of Albert's, an outdoor adventure and work wear store, and the target sample size (n = 100) was achieved after two days of data collection. In Wawa, the table was set up inside the arena during the registration of a fishing derby and the target sample size (n = 100) was achieved after one day of data collection. In Hearst, the table was set up in front of the local Tim Hortons and the target sample size was not achieved after the first three days of data collection. Therefore, the researcher used snowball sampling in the community of Hearst in order to reach an adequate sample size (n = 90).

Although the researcher would have ideally chosen similar locations in each of the respective communities to recruit participants, this intention for data collection was not fully

realized. In order to determine a viable location (i.e., high traffic zone that would draw in a lot of people, including hunters who were the focus of the study), the researcher contacted a person from each community in order to determine high traffic zones that would enable her to collect 100 participants as quickly as possible given the financial burden of travelling to and from, as well as lodging in these communities. Each location provided by the community member was assessed and access to these locations was explored. Gaining access to these locations was not always easy as some business owners did not want a study to take place outside of their establishment that might deter customers since not everyone might want to be asked to complete a survey.

In Wawa, the original study location suggested by the community member was Tim Hortons, which would have been good since all types of people can be found at such a location. However, the owner was contacted and no access was gained. The other suggestion offered by the community member was the Wawa Fishing Derby, which would fall in the time frame of the researcher's data collection and the flow of pedestrian traffic would be heavy. Therefore, this time and location was selected. Although most people passing through the arena were likely registered in the derby, often, family members and friends who were not fishing but were interested in the activities taking place at the arena (i.e., raffle draws, bake sales, vendors, and an evening dance open to the entire community) were also in attendance and participated in the survey questionnaire. This means that the event drew in all sorts of people, not just outdoor enthusiasts, which helped to eliminate possible sampling biases. In fact, during the two days at this study location, the researcher observed many people entering the store for work-related items rather than to purchase outdoor adventure items.

The other location that was less than ideal was Albert's Sports and Workwear store in Porcupine since this store tends to attract outdoor enthusiasts and/or hunters. That being said, Albert's also draws in customers who are looking for work wear and these people are not necessarily interested in the outdoors. The researcher had originally tried contacting a grocery store in Porcupine, however she never received a response from the owner. Furthermore, the researcher's contact person from Porcupine recommended this location over other locations due to the large amount of pedestrian traffic, particularly on weekends.

When the researcher noted that target sample sizes were not being achieved, she used snowball sampling and asked participants to provide the names and contact information of one or more friends or family members who could be contacted to complete the survey. In order to encourage participation, there were raffle tickets available at the survey table on the days of data collection for each participant to enter his/her name in a draw to have a chance to win a $300 gift certificate for Cabela's outfitting store. A winner was randomly selected from the tickets and was awarded with the gift certificate in November of 2017.

Instrument

With regards to the actual survey, participants in each of the four respective communities were asked to complete the short, self-administered, paper questionnaire to gather data that was then analyzed to answer the study's research questions. Attached to each questionnaire was an information letter, which specified all study instructions and the researcher was on site to answer any questions that participants had. The survey questionnaire and supporting documents were available in both French and English (see Appendices D & E). The majority of respondents completed the questionnaire in English, however thirty-four participants from Hearst completed the questionnaire in French.

Questions were mainly closed-ended, which allowed for uniform responses and ease of recording. Closed-ended questions are also less of a burden for participants (Neuman, 2011). Some open-ended questions were included when additional explanations were required in order to understand a respondent's logic, thinking process and/or frame of reference (Neuman, 2011). Structurally, the questionnaire was divided into four sections: hunting practices, health status, personal wellbeing, and socio-demographic information.

Hunting practices. In this section of the questionnaire, participants were asked a total of 12 questions, two questions (#s 1 & 2) were adapted from Appendix 4 of the Institut National de Santé Publique Quebec's study by Dewailly and Nieboer (2013) and 10 others (#s 3-12) were formulated based on the literature review and the researcher's knowledge of hunting. Questions 10 and 11 investigated perception of environmental risk associated with eating hunted meat that may contain mining contaminants, while question 12 explored how this perception of environmental risk affected hunting practices.

Question 8 asked whether hunters hunted within a 10 km radius of a mine or tailings site. This radius was chosen for a number of reasons. First, animal travel was considered when developing the 10-kilometer (km) radius. The researcher tried to cover the life foraging range of the majority of the animals being hunted (with the exception of waterfowl since they have a large migration range). Case in point, moose movement patterns can differ based on the availability of food in a given region as well as the sex of the moose and therefore, cannot be generalized to a specific number for all moose. That being said, studies have observed summer and fall ranges of between 1.3 to 39.1 square kilometers and winter ranges of 0.8 to 7.5 square kilometers, which is well within the 10 km radius chosen (Phillips, Berg, & Siniff, 1973). Another animal studied that has a usual travel/foraging range under 10 km in radius is deer. Due to snow in northeastern

Ontario, northern white-tailed deer populations tend to migrate between summer and winter months. Their home ranges in the summer and fall months were estimated at approximately 2.21 to 2.33 square kilometers and in the winter months, 1.32 to 1.50 square kilometers, which again, is well within the 10 km radius chosen for this study (Lesage, Crete, Huot, Dumont, & Ouellet, 2000).

Other factors that play into the 10 km radius chosen for this study included the fact that really large foraging ranges of certain animals (i.e., waterfowl and bears) could place them outside of the polluted area where they consume non-contaminated plants and animals; consuming these animals would likely not affect human health because concentrations of contaminants would be too low (Gall et al., 2015). Heavy metal concentrations are directly related to the type of animal contamination (i.e., bone contamination, organ contamination, and/or tissue contamination). The type of animal contamination that humans should be most concerned about is tissue metal accumulation since this is the portion of the animal that is generally consumed. Tissue metal accumulation depends on a number of things such as the type of metal ingested. A tissue metal accumulation that would affect human consumers would only result from animals that are consuming a diet that is very rich in these metals. Obviously, such a level of metal concentration is going to be highest closer to the point of pollution. As empirical evidence, Reglero et al. (2009) found higher lead concentrations in animals that continually foraged near a contaminated mining area than in animals that foraged further away from polluted sites. Furthermore, since animal foraging ranges can change with seasons, age, and sex, it was hard to incorporate all of these changes into a short questionnaire, especially when animal movement patterns were not exactly the focus of the study. Therefore, for these reasons, the researcher chose to maintain a radius which she felt was large enough to account for some

foraging movement while still maintaining a proximity that would have an effect on animal health. These are wild animals roaming freely and this was a best attempt to study contamination in a non-controlled setting.

Health status. Health status consisted of perceived health, general health, physical health, physical activity readiness, mental health, and health conditions. In this section of the questionnaire, participants were asked questions derived from various surveys, literature, and previous knowledge held by the researcher. These questions used both Likert-scale and "check all that apply" response formats.

Perceived health. The first question in the health section pertained to perceived health, that is health from a participant's point of view. Participants were asked to rate their health on a scale from excellent to poor. This question was adapted from the general health domain of the SF-36v2 Health Survey which is a practical, reliable and valid instrument to measure health from a patient's perspective (Optum, 2018).

General health. The second question in the health section asked respondents four questions about their general health. General health was used in this study as a measure of a person's basic health based on their subjective self-assessment. Similarly to perceived health, these four sub-questions were adapted from the general health domain of the SF-36v2 Health Survey.

Physical health. The third question in the health section of the survey pertained to physical health. The operational definition of physical health in this survey was: a person's perception of their physiological system and how it affects the person's ability to perform rudimentary activities. This question had ten sub-questions which were taken from the Nottingham Health Profile (2001), which is a measure that underwent extensive testing and was

created for primary healthcare systems as a means of providing an indication of a patient's perceived emotional, social, and physical health problems. Part one of the Nottingham Health Profile consists of eight health domains however only two of the domains related to physical health, energy level and physical abilities, were used to measure physical health in this study.

Physical activity readiness. The fourth question in the health section of the questionnaire asked participants six sub-questions regarding their physical activity readiness. Physical activity readiness was defined in this study as a measure of a person's preparedness to perform physical activity. These sub-questions were taken directly from the Physical Activity Readiness Questionnaire (PAR-Q Collaboration, n.d) which was created by international authorities as well as regional health and fitness organizations in order to reduce costs to patients by expediting the involvement of physicians in regards to the follow-up of traditional physical activity participation clearance. Ultimately, it provides a self-reported measure of physical activity readiness with the hopes of increasing the number of people who are physically active and reducing the dependence on the healthcare system. It helps to determine whether it is necessary for a person to seek assistance from a doctor or other qualified exercise professional before increasing his or her level of physical activity (PAR-Q Collaboration, n.d.).

Mental health. The fifth question in the health section of the survey asked participants ten sub-questions about their mental health. The operational definition of mental health in this study was a person's perception of their mental wellbeing; how well they are able to cope with daily life. These sub-questions were taken directly from part one of the Nottingham Health Profile (2001) and came from two specific health domains, emotional reaction and social isolation.

Health conditions. The sixth and final question in part two of the survey asked participants whether or not they experienced any of the listed physical health conditions. In this case, the health conditions referred to 63 physical conditions or illnesses that are common to exposure from heavy metals that can be found in nickel, copper, and gold mines (the types of mines in the mining communities that were studied). These physical health conditions were based on the literature review.

Personal wellbeing. In the personal wellbeing section of the questionnaire, participants were asked eight questions (#s 1-8) taken directly from the International Wellbeing Group's (2006) Personal Wellbeing Index (PWI). The domains included in the PWI have been subjected to extensive testing and therefore reflect strong factor analysis (OECD, 2013). The questions in this section used a Likert-scale response format and each question related to a quality of life domain: standard of living, health, achievement in life, relationships, safety, community-connectedness, future security and spiritual satisfaction. Two additional questions (#s 9 & 10) came directly from the 2013 OECD Guidelines on Measuring Subjective Wellbeing as these two domains were not included in the Personal Wellbeing Index. These two questions also used a Likert-scale response format.

Socio-demographic information. In this section of the questionnaire, participants were asked a total of six questions: three (#s 1, 3 & 4) were drawn from Appendix 4 of the Institut National de Santé Publique Québec's study by Dewailly and Neiboer (2013) and three questions (#s 2, 5 & 6) were formulated by the researcher.

Data Analysis

Data from the questionnaire was entered into the Statistical Package for the Social Sciences (SPSS) and then a variety of statistical analyses, which included descriptive, parametric

and non-parametric analyses were performed on the data collected in order to answer the research questions concerning the relationships between (1) hunting practices and health and personal wellbeing; and (2) environmental risk perception, hunting practices and health and wellbeing. In some cases socio-demographic variables were included in this analysis. Specifically, the Pearson product-moment correlation, Spearman's rank order correlation, and the Chi-square test of association were used to determine if there were any statistically significant relationships. Data from open-ended questions was gathered and organized into themes.

Community Engagement and Feedback to Participants

The researcher found that being present at the survey table allowed her to connect and engage with community members. This allowed her to answer questions that participants had regarding the questionnaire, the study and/or the research results. The researcher found that because she was present and actively engaging with her participants, people were more likely to volunteer to participate. As many participants were hesitant to ask for the study results, when participants did show interest in the results she encouraged them to provide their e-mail address. Upon completion of the thesis she will contact those who left their e-mail and will provide them with a copy of the results.

Ethics Statement

Since this research dealt with human subjects, participants' rights and welfare were considered in order to minimize the possibility of harm. Although the risks to human wellbeing were considered low for this study, appropriate measures were taken in order to ensure sound ethical research. An application was made to the Council of Research Ethics Board (COREB) at

the University of Ottawa for its approval at the beginning of August 2016 and the researcher received ethical clearance at the end of September 2016.

Chapter 4 : Results

As outlined in Chapter 3, survey questionnaires were distributed to participants in each of the four study communities. The questionnaires gathered information regarding participants' hunting practices, health status, personal wellbeing, and socio-demographic characteristics. The survey questionnaires also gathered participants' responses to open – ended questions when quantitative information required an explanation. This chapter presents a summary of the results based on an analysis of the data gathered from the survey questionnaires.

Specifically, this chapter presents the socio-demographic characteristics of the sample and then compares these characteristics with those of the population. This chapter also presents the hunting practices engaged in by hunters and former hunters as well as the reported health and wellbeing of participants, the associations between hunting practices and composite health and wellbeing measures, and the relationship of hunting near mines and tailings sites with health and wellbeing. It also reports the perceived risks related to hunting and consuming animals shot near mining activity, as well as the relationships between environmental risk perception, hunting practices, and health and personal wellbeing.

Sample

For this research study, the sample population was made up of 100 participants from three of the four communities (Onaping Falls, Porcupine and Wawa) and 90 participants from the fourth community (Hearst) for a total of 390 participants in order to have a sufficient sample size for statistical analysis (see Table 4.1). The researcher hoped to have equal ratios of hunters versus non-hunters and former hunters (combined) from each of the four communities. As is observable in Table 4.1, nearly 50% were hunters and 50% were non-hunters and former hunters (combined) in each of the communities.

Table 4.1.
Hunters, Non-hunters and Former Hunters According to Community

Community	Participants	Hunters		Non-Hunters		Former Hunters	
	N	*n*	*%*	*n*	*%*	*n*	*%*
Onaping Falls	100	47	12.1%	38	9.7%	15	3.8%
Porcupine	100	67	17.2%	24	6.1%	9	2.3%
Wawa	100	54	13.8%	38	9.7%	8	2.1%
Hearst	90	33	8.5%	45	11.5%	12	3.1%
Total	390	201	51.6%	145	37.0%	44	11.3%

Socio-Demographic Characteristics of All Participants

The socio-demographic findings reveal that 57.4% of participants were male (n = 219) which is slightly higher than percentages of males in the four study communities, which range from 48.2% to 51.0% (Statistics Canada, 2017a, b, c, d, e) (see Figure 4.1). In the sample, 43.7% of participants were aged 26-50 years old, 40% were 51 years old or older, and 16.1% were 18-25 years old. When the population over 18 years is considered, 42.2% of the Onaping Falls population, 46.2% of the Porcupine population, 52.1% of the Wawa population and 52.1% of the Hearst population were 51 years or older (Statistics Canada, 2017a, b, c, d, e). Thus this study sample with 40% aged 51 years or older has a smaller percentage of older people than the population in all four communities (42.2% to 57.4%).

The educational levels of the sample based on the highest educational level achieved were as follows: 3.0% had either no schooling or some elementary schooling, 10.0% had

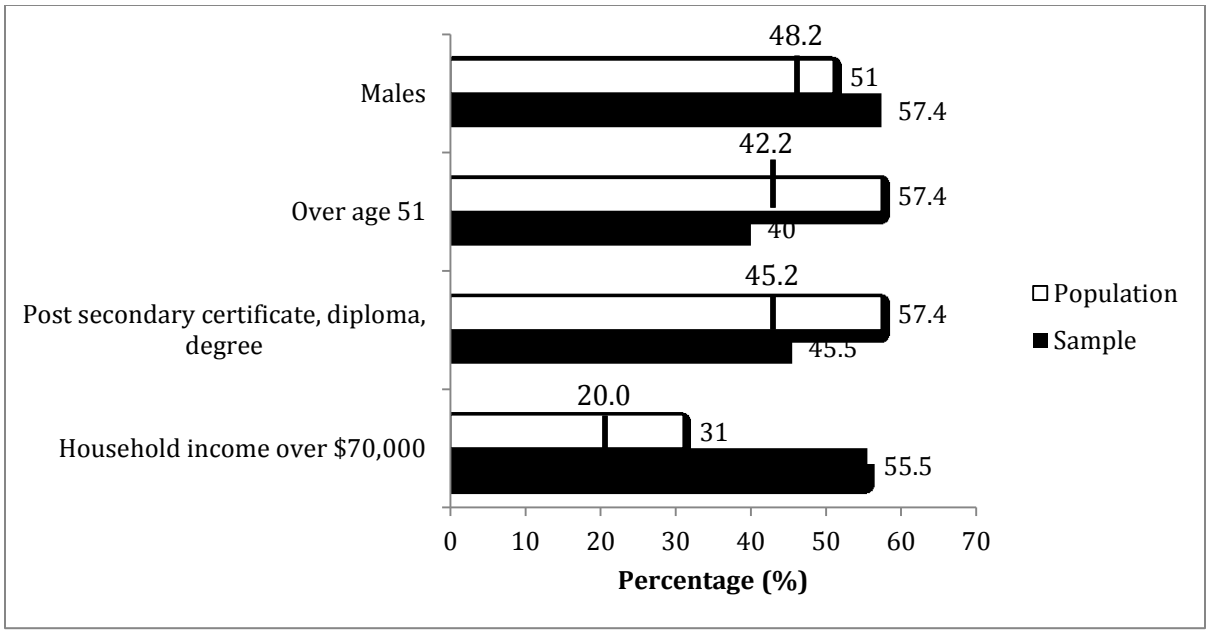

Figure 4.1. A graphical representation of selected socio-demographic characteristics of the sample studied compared to Statistics Canada census data from the four study communities.

completed elementary schooling and/or some secondary schooling, 39% had completed secondary and some college or some university schooling, 25.0% had completed community college, 14.0% had completed a university degree(s), and 5.0% had completed a graduate degree(s) (see Figure 4.2). Of those who had completed post-secondary education, 25.8% had completed community college, 14.4% had completed a university degree, 5.3% had completed a graduate degree and together, these add up to 45.5%. In comparison, in the four communities, between 45.2% and 57.4% of people had completed a college, a university degree and/or a graduate degree (Statistics Canada, 2017a, b, c, d, e) (see Figure 4.1). Therefore, the sample was slightly less educated than the population in the four communities.

With regards to annual household income levels before taxes, 44.5% of the sample reported an annual household income (before taxes) of less than $70,000 while 55.5% reported an annual household income of $70,000 or higher ($n$ = 362) (see Figure 4.5). Data from

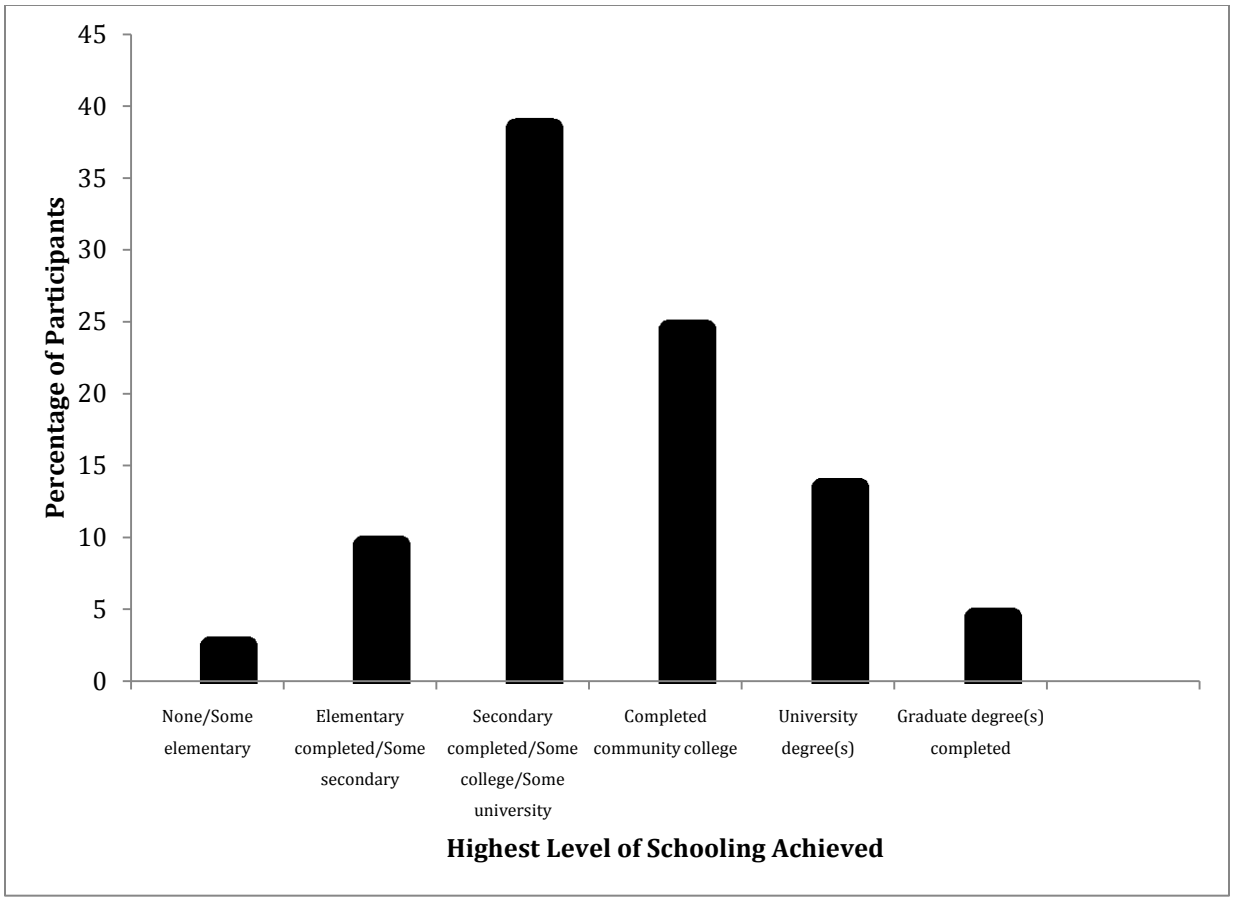

Figure 4.2. Education levels of participants (n = 386).

Statistics Canada (2017a, b, c, d, e) indicates that between 20.0% and 31.0% of households in the four study communities had an income of $70,000 or higher before taxes (see Figure 4.1). Therefore, the sample tends to have a higher income than the population.

Participants from all communities were also asked to identify their type of employment. The most common types of work identified were professional (22.2%), 'other' (19.7%), trades (15.4%), managerial (9.6%), part-time work (7.9%), service or sales (7.3%), and plant or machine operation (6.2%) (n = 356).

Hunting Practices of Hunters and Former Hunters

In regards to participation in hunting in all four of the study communities, 51.7% of participants were hunters, 37.0% of participants were non-hunters and 11.3% of participants

were former hunters. The researcher had tried to get 50% hunters and 50% former hunters and hunters combined and these results show that she was very close to achieving the 50:50 ratio.

Current hunters were also asked about the amount of time that they spent hunting in the bush in the last year because this would shed light on the amount of time they might be exposed to environmental contaminants if they hunted near mines or tailings sites. The majority of hunters spent between zero and ten days hunting in the spring (86.1%), summer (87.6%), and winter (85.8%). However, in the fall, the number of days spent hunting in the bush was more evenly distributed between the four response categories meaning that hunters hunt more often in the fall than in any other season; 33.8% reported hunting between zero and ten days, 33.8% between 11 and 25 days, 20.4% between 26 and 50 days, and 11.9% hunted 50 or more days (see Table 4.2). The increase in participation in the fall is consistent with hunting seasons, which typically run from early October to early December in northeastern Ontario.

Table 4.2.
Frequency of Hunting by Season

	Season			
Days	Spring (n = 198)	Summer (n = 197)	Fall (n = 198)	Winter (n = 198)
0-10	86.1%	87.6%	33.8%	85.8%
11-25	5.9%	5.9%	33.8%	4.7%
26-50	5.4%	2.5%	20.4%	6.2%
50+	2.5%	4.0%	11.9%	3.3%

Moreover, hunters and former hunters from both the mining communities and Hearst were asked what types of animals they hunted. The top five animals hunted were partridge (100% of hunters hunted partridge), followed by moose (74.0% of hunters hunted moose), deer

(44.0% of hunters hunted deer), rabbit (39.0% of hunters hunted rabbit), and then bear (26.0% of hunters hunted bear) (see Table 4.3).

Table 4.3.
The Types of Animals that Hunters and Former Hunters Reported Hunting

	Hunters and Former Hunters	
Animal	*n*	*%*
Partridge	198	100
Moose	146	74.0
Deer	87	44.0
Rabbit	78	39.0
Bear	52	26.0
Waterfowl	47	24.0
Turkey	12	6.0
Others (wolf, coyote, raccoon, caribou, and squirrel)	9	5.0

Furthermore, results revealed that relatively few hunters (31.5%) reported supplementing their income with hunted animals (n = 197). Similarly, few former hunters (33.3%) reported supplementing their income with hunted animals (n = 6). There were four hunters and 38 former hunters that chose not to answer this question. The reason for this non-response is unknown but it can be speculated that former hunters skipped this question because they often seemed confused about what sections were pertinent to them since they no longer hunted.

It was observed in the study results that the vast majority of hunters always or very frequently consumed the animals that they hunted: 86.9% answered always, 6.0% answered very frequently, 6.0% answered occasionally, 1.0% answered very rarely, and no one answered never (n = 199). Results for former hunters revealed the opposite trend as former hunters rarely consumed hunted animals: 60.0% answered never, 33.3% answered always, 6.7% answered very frequently, and none answered very rarely or occasionally (n = 15). It is likely that because

former hunters no longer hunt, they do not have access to hunted animals, which would explain the differences in consumption between current and former hunters.

In addition, when hunters or former hunters from the mining communities were asked if they ever discarded or gave away the animals that they hunted, the vast majority of current hunters (75.6%) said never, 7.2% said very rarely, 7.8% said rarely, 6.0% said occasionally, 1.2% said very frequently, 1.2% said always (n = 166). In terms of former hunters, 64.3% answered occasionally, 35.7% answered never, and no one answered always, very frequently, rarely, or very rarely (n = 14). When hunters and former hunters were asked why they discarded or gave meat away, 13 respondents said that they shared hunted animals with friends and family while five others responded that there were problems with the meat (see Table 4.4). Given this study's focus on mining contaminants, it is important to note that no hunters or former hunters stated that they discarded meat due to concern that it contained mining contaminants. Again, this question was not asked of Hearst hunters.

Table 4.4.
Hunters and Former Hunters' Reasons for Discarding/Giving Away Animals (n = 18)

Reasons	*n*
Shared hunted animals with friends and family	13
Lost meat due to the heat or infection/growth on animal	3
Discarded meat due to worms or ticks	2

In relation to the frequency of consumption of hunted animals by hunters, results revealed that 55.7% ate hunted animals 0-3 times per month, and 44.3% ate hunted animals four or more times per month (n = 167). On the other hand, 60.0% of former hunters reported eating hunted animals 0-3 times per month and 40.0% ate hunted animals four or more times per month (n = 5).

Although the percentages are similar for the two groups, since the n value for former hunters is so low, a comparison between the two groups is not plausible.

Participants that hunt or used to hunt were also asked about their motivations for hunting to provide insight into why they hunt and the importance of hunting to their way of life. The strongest motivation was that of liking the taste of hunted animals more than store-bought foods (n = 202). The next strongest motivations were that hunting is enjoyable (n = 200), it provides stress relief (n = 194) and is a family tradition (n = 188). Not liking to consume store bought foods (n = 184), hunting for trophies (n = 183), and not liking animals (n = 179) were very weak motivations (see Table 4.5). There were many missing values in the motivation section of the questionnaire, which might explain why the largest number of responses to any one motivation item was 202 participants when there was a total of 245 hunters and former hunters surveyed in the questionnaire.

Table 4.5.
Hunting Motivations of Hunters and Former Hunters (n = 245)

Motivations	*n*	*M*	*SD*
I hunt because I do not like to consume store bought foods	184	3.22	+/-1.49
I hunt because I find the practice of hunting enjoyable	200	1.14	+/-0.46
I hunt in order to provide for my family	185	2.91	+/-1.59
I hunt because I like to hang trophy animals on my wall	183	4.00	+/-1.33
I hunt because I do not like animals	179	4.81	+/-0.77
I hunt because it is a family tradition	188	2.34	+/-1.47
I hunt because it is a form of stress relief for me	194	2.19	+/-1.32
I hunt because I like the taste of hunted, better than store-bought food	202	2.08	+/-1.34

Note. n = number of hunters and former hunters; SD = standard deviation; M = mean and mean scores were based on a Likert scale (*Definitely true* = 1 to *Definitely false* = 5)

Hunting Near Mining Activity by Hunters and Former Hunters

As this study had a particular focus on mining contaminants and the possible effects of hunting near mines and tailing sites, the possible relationships of hunters and former hunters

hunting within 10 km of mines or tailing sites will health and wellbeing variables were explored. First, in terms of hunting near mine or tailings sites on a very rarely to always basis, Onaping Falls had considerably more people hunting within 10 km of a mine or tailings site than Porcupine and Wawa (see Table 4.6); 89.9% of hunters and former hunters from Onaping Falls hunted within 10 km of a local mine or tailings site compared to 56.7% of hunters and former hunters from Porcupine and 45.4% of hunters and former hunters from Wawa.

Table 4.6.
Hunters and Former Hunters Hunting within 10 km of a Mine or Tailings Site According to Community (n = 107)

	Hunters	
Community	*n*	*%*
Onaping Falls	44	89.9
Porcupine	38	56.7
Wawa	25	45.4

Notes.
1. This included anyone who answered 'always', 'very frequently', 'occasionally', 'rarely', or 'very rarely' to hunting within 10 km of a local mine or tailings site
2. Participants from Hearst were not asked this question

In regards to the frequency of hunters and former hunters from the three mining communities hunting close (within 10 km) to a local mine or tailings site, 1.8% responded always, 18.7% very frequently, 22.9% occasionally, 9.6% rarely, 11.4% very rarely, and 35.5% never (n = 166) (see Figure 4.3). In regards to former hunters from the mining communities hunting close (within 10 km) to a local mine or tailings site, 15.6% answered never and none answered always, very frequently, occasionally, rarely, or very rarely. For some reason, which was not evident to the researcher, 84.4% of former hunters did not answer this question (n = 32). Hearst hunters were inadvertently instructed to skip this question; therefore no information exists for Hearst hunters on this variable.

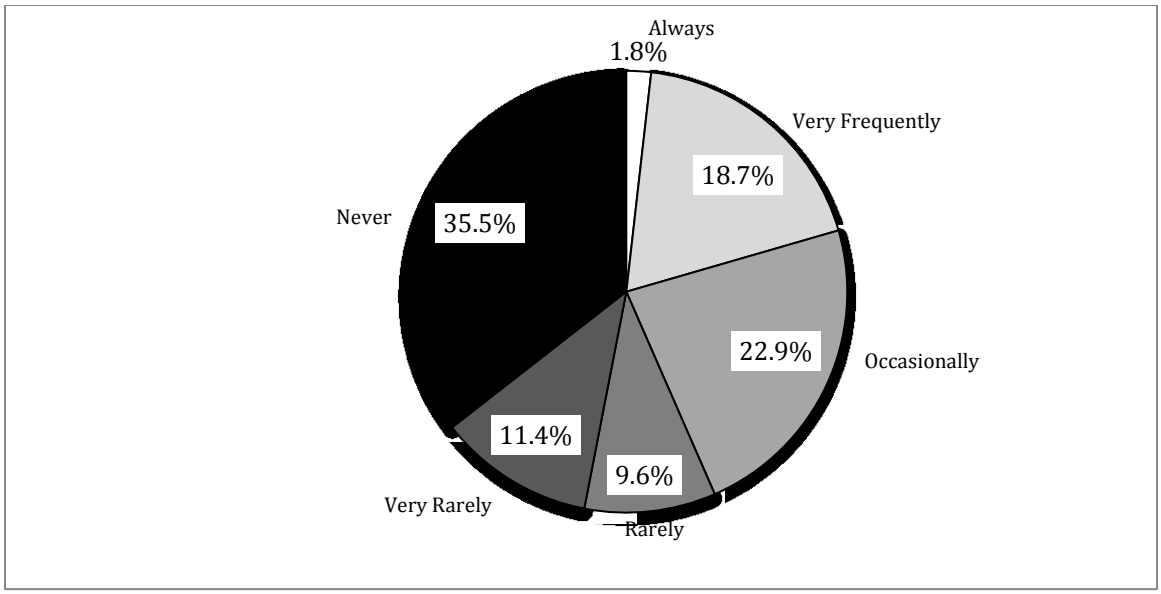

Figure 4.3. The frequency with which current and former hunters hunt within 10 km of a mine or tailings site (n = 166).

Hunting Practices of Current Hunters who always or Very Frequently Hunt near Mine or Tailings Sites

When the hunting practices of hunters who always or very frequently hunt near mine or tailings sites are compared with all hunters there are a few noteworthy observations. While 86.9% of all hunters always eat hunted animals, 91.2% of hunters who always or very frequently hunt near mine or tailings sites reported always eating hunted animals. With regards to frequency of consuming hunted animals, 44.2% of hunters and 58.8% of hunters who always or very frequently hunt near mine or tailings sites reported consuming animals four or more times per month. Thus a greater percentage of hunters who always or very frequently hunt near mine activity always eat hunted animals and do so more often. Furthermore, in terms of discarding or giving away hunted animals, 75.6% of hunters reported never giving away or discarding hunted animals while slightly less (70.6%) of hunters who hunt near mine or tailings sites reported that they gave away or discarded hunted animals.

Socio-Demographic Characteristics of Current Hunters those who Always or Very Frequently Hunt Near Mine or Tailings Sites

Findings from this study revealed that Onaping Falls was the community with the highest prevalence of current hunters always or very frequently hunting near mine or tailings sites followed by Porcupine and then Wawa. In Onaping Falls, 25 current hunters (53.2%) always or very frequently hunted near mine or tailings sites. In Porcupine, only seven current hunters (10.4%) reported always or very frequently hunting near mine or tailings sites. Lastly, in Wawa, only two current hunters (3.7%) reported always or very frequently hunting near mine or tailings sites. These findings are likely due to the fact that Onaping Falls is situated amongst a number of mines and it is more difficult to get out of mine territory in this community than in the others studied.

What are the socio-demographic characteristics of current hunters who always or very frequently hunt near mines and tailing sites? This question is important to answer because it might give us an indication of the types of people who always or very frequently hunt near mine tailings. It is also possible that the health status of hunters who always or very frequently hunt near mines or tailings sites surveyed could be related to socio-economic factors and pre-existing lifestyle characteristics rather than being a consequence of hunting near mining tailings. As was discussed in the literature review, certain factors (i.e., income, education, gender) impact peoples' perception and/or tolerance of risk.

Table 4.7 summarizes the socio-demographic characteristic of current hunters who always or very frequently hunt within 10 km of mines and tailings sites. Firstly, considerably more males (78.8%) always or very frequently hunt within 10 km of a mine or tailings site than females (21.2%). It must be taken into consideration however that 72.9% of hunters and former hunters sampled were male and only 27.1% were female (n = 240). Secondly, people aged 26 to

50 years of age were the most likely (42.4%) age group to always or very frequently hunt close to mine tailings followed by those aged 51 years or older (33.3%) and then those aged 18 to 25 (24.2%).

In terms of schooling, 44.1% of hunters who always or very frequently hunt near mine or tailings sites and 50.8% of hunters who occasionally, rarely, very rarely or never hunt near mine or tailings sites reported not having completed college or a higher level of education (see Table 4.7 & Figure 4.4). Furthermore, 55.8% of hunters who always or very frequently hunt near mine or tailings sites and 49.2% of hunters who occasionally, rarely, very rarely or never hunt near mine or tailings sites reported having completed college or a higher level of education (see Figure 4.4).

With respect to the type of work that hunters who always or very frequently hunted within 10 km of a mine or tailings site, being a professional or trades worker was by far the most prominent type of employment (each having 26.5%), followed closely by 'other' (23.5%). These results are similar to all hunters and non-hunters surveyed with trades work being the most prominent type of work (21.2%), followed closely by professional (20.3%), and then 'other' forms of employment (19.4%).

Regarding the household income acquired before taxes in 2016, hunters who always or very frequently hunted close to a mine or tailings site had a higher occurrence of incomes of $70,000 or more (73.6%) than hunters who occasionally, rarely, very rarely, or never hunt near mines or tailings sites (65.6%) (see Figure 4.5). However, hunters who always or very frequently hunted near mine tailings sites reported an income of $150,000 or higher in 8.8% of cases and 9.3% of hunters who occasionally, rarely, very rarely or never hunt near mine or tailings sites had an income of $150,000 or higher.

Table 4.7.
Socio-Demographic Characteristics of Hunters who Answered Always or Very Frequently to Hunting close (within 10 km) to a Local Mine or Tailings Site (n = 34)

Socio-demographic variables		Always & Very Frequently	
		n	%
Gender	Male	26	78.8%
	Female	7	21.2%
Age	18-25 years	8	24.2%
	26-50 years	14	42.4%
	51+ years	11	33.3%
Schooling	Partial training in community college or less	15	44.1%
	Completed community college or higher	19	55.9%
Type of work	Manager	1	3.0%
	Professional	9	27.3%
	Work part time	1	3.0%
	Technician	2	6.1%
	Service or sales worker	2	6.1%
	Skilled agriculture, forestry or fishery worker	1	3.0%
	Trades worker	9	27.3%
	Other	8	24.2%
Household income	Less than $70,000	9	26.5%
	$70,000 or more	12	73.5%

Chi-square tests determined that there were no significant associations between always or very frequently hunting in close proximity to mine or tailings sites and the socio-economic variables of ‘age’, ‘gender’, ‘schooling level’, ‘type of work’, and ‘income level’.

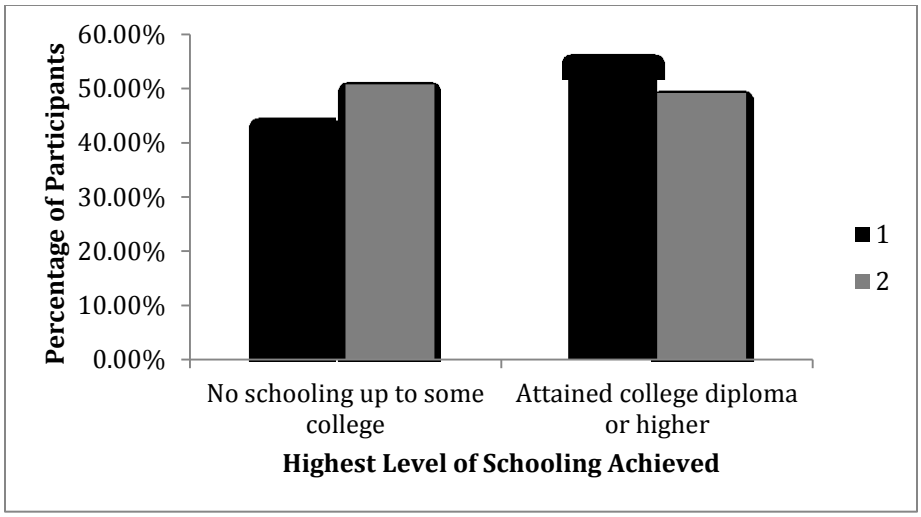

Figure 4.4. Highest level of schooling achieved for (1) Hunters who answered always or very frequently to hunting close to a mine and (2) Hunters who answered occasionally, rarely, very rarely, or never to hunting close to a mine.

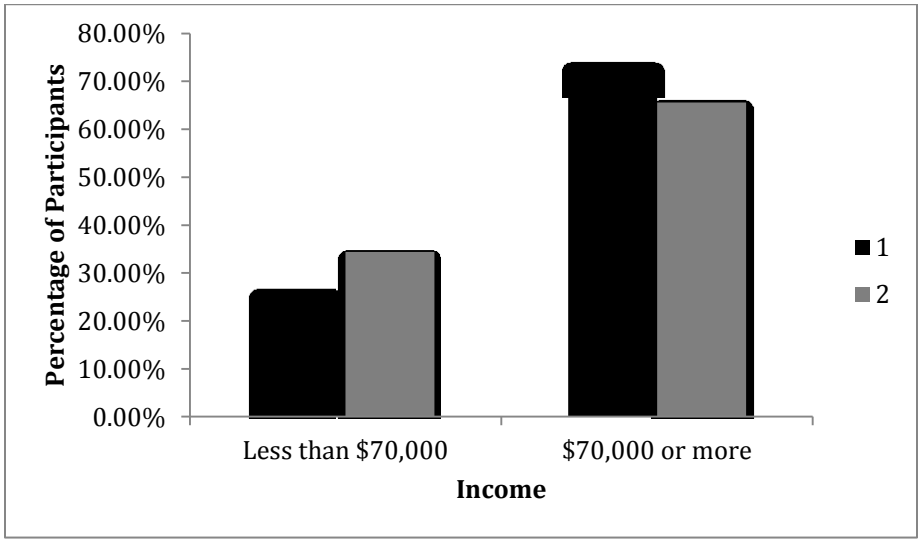

Figure 4.5. Income of Households Before Taxes in 2016 for (1) Hunters who answered always or very frequently to hunting close to a mine (2) Hunters who answered occasionally, rarely, very rarely, or never to hunting close to a mine.

Health Status of Participants

All participants were asked to report their health status whether they hunted or not. The first health question on the questionnaire asked participants to rank their perceived health on a

scale from *excellent* to *poor* (see Table 4.8 & Figure 4.6). Results were very similar for all three groups; the majority of hunters (69.6%), non-hunters (60.7%), and former hunters (59.1%) reported that their health was either excellent or very good. These percentages are very similar to the rates provided for northeastern Ontario, which ranged from 53.3% to 60.0% (reporting health as either excellent or very good) (Porcupine Health Unit, 2012; Algoma Public Health, 2011; Sudbury & District Health Unit, 2016). Only 5% of hunters, 6.9% of non-hunters and 6.8% of former hunters reported fair or poor health. In addition, slightly more hunters (30.3%) reported having excellent health compared to 22.8% of non-hunters and 11.4% of former hunters (see Table 4.8 & Figure 4.6).

Table 4.8.
Perceived Health of Participants (N = 390)

	Hunters		Non-Hunters		Former Hunters	
Health Rating	*n*	%	*n*	%	*n*	%
Excellent	61	30.3	33	22.8	5	11.4
Very good	79	39.3	55	37.9	21	47.7
Good	51	25.4	46	31.7	15	34.1
Fair/poor	10	5.0	10	6.9	3	6.8
Total	201	100	145	99.3	44	100

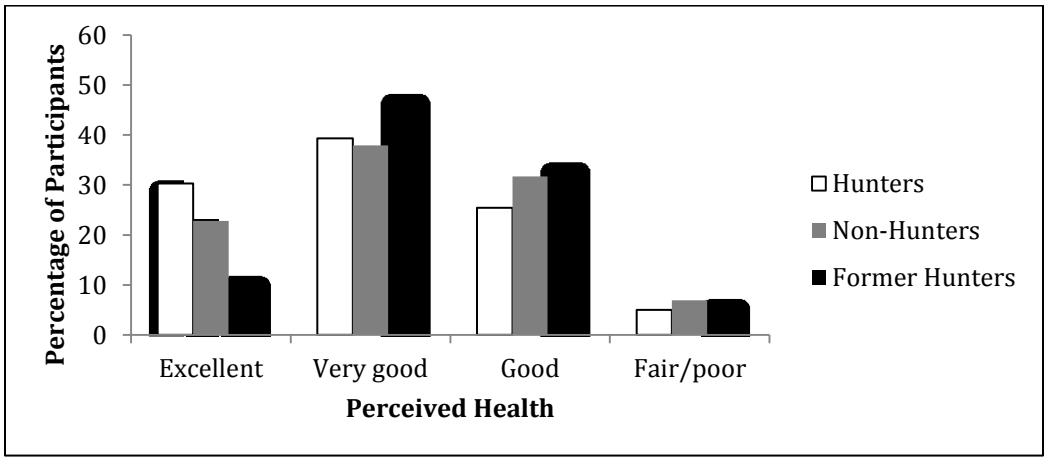

Figure 4.6. Perceived health of all hunters, non-hunters, and former hunters (*N* = 390).

In order to further investigate health and personal wellbeing, composite scores were created for general health, physical health, physical activity readiness, mental health, health conditions, as well as personal wellbeing. After reverse coding items where necessary, the compute new variable function in SPSS was used to compute the composite scores. Note that the composite personal wellbeing score was based on the first eight of the ten items since the last two items were not part of the original PWI. These first eight items represent domains for which there is the most evidence to support their reliability and validity; the last two domains have not gone through as much testing (OECD, 2013). The means and standard deviations of the health and wellbeing composite variables were calculated in order to see whether there were any differences in the health and wellbeing of the three groups. Means between hunters, non-hunters, and former hunters were very similar for all health variables, which seems to suggest that participants reported similar health and wellbeing regardless of whether they hunted or not (see Table 4.9). Note that the mean of personal wellbeing represents the mean for the overall level of personal wellbeing. For example, hunters had a mean personal wellbeing score of 8.52 out of 10.0, which suggests that, on average, they have a high overall satisfaction with the domains of personal wellbeing.

A list of common physical health conditions that can be indicative of exposure to high levels of arsenic, copper, mercury, and silver was compiled and respondents were asked to check off any health conditions that they suffered from. None of the 63 health conditions listed showed extremely high levels of occurrence. Health conditions that had a frequency of 12 or more participants were recorded. The top three health conditions for all participants were headaches (15.8%), high blood pressure (12.6%), and insomnia (6.9%) (see Table 4.10). When the health conditions reported by hunters who occasionally, rarely, very rarely, or never hunt within 10 km

Table 4.9.
Health and Wellbeing Scores for Hunters, Non-hunters and Former Hunters

	Hunters			Non-Hunters			Former Hunters		
Health and Wellbeing Variables	*n*	*M*	*SD (+/-)*	*n*	*M*	*SD (+/-)*	*n*	*M*	*SD (+/-)*
Perceived Health[1]	201	2.06	0.90	144	2.26	0.95	44	2.36	0.78
General Health[2]	200	1.97	0.87	144	2.06	0.84	44	1.99	0.65
Physical Health[3]	200	4.26	0.86	144	4.16	0.89	44	4.16	0.72
Physical Activity Readiness[4]	200	0.74	1.09	143	0.80	1.10	42	0.71	0.89
Mental Health[3]	199	4.33	0.73	142	4.20	0.89	42	4.27	0.72
Health Conditions[5]	200	1.03	1.73	145	0.98	1.79	44	1.20	1.68
Personal Wellbeing[6]	196	8.52	1.16	141	8.27	1.39	44	8.54	1.03

Notes. n = number of participants; M = mean; SD = standard deviation.

1. Mean scores based on scale (*Excellent* = 1 to *Poor* = 5);
2. Mean scores based on scale (*Definitely True* = 1 to *Definitely False* = 5 where a lower score reflects a higher level of health);
3. Mean scores based on scale (*Definitely True* = 1 to *Definitely False* = 5 where a higher score reflects a higher level of health);
4. Mean occurrence of six possible health conditions;
5. Mean occurrence of 63 possible health conditions;
6. Mean scores based on scale (*No Satisfaction at All* = 0 to *Completely Satisfied* = 10).

of a mine or tailings site were compared with those hunters who always or very frequently hunt within 10 km of a mine or tailings site, it is observable that the most prevalent conditions were different (see Tables 4.10 & 4.11). The top health condition for hunters who always or very frequently hunt within 10 km of a mine or tailings site was heart arrhythmia (8.8%), the second was shared by three conditions (5.9%) and the third by nine conditions (2.9%) (see Table 4.11). Hunters who occasionally, rarely, very rarely, or never hunt within 10 km of a mine or tailings site had a higher percentage of headaches (14.7%), high blood pressure (14.0%) and pain/numbing on foot soles (8.8%) than those hunters who always or very frequently hunt within 10 km of a mine or tailings site. Hunters who always or frequently hunt within 10 km of a mine

or tailings site than those hunters who do not, had a slightly higher percentage on all other health conditions listed in Table 4.11. Interestingly, heart arrhythmias (8.8%) was more commonly reported in hunters who always or very frequently hunt within 10 km of a mine or tailings site which might suggest that those who hunt closer to tailings sites are more likely to have heart problems than those that do not. However, with such a small number of hunters (n = 34), even a small change in reporting would have a huge impact on the numbers and therefore, one should be cautious about extrapolating generalizations from this health condition data.

Table 4.10
Health Conditions Reported by all Participants

Health Condition	All Participants (N = 390)*	
	n	*%*
Headaches	57	15.8%
High blood pressure	49	12.6%
Insomnia	27	6.9%
Pain/numbing on foot soles	21	5.4%
Diarrhea	18	4.6%
Type 2 diabetes	17	4.4%
Hypertension	15	3.8%
Dark skin pigmentation	14	3.6%
Gastrointestinal cramps	13	3.3%
Irritability	12	3.1%

Note. *For this question it was not possible to distinguish between those who had no health conditions and those who skipped the question, therefore n may have been less than 390.

Associations between Hunting Practices and the Composite Health and Wellbeing Scores for Current Hunters

Possible associations between the hunting practices of current hunters and the composite health and wellbeing scores were first investigated using Pearson's and Spearman's correlations however, if a correlation was found but the assumptions for these tests were not met (which was

Table 4.11
Most Common Health Conditions for Hunters who Always/Very Frequently versus Occasionally/Rarely/Very Rarely/Never Hunt Within 10 km of a Mine or Tailings Site

Health Condition	Hunters who Always or Very Frequently Hunt within 10 km of a Mine or Tailings Site (n = 34)		Hunters who Occasionally, Rarely, Very Rarely, or Never Hunt within 10 km of a Mine or Tailings Site (n = 132)	
	n	*%*	*n*	*%*
Heart arrhythmia	3	8.8	4	3.0
Dark skin pigmentation	2	5.9	6	4.4
Pain/numbing on foot soles	2	5.9	12	8.8
White lines on nails	2	5.9	4	2.9
High blood pressure	1	2.9	19	14.0
Cardiomyopathy	1	2.9	0	0.0
Irritability	1	2.9	4	2.9
Burning lips	1	2.9	2	1.5
Headaches	1	2.9	20	14.7
Gastrointestinal cramps	1	2.9	4	2.9
Chronic coughing	1	2.9	1	0.7
Type 2 diabetes	1	2.9	6	4.4
Low sperm count	1	2.9	0	0.0

Note. *Two hunters did not answer this question which is why n = 166 and not n = 168.

often the case), a Chi-square test of association was used. This analysis was only conducted for current hunters, as data had not been collected on exactly how long former hunters had hunted for and how long it had been since they stopped hunting.

Days Spent Hunting. Since more hunters hunted during the fall and there tended to be a better distribution over the four possible responses for this season compared to the other seasons, the fall season was chosen as the season to use to investigate the relationships between days spent hunting and the health and wellbeing measures. Correlations and Chi-square tests revealed no significant associations between the number(s) of days spent hunting in the fall and the seven health and wellbeing measures (perceived health, general health, physical health, physical activity readiness, mental health, health conditions, personal wellbeing).

Hunting for Income. Correlations and Chi-square tests revealed no significant associations between hunting for income and the seven health and wellbeing measures.

Animal Consumption. Correlations and Chi-square tests revealed no significant associations between consuming hunted animals and the seven health and wellbeing measures.

Frequency of Eating Hunted Animals. Correlations and Chi-square tests revealed no significant associations between the frequency of eating hunted animals and the seven health and wellbeing measures.

Motivations. Correlations and Chi-square tests revealed no significant associations between five of the hunting motivations (enjoy hunting, provide for family, like trophies, family tradition, prefer the taste of hunted foods) and any of the health and wellbeing measures. However, the other three motivations (do not like store bought foods, stress relief, and do not like animals) each had one significant association with one of the health and wellbeing variables.

A Chi-square test revealed a significant association between the hunting motivation 'do not like store bought foods' and physical health (X^2 (1) = 4.677, p = 0.031); 4.3% of hunters who are motivated to hunt by their dislike for store-bought foods and 13.3% of hunters who are not motivated by their dislike for store-bought foods had poor physical health. In addition, a Chi-square test revealed a significant association between the hunting motivation 'stress relief' and general health (X^2 (1) = 4.048, p = 0.044); 69.8% of hunters motivated by stress relief and 54.5% of hunters not motivated to hunt based on it being a form of stress relief answered true to having excellent general health. Also, there was a significant association between the hunting motivation 'do not like animals' and the occurrence of health conditions (X^2 (1) = 7.023, p = 0.008); 92.3% of hunters who said they were motivated by their dislike for animals and 55.7% of hunters who are not motivated based on a dislike for animals answered no to having any health

conditions. Therefore, it can be speculated that hunters who are motivated to hunt based on their dislike of animals are more likely to have a health condition than those that are not.

Discarded Animals. There were no significant associations between discarding hunted animals and six of the health and wellbeing measures. However, a Chi-square test revealed a significant association between discarding animals and general health (X^2 (1) = 4.334, p = 0.037); 57.1% of hunters or former hunters who always, very frequently, occasionally, rarely, or very rarely discard hunted animals and 73.3% of hunters or former hunters who never discard hunted animals answered definitely true to having excellent general health (see Table 4.12).

Hunting near Mine or Tailings Sites. To explore possible relationships between hunting near mining activity and health and wellbeing, correlation and Chi-square analyses were performed. There were no significant associations found between hunting within 10 km of mines or tailings sites and perceived health, general health, health conditions, mental health, or personal wellbeing. However, a Chi-square test revealed a significant association between hunting near mines or tailings sites and physical health (X^2 (1) = 4.022, p < 0.05); 56% of hunters and former hunters who either always, very frequently or occasionally hunt close to mine or tailings sites and 43% of hunters and former hunters who rarely or never hunt close to mine tailings sites answered definitely true to having problems with their physical health (see Table 4.12). In addition, a significant association was also discovered between hunting near mines or tailings sites and the composite score for 'physical activity readiness' (X^2 (1) = 3.828, p = 0.05); 74% of hunters and former hunters who always and 86% of hunters and former hunters who never hunt close to a mine or tailings site reported having no physical activity readiness conditions that require a physician's attention.

Table 4.12
Significant Associations between Hunting near Mines and Health

Hunting Practice Variable	Health Variable								
	Physical Health			General Health			Physical Health Readiness		
	X^2	*df*	*p*	X^2	*df*	*p*	X^2	*df*	*p*
Discard/give away animals	-	-	-	4.334	1	0.037*	-	-	-
Hunt near mine or tailings sites	4.022	1	0.050*	-	-	-	3.828	1	0.045*

Note. *Association is significant at the 0.05 level (two-tailed); X^2 = Chi-square value; df = degrees of freedom; p = significance value

Environmental Risk Perception Related to Hunting near Mining Activity

In order to explore environmental risk perception, hunters and former hunters were asked three questions (questions 10, 11 and 12). Questions 10 and 11 measured environmental risk perception while question 12 investigated actions hunters had taken as a result of perceived environmental risk resulting from toxic mine residues. It is important to note that only hunters and former hunters in mining communities, and not hunters and former hunters from Hearst, answered these questions.

Hunters and former hunters were asked whether they were concerned with their health after consuming animals that were shot near mine tailings. Results revealed that 17.2% were concerned while an overwhelming 82.8% were not concerned (n = 169). Of those hunters who always or very frequently hunt close to mine or tailings sites, 32.4% of hunters and former hunters said that they were concerned while 67.6% reported not being concerned about their health after consuming animals that were shot near mine tailings (n = 34).

A similar question asked hunters and former hunters if they were ever worried that there are mining contaminants in the meat that they hunt and eat, or if they no longer hunted, that they used to hunt and eat. The results revealed that hunters and former hunters were not overly

concerned: 5.1% answered always, 2.8% answered very frequently, 16.9% answered occasionally, 10.7% answered rarely, 15.3% answered very rarely, and 49.2% answered never.

Thirty-two hunters and former hunters have taken one or more actions as a result of their concern about mining contaminants being present in the animals that they hunt and eat. Twenty-six people had taken one action, three had taken two different actions, one person had taken three different actions, and two people had taken four different actions. Of those concerned about contaminants being present in meats hunted and eaten, only 15.6% reported that they currently or in the past hunted near mine or tailings sites very frequently, 31.3% occasionally, 12.5% rarely, 12.5% very rarely, 28.1% never, and none said always. Therefore, the majority of hunters who took action with regards to their concern about mining contaminants being present in the animals that they hunt and eat, rarely, very rarely or never hunt near mine or tailings sites.

Table 4.13 lists the actions that have been taken as a result of concern about mining contaminants in animals hunted and eaten; 71.9% of all hunters and former hunters in mining communities that answered this question started hunting in other places, 28.1% don't hunt as much, let license lapse, or stopped hunting, 12.5% started researching possible effects or looked in books, 6.3% gave meat away, and 3.1% took other measures.

It is important to look at the socio-demographic characteristics of those who took action as a result of their concern about mining contaminants in animals that they hunt and eat to see if they have certain socio-demographic characteristics. For instance, do the majority of hunters who took action make a high income or do they have a high level of education, or are they of a certain age or gender? When looking at socio-economic variables, most actions were taken by hunters aged 26 to 50 years old (59.4%). In addition, the actions were taken mostly (65.6%) by

Table 4.13.

Responses from Hunters and Former Hunters in Mining Communities about Actions Taken as a Result of their Concern about Mining Contaminants in Animals that they Hunt and Eat

	Hunters & Former Hunters (n = 32)	
Actions taken	*n*	*%*
Started hunting in other places	23	71.9
Don't hunt as much, let license lapse, stopped hunting	9	28.1
Started researching possible effects or looked in books	4	12.5
Contacted Ministry of Natural Resources	3	9.4
Gave meat away	2	6.3
Discussed with coworkers	1	3.1

Note. These percentages do not add up to 100% because some people took more than one action.

those hunters who had an annual household income (before taxes) of $70,000 or more in the year 2016. Lastly, in terms of the highest level of schooling achieved by those who took actions as a result of their concern over mining contaminants, slightly more than half reported having completed secondary school and/or community college (53.1%). Therefore it was not necessarily only highly educated hunters and former hunters that were taking actions. Lastly, most actions were taken by males; 21.0% of actions were taken by females and 79.0% of actions were taken by men. Males accounted for 73.0% of the hunters and former hunters in the study therefore proportionately, males took actions slightly more than females. In Onaping Falls, 15 hunters reported taking action as a result of their concern over mining contaminants; 11 hunters took actions from Porcupine; 6 hunters took action from Wawa. This finding is consistent with the findings that a greater percentage of hunters in Onaping Falls hunt near mines compared to hunters in the other mining communities.

Relationships between Hunting Practices and Environmental Risk Perceptions (Mining Communities)

Statistical tests were performed in order to investigate whether there were any associations or correlations between hunting practices and environmental risk perceptions of hunters and former hunters in the mining communities of Onaping Falls, Porcupine and Wawa. First, Pearson coefficient correlations and Spearman's rank order correlations were conducted. When a correlation was found but the assumptions necessary to perform these tests were not met (i.e., normal distribution of data) the association was checked using a Chi-square test of association. The hunting practices analyzed for an association with environmental risk perception were: hunting as a supplement to income, consumption of animals hunted, hunting motivations, frequency of eating hunted animals, hunting close to mine or tailing sites, and discarding/giving away hunted animals. As mentioned above, environmental risk perception was measured in two ways: concern about health due to consuming animals shot near mine tailings and worry about mining contaminants in meat hunted and eaten. As might be expected, there was an association between these two measures of environmental risk perception (X^2 (1) = 32.209, $p < 0.001$); 62% of hunters who answered no to being concerned about their health and four percent of hunters who answered yes to being concerned about their health after having consumed hunted animals were not worried that there are mining contaminants in the meat that they hunt and eat. In other words, these two variables are positively associated with one another.

Hunting as income. There were no significant relationships discovered between supplementing one's income with hunted animals and being concerned about health due to consuming animals shot near mine tailings or worry that there are mining contaminants in the meat that is hunted and eaten.

Consuming animals. There were no significant relationships found between consuming hunted animals and the environmental risk perception variables of health concern or worry that there are mining contaminants prevalent in the meat that is hunted and eaten.

Hunting motivations. There were no significant relationships between any of the eight motivations for hunting and 'health concern'. However there were associations between two of the motivations and worrying about mining contaminants being present in the meat that is hunted and eaten. A Chi-square test found a significant association between the hunting motivation 'dislike for store-bought foods' and concern that there are contaminants in the hunted meat that they eat (X^2 (1) = 14.725, $p < 0.001$); of those hunters and former hunters who have never been concerned that there are contaminants in the meat that they eat, 66% are not motivated by their dislike of store bought food and 33% are motivated by their dislike of store bought food (see Table 4.14). Similarly, a Chi-square test discovered a significant association between the hunting motivation desire to hang trophy animals on their wall and concern that there were contaminants in the hunted meat that they eat (X^2 (1) = 8.039, $p < 0.01$); 66% of hunters who are not motivated by their desire to hang trophy animals on their wall have never been concerned that there are contaminants in the hunted meat that they eat while 37% who are motivated by their desire to hang trophy animals on their wall are concerned that there are contaminants in the hunted meat that they eat (see Table 4.14).

Frequency of eating animals. No significant associations were observed between the variable 'frequency of eating animals' and the variables 'health concern' and 'mining contaminant worry'.

Hunting near mines or tailings. No significant association was found between the variable 'hunt near mine tailings' and 'health concern'. However, a Chi-square test revealed a

significant association between hunters and former hunters who hunt close to a mine tailings site and worry over mining contaminants being present in the hunted meats that they eat (X^2 (1) = 8.055, $p < 0.01$); 38% of hunters who always hunt close to mine and tailings sites answered yes to being worried about mining contaminants being present in hunted meats and four percent of hunters who do not hunt close to mine tailings sites answered yes to being worried about mining contaminants being present in hunted meats. There is thus a positive association between these two variables; as proximity to the mine sites increases, so does worry with regards to contaminants (see Table 4.14).

Discarding/Giving away animals. A significant association was found between the variable 'discarding/giving away animals' and the variables 'mining contaminant worry' and 'health concern'. A Chi-square test discovered a significant association between hunters who gave away animals that they hunted and worrying about mining contaminants being present in the hunted meat that they eat (X^2 (1) = 7.949, $p < 0.01$); 78% of hunters who gave away animals that they hunted and 48% of hunters who did not give away animals that they hunted were worried that there are mining contaminants in the hunted meat that they eat (see Table 4.14). This means that there is a positive association between worrying that there are mining contaminants in hunted meats and discarding or giving away hunted meats. A significant association was also found between hunters and former hunters who have discarded or gave away animals that they hunted and the variable 'health concern' (X^2 (1) = 5.265, $p < 0.05$); 29% of hunters and former hunters who discarded or gave away animals that they hunted said they were concerned about their health because they consumed animals that were shot near mine tailings while 14% of hunters and former hunters who have never discarded or given away animals that they hunted were not concerned about their health because they consumed animals

that were shot near mine tailings. However, it is important to note that no hunters or former hunters stated that they discarded meat due to concern that the meat was contaminated by mine tailing residues.

Table 4.14
Significant Associations between Hunting Practices and Mining Contaminants Worry

	Chi-square test of Association		
Hunting Practice	X^2	*df*	*p*
Hunting motivation 'dislike store bought foods'	14.725	1	0.000
Hunting motivation 'like trophies'	8.039	1	0.005
Hunt near tailings	8.055	1	0.005
Discarded animals	7.949	1	0.005

Relationships between Environmental Risk Perception and Health and Wellbeing (Mining Communities)

Health Concern. There were no significant associations between the environmental risk perception variable, concern with health after consuming animals that were shot near mines/tailings, and all seven of the health and wellbeing variables.

Mining Contaminants Worry. There were no significant associations found between the environmental risk perception variable, 'worry that there are mining contaminants in the hunted meat eaten' and five of the health and wellbeing variables (perceived health, general health, physical health, physical activity readiness and the physical health conditions).

A Chi-square test revealed an association between the environmental risk perception variable 'mining contaminant worry' and the personal wellbeing variable (X^2 (1) = 5.811, p = 0.016); 72.7% of hunters who always or frequently worry about there being mining contaminants in the meat that they hunt and eat and 87.9% of hunters who rarely or never worry about there

being mining contaminants in the meat that they hunt and eat reported a personal wellbeing score of 7.5 or higher (see Table 4.15). Therefore, one is likely to have better personal wellbeing if he or she rarely worries about mining contaminants and vice versa. There was also a significant association between 'mining contaminant worry' and mental health (X^2 (1) = 8.505, p = 0.004); 25% of hunters and former hunters who are always, very frequently, occasionally or rarely worried about mining contaminants and 8.8% of hunters and former hunters who are very rarely or never worried about mining contaminants answered true to having mental health issues (see Table 4.15). Therefore, worrying about mining contaminants is negatively associated with mental health.

Table 4.15.
Risk Perception and its Relationship with Health and Wellbeing

	Chi-Square Test of Association		
Variables Compared	X^2	*df*	*p*
Worry about mining contaminants (RV) & Personal Wellbeing	5.811	1	0.016*
Worry about mining contaminants (RV) & Mental Health	8.505	1	0.004*

**Note.* Association is significant at the 0.05 level (two-tailed); X^2 = Chi-square value; df = Degrees of freedom; *p* = significance value; HP = Hunting Practice variable; RV = Risk Variable

Chapter 5 : Discussion and Conclusion

This chapter discusses the findings from the survey questionnaire as presented in Chapter 4. Chapter 5 critically analyzes the results with regards to the two research questions posed in Chapter 1:

1. Is there a relationship between hunting practices, including the consuming of hunted foods, of non-Indigenous hunters and their health status and personal wellbeing?
2. How does the perception of environmental risk associated with mining contaminants (e.g., expansion and waste disposal) affect the hunting practices, health and wellbeing of non-Indigenous hunters living in northeastern Ontario communities?

Given that Hearst hunters were not asked the questions regarding mining contaminants, it was not feasible to include Hearst data in the response to research question number two. However, data from Hearst was used in order to answer research question number one. Modified forms of the conceptual maps presented in Chapter 1 to illustrate the anticipated associations between variables are included to explain the actual relationships discovered. This chapter concludes with a discussion of the limitations of this study as well as a discussion of the potential implications for future research and policy.

Health and Wellbeing of Hunters Relative to Non-Hunters

In order to answer the first research question regarding hunting practices and their possible relationship to hunters' health status and personal wellbeing, the health and wellbeing of hunters was compared to non-hunters. First, in regards to perceived health, the majority of participants, regardless of whether they hunted or not, reported their health as excellent or very

good. This finding may suggest that being a hunter, non-hunter or former hunter might not be associated with how one perceives his or her health. Interestingly, hunters reported the highest percentage of excellent health and former hunters reported the highest percentage of very good health. The category where non-hunters reported higher levels than the other two groups was that of poor health. However, the differences between the groups were not very large and were not analyzed statistically to see if they were significant. It is possible that perceived health is not related to hunting but related to other factors like geographic location. Population health data from the Sudbury District Health Unit, the Algoma and District Health Unit, as well as the Porcupine Health Unit data, which encompasses the four researched communities, indicates that the majority of the population in each district perceived their health as either excellent or very good (Algoma Public Health, 2011; Porcupine Health Unit, 2012; Sudbury & District Health Unit, 2016). The respondents in these communities were asked to rate their perceived health in much the same way as the respondents in the sample study; they were instructed to rate their health as excellent, very good, good, fair, or poor. The results from the districts are congruent to what was found in this study and therefore, it is possible that the sample is representative of the population in terms of perceived health. Although the literature reviewed suggested that hunters' active lifestyles are beneficial to their health and wellbeing, the means for hunters, non-hunters, and former hunters were very similar for all health and wellbeing variables, which might suggest that hunting participation is only one of many variables that contribute in a complex way to perceived health.

Hunting Practices and Health

The anticipated associations between consuming hunted animals often, spending a great deal of time hunting, as well as hunting for many years with health and personal wellbeing,

illustrated by the conceptual map in chapter one (see Figure 1.1) were not confirmed. One possible reason for not finding a relationship between these variables is that these analyses included hunters who hunted near mines and hunters who did not hunt near mines. For example, frequency of hunting might have a different relationship with health depending on whether a hunter hunted near mines or not.

Hunting near Mines and Physical Health/Physical Activity Readiness

As reported in the results, the frequency of hunters from the three mining communities hunting within 10 km of a local mine or tailings was as follows: 1.8% always; 18.7% very frequently; 22.9% occasionally; 9.6% rarely; 11.4% very rarely, and 35.5% never (n = 166). Especially noteworthy is that: 25 of the 34 hunters who always or very frequently hunted near mines were from Onaping Falls; 53.2% of hunters in Onaping Falls always or very frequently hunted near mines; and 15 of the 32 hunters who took action as a result of their concern about mining contaminants in animals they hunt and eat were from Onaping Falls. Based on the researcher's visual observations and knowledge of the towns surveyed, possible factors affecting these differences are the number and location of mines or tailings sites relative to the mining communities. For instance, in Onaping Falls, there is virtually nowhere you can go within the town or the immediate peripheries that is not owned by the mining companies and is thus, mine property. On the other hand, in Porcupine, the mines and tailings sites are concentrated in a smaller area so it is possible to travel a short distance within the town and immediate outskirts yet not be close to the mining sites. Lastly, in Wawa, the mine is actually not situated directly in the town and thus, getting away from the mine and tailing sites is not difficult.

Based on the literature review, the anticipation before performing this study was that hunters who hunted in close proximity to mine or tailings sites would have lower levels of health

and wellbeing than those hunters who did not hunt near mine or tailings sites since exposure to mining contaminants, especially through the eating of hunted animals, has been known to be responsible for a variety of serious human health problems (Abdul et al., 2015; Holmes et al., 2009; Yeganeh et al., 2013). However, significant associations were found between hunting near mines and only two of the health and wellbeing measures; physical health and physical activity readiness. These associations are not surprising, as one would expect that the exposure to contaminants would have an effect primarily on the physical dimensions of health, if nothing else. When statistical analysis was used to explore the relationship between hunting near mine and tailings sites and physical health, it was found that hunters who always, very frequently, or occasionally hunt within close proximity to these contaminated sites are more likely to report a lower level of physical health than those hunters who rarely or never hunt near mining activity (see Figure 5.1).

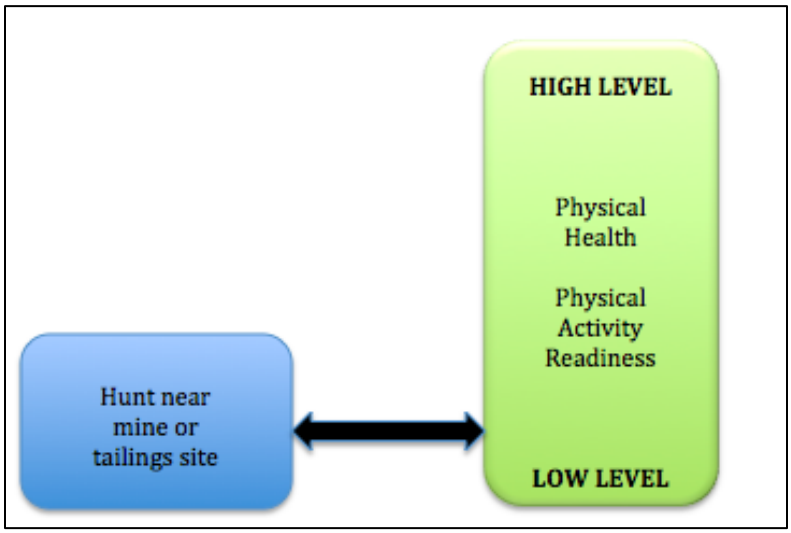

Figure 5.1. Relationship between hunting near mine or tailings sites and physical health as well as physical activity readiness.

Another significant association observed in this study was that hunters and former hunters who never hunted close to a mine or tailings site tended to have a better physical activity

readiness score than hunters who always hunted close to a mine or tailings site (see Figure 5.1). This makes sense given that, as just discussed, hunting close to a mine or tailings site was associated with lower levels of physical health. Reduced physical health has been associated with a reduced ability to perform physical activities (Kopelman, 2000).

A possible explanation for these findings is that physical health is known to deteriorate upon acute or chronic exposure to heavy metals in tailings via dust inhalation, or consumption of water, vegetation, or animals that have been contaminated. Through an empirical study, Ngole-Jeme, Fantke, & Paz-Ferreiro (2017) discovered that heavy metal exposure could impact major human physiological-systems including but not limited to the skeletal, respiratory, nervous, and excretory systems. This exposure could result in physically debilitating health complications such as bone fragility (Ngole-Jeme, Fantke, & Paz-Ferreiro, 2017). The research findings from Ngole-Jeme, Fantke, and Paz-Ferreiro (2017) regarding heavy metal exposure, provide a possible explanation for the negative relationship found between hunting near mines and both physical health and physical activity readiness in this study.

Hunting Near Mines and Physical Health, Physical Health Readiness and Consumption of Hunted Meat

As mentioned above, exposure to heavy metals in tailings may be through dust inhalation, or consumption of water, vegetation, or animals that have been contaminated. For hunters, this contamination most probably occurs through consuming animals that have been hunted. If so, why was there not a significant relationship between frequency of consuming hunted animals and either physical health or physical activity readiness? The lack of significant association might be explained by the fact that this analysis involved both hunters who hunted near mine activity and hunters who did not hunt near mine activity. As a result, higher levels of

consuming hunted meat did not necessarily mean consuming higher levels of hunted meat that had mining contaminants.

It is important to note that those who hunted near mining activity had high levels of hunted meat consumption. Almost all hunters (91.2%) who always or very frequently hunt near mine or tailings sites reported always eating hunted animals which is slightly higher than the 86.9% of all hunters sampled who always ate hunted animals. Furthermore, 58.8% of hunters who always or very frequently hunt near mine or tailings sites reported eating hunted animals four or more times per month which is 14.6% more than the 44.2% of all hunters who reported eating hunted animals four or more times per month. Thus, the most important factor in the association between hunting near mine or tailings sites and physical health/physical activity readiness may not necessarily be the actual location of the hunting near the mines but the consumption of the animals that are hunted near the mines.

Hunting Near Mines and Health Conditions

While there was a significant association between hunting near mines and both physical health and physical activity readiness, there was no association found between hunting near mines and the number of physical health conditions typically associated with exposure to mining contaminants. Furthermore, when the most prevalent health conditions of hunters who always or very frequently hunt near mines are considered (see Table 4.11), none of the health conditions are particularly prevalent and the percentages for the most prevalent conditions are lower than for the most prevalent health conditions for all study participants or hunters who occasionally, rarely, very rarely, or never hunt near mines (see Tables 4.10 & 4.11). It is important to note that only 34 hunters reported always or very frequently hunting within 10 km of mine or tailing sites compared to 73 hunters who occasionally, rarely or very rarely hunt near mine or tailings sites

and 64 hunters who never hunt near mine tailings (n = 166). There was such a small number of hunters who always or very frequently hunted near mines that an increase in prevalence by just one participant would significantly increase or decrease percentages. Other physical health conditions did not vary enough between hunters who hunt near mine or tailings sites and hunters who do not hunt near mine or tailings site to warrant further discussion.

Given the significant associations between hunting near mines and both physical health and physical activity readiness, one might also expect a significant association with physical health conditions typically associated with mining contaminants. One possible explanation is that the two significant relationships were spurious relationships. Another possibility is that physical health was measured by only two domains of physical health - energy level and physical abilities - which may not be congruent with the health conditions typically associated with mining contaminants. Likewise physical activity readiness measured whether a person can engage in physical activity without first seeing a doctor.

Concern about Health and Worry that there are Mining Contaminants Present in Animals that are Hunted and Eaten

In terms of risk perception, as anticipated in chapter one an association was found between hunting within 10 km of a mine or tailings site and being worried about consuming animals shot near mine tailings due to possible toxic contamination (see Figure 5.2). However, the majority (82.8%) of hunters and former hunters reported that they were not concerned about their health after consuming animals that were shot near mine tailings. Likewise, the majority of hunters (66.9%) were either very rarely or never worried that there were mining contaminants in the animals that they were hunting and eating. That being said, out of 168 hunters from mining communities surveyed, only 34 said that they always or very frequently hunt near a mine or tailings site. Ultimately, if hunters are not always or very frequently hunting near mine or tailings

sites, it makes sense that their level of concern would be low since they have no reason to be concerned.

A possible explanation for low levels of mining contaminant concern from those who do hunt near mine or tailing sites is that perhaps these people are unaware and/or uneducated about the risks (Laferriere & Crighton, 2017). Unfortunately participants were not asked in this study if they were aware or educated about these risks. Research findings showed that level of education was not a determinant since most hunters who hunted near mine or tailings sites were educated (i.e., 55.8% of hunters who hunted near a mine or tailings site had completed community college or higher). However, level of education does not necessarily indicate whether someone is aware of the above-mentioned risks. Another possible reason for low levels of mining contaminant concern is that not only were a majority of hunters in the study male (73.0%) but 78.8% of hunters who always or very frequently hunted close to mine or tailings sites were male. According to Krewski et al. (2011), women are typically more concerned about environmental hazards than their male counterparts.

It does appear that those who hunt near mines and tailings have a higher level of perceived environmental risk perception than those that do not. Evidence is provided by the Chi-square test that found a significant positive association between hunters and former hunters who hunt close to a mine tailings site and worry over mining contaminants being present in the hunted meat that they eat; the closer one hunts to mine or tailings sites, the more likely they are to experience worry over mining contaminants.

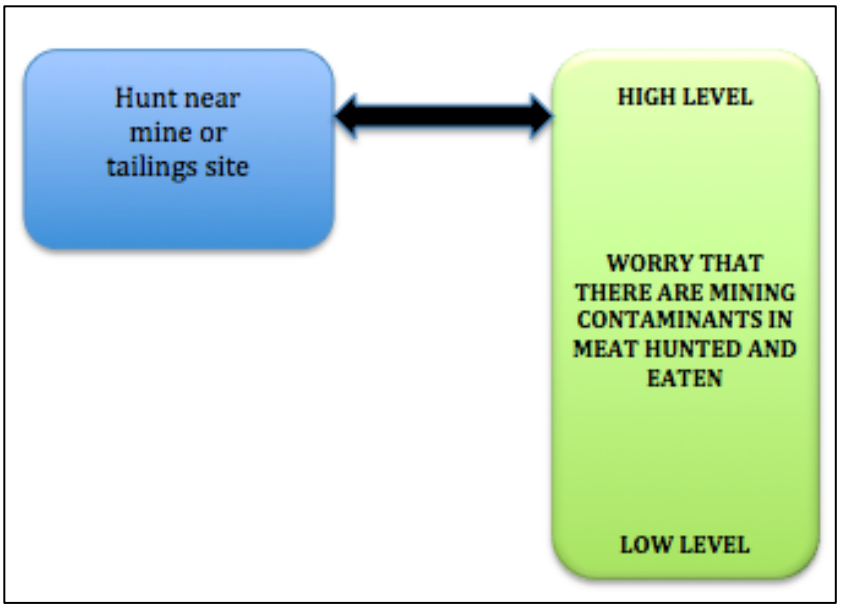

Figure 5.2. The relationship between hunting practices and risk perception.

The finding that there were significant associations between discarding or giving away animals because the hunters did not want to eat them and both environmental risk perception variables is what would be expected. In fact, 29.4% of hunters who always or very frequently hunt near mine or tailings sites gave away or discarded hunted meat while 24.4% of all hunters gave away or discarded hunted animals. However, the written explanations provided by participants are perplexing. One would anticipate that worrying about mining contaminants and being concerned about one's health as a result of eating animals shot near mine or tailings sites would be the reason that a hunter reports discarding or giving away animals however, this was not the case in the written explanations. None of the responses provided to explain the reason why a hunter discarded or gave away animals were related to concerns about mining contaminants. In fact, the most common reason for giving away food was merely to share it with family and friends. There were only five people who discarded hunted animals and this was due to worms, ticks, or rot. It is possible that those who provided responses to the open-ended questions were not those who had higher levels of perceived environmental risk. In fact, in

response to Question 12 regarding actions taken as a result of concern about mining contaminants being present in animals that are hunted and eaten, only two of the 32 people who reported having taken action, discarded or gave meat away and the reasons for this discarding are unknown. Furthermore, there was a significant association between discarding animals and general health. A greater percentage of those who never discarded animals had excellent general health than those who discarded animals. However, this association was for all hunters and not just those who hunted near mines.

Actions Taken by Hunters and Former Hunters as a Result of Their Concern about Mining Contaminants in Animals They Hunt and Eat

The fact that 32 hunters took actions as a result of their concern about mining contaminants in the animals that they hunt and eat provides evidence to answer research question two, that environmental risk perception does impact the hunting practices of these hunters. Of the 32 people who took action as a result of their concern, only 15.6% said that they very frequently hunt(ed) near mine or tailings sites and none indicated that they always hunt near mines or tailings sites. Thus many of these hunters who took actions with regards to their concern about mining contaminants no longer hunt near mine and/or tailing sites. This last finding is consistent with the fact that, of the 32 people that answered this question, the most common action they had taken was to start hunting in other places as opposed to researching and/or advocating for better environmental conditions.

Since only 32 out of 245 hunters and former hunters in the three mining communities (the hunters and former hunters in Hearst were not asked to answer this question) took one or more actions as a result of their concern about mining contaminants being present in the animals that they hunt and eat, it is clear that the majority of hunters and former hunters are not sufficiently concerned about the risk posed by mining contaminants to their health that they take action. As

mentioned previously, the majority of hunters and former hunters (66.9%) were either very rarely or never worried that there were mining contaminants in the animals that they hunt and eat. In addition, it is important to note that only 34 hunters always or very frequently hunted near mines and tailings sites and no former hunters indicated that they always or very frequently hunted near mines or tailings sites. Therefore it is possible that most hunters and non-hunters did not take action due to the fact that not many of them hunt near mines or tailings sites.

Although, as previously noted, women are typically more concerned about environmental hazards than men (Krewski et al., 2011), only 28.0% of actions were taken by women. Laferriere and Crighton (2017) found that people with lower incomes were often less educated about environmental risks and felt that they were unable to affect change because they did not have the finances necessary to change their level of risk and thus, would tolerate a higher level of risk. In this study, 65.6% of those who took action had a household income of $70,000 indicating that those with a higher income are more likely to take action, which is consistent with Laferriere and Crighton's (2017) findings. In addition, it is also quite possible that hunters do not take action because the benefit of the activity, hunting off the land, outweighs the risks of contamination as was the case for the Inuit people in Furgal and Rochette's (2007) empirical study which found that despite the contamination, the Inuit people continued to hunt and eat the animals because maintaining their way of life was too important to sacrifice. Hunters may think that giving up this lifestyle would have detrimental effects on their way of life and therefore, they chose to either ignore the risks or believe that they have not been negatively impacted yet so perhaps, they would not be (Furgal & Rochette, 2007). As a result they do not take any action.

The Association between the Environmental Risk Perception of Mining Contaminant Worry and Mental Health

It was also anticipated before performing the study that having a higher level of risk perception in terms of worry about mining contaminants in meat hunted and eaten, would result in a lower level of mental health and personal wellbeing. This anticipation was confirmed with a significant association found between always worrying that there are mining contaminants in hunted meat and mental health (see Figure 5.3). There were no significant associations between environmental risk perception and the other dimensions of health. It is not surprising that worry would be associated with mental health and not the other dimensions of health. That being said, it was anticipated that concern about health due to consuming animals shot near mine or tailings sites would also have a significant association with low levels of mental health however, this association was not confirmed with any tests performed.

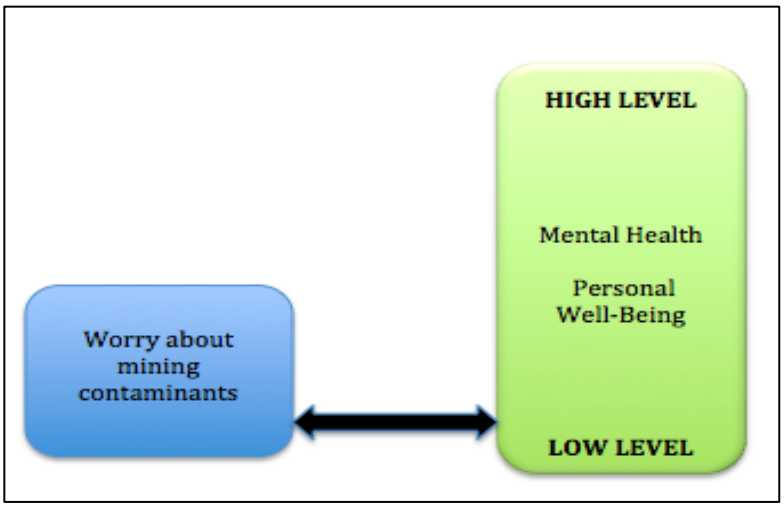

Figure 5.3. Risk perception and its relationship with health and personal wellbeing.

The significant association found between the environmental risk perception variable 'mining contaminant worry' and mental health is consistent with previous research. In their research regarding risk perception, Janmaimool and Watanabe (2014) stated that according to risk perception theories, lay people have limited scientific knowledge and abilities to cope with

the environmental risks that they face. The mental ability of lay people to cope was dependent upon psychological factors like fear, familiarity with the risk they are facing and their ability to control the said risk (Janmaimool & Watanabe, 2014; Laferriere & Crighton, 2017). Risk perception researchers explain that the ability to cope and reduce feelings of unease associated with environmental hazards can be ameliorated through appropriately timed education of those at risk, the elimination of the risk via remediation efforts such as a change in situation (geographic relocation, new awareness, development of a serious health problem, and/or the release of new trustworthy information), and the delivery of risk information from a source that the community trusts and respects (Laferriere & Crighton, 2017; Laferriere et al., 2016).

The Association between the Environmental Risk Perception of Mining Contaminant Worry and Personal Wellbeing

As anticipated, there was a significant association discovered between the environmental risk perception variable 'mining contaminant worry' and personal wellbeing, which suggests that worrying about mining contaminants being present in animals that are hunted and eaten is associated with lower personal wellbeing scores (see Figure 5.3). However, as with mental health, there was no association between concern about health due to consuming animals shot near mine or tailings sites and personal wellbeing. Although the association between worry and personal wellbeing does not indicate causation, it is logical that aspects of personal wellbeing might be compromised by mining contaminant worry. For example, if a person worries about mining contaminants, it makes sense that their satisfaction with components of personal wellbeing such as their future security and/or health could be low. In addition, if their worry about mining contaminants results in a reduction in their participation in hunting activities, it is possible that their satisfaction with personal relationships could be reduced. This reduced satisfaction may result from less hunting-related socializing and particularly for men, self-esteem

may be compromised if they use hunting as a means of defining their masculinity (Stough-Hunter & Donnermeyer, 2010). According to a review of an Inuit survey assessment conducted by Van Oostdam et al. (2005), hunting and country food is fundamental to how Inuit individuals frame their own wellbeing. This was reiterated in Stough-Hunter and Donnermeyer's (2010) empirical study, which found that hunting was tied to masculinity and satisfaction with the self. In other words, the cultural aspects of hunting and sharing country foods are very important to individual and community health and therefore, threats to this way of living are a direct threat to many hunters' personal wellbeing. Keeping that in mind, in the literature review for this research study, it was suggested that non-Indigenous hunters place the same importance on hunting and eating country foods as Indigenous hunters (Dunk, 2002). If this is true, and using the review by Van Oostdam et al. (2005) as supportive evidence, threats to non-Indigenous hunting practices (i.e., mining contaminants) can be seen as a threat to non-Indigenous hunters' personal wellbeing. Although hunters who hunted closer to mine tailings were found to have lower levels of wellbeing in this study, most of the hunters continued to hunt and took no action against the risk. Perhaps for these avid hunters, the benefit of continuing with the hunting lifestyle outweighs the risks that the continuation of this activity might have on their wellbeing. This might explain why hunters continue to hunt despite toxic residues left behind by mining activities. Unfortunately, this does not help health organizations like Health Canada that are trying to ameliorate the health of all Canadians and decrease the health inequities experienced by vulnerable members of society.

Limitations

The researcher is aware that there were limitations to this study. Calder (1998) stated that although researchers have ideals when it comes to their study, the reality is that practical

constraints (i.e., time, finances, personnel, and research sponsors) can be a limiting factor in one's investigation. It is important to note these limitations so that the researcher is not being deceptive and/or inaccurate in reporting his or her results.

The first and probably most crucial limitation to this study was the fact that only 34 hunters reported always or very frequently hunting close (within 10 km) of a mine or tailings site. This is a very small sub-sample size and given that the study looked specifically at the relationships between hunting near mine contaminants and hunting practices, health, wellbeing, and risk perception, it would have been beneficial to have a larger number of participants who always or very frequently hunt near mines. The second limitation to this study was that hunters and former hunters from Hearst were inadvertently directed not to answer questions eight to twelve, which were the foundation to answering questions about hunting close to mine and tailings sites as well as concerns regarding mining contaminants. This omission significantly decreased the number of hunters and former hunters for the data analyses that involved these questions. Thirdly, the hunters and non-hunters being sampled were a non-representative sample and thus, the findings cannot be generalized to all people in these communities. Fourth, the researcher is aware that the study only measured perceived and self-reported health and personal wellbeing rather than objectively measuring each of these constructs. Hunt, McKenna, McEwen, Backett, Williams & Papp (1980) wrote about the difficulty in determining the validity of self-reported health. Sometimes there is very little positive association between self-health assessments and physician reports, however at other times, the two assessments are in agreement (Hunt et al., 1980). Therefore, it is challenging to determine if the self-reported health in this study with a large sample size reflects accurate health assessments. It would have been

beneficial to have included physiological health testing in order to make a comparison with the self-reported measures of health used in the study (Hunt, et al., 1980).

Fifth, a number of improvements could have been made to the questionnaire. It would have been helpful to know how many years the hunters and former hunters had spent hunting. For example, the impact of hunting near mines and tailings for 50 years might be different than the impact for one year. The manner in which the question regarding days hunted per year was asked made it difficult to use. It would have been a more useful question if it had asked hunters how many days they hunted in a year. Also, it would have been helpful if the phrase, "due to concern about it containing mining contaminants" would have been added to the end of question nine which was worded: "Have you ever discarded or given away the animal you hunted because you did not want to eat it?" The questionnaire could have also included a couple of questions regarding fishing since it is likely that those who hunt also fish, and fishing would affect their exposure to contaminants, especially the neurotoxin, methyl-mercury. In addition, the researcher worded some scale items (Part 2, Question 3 and Part 2, Question 5) positively and others negatively in order to avoid people just checking the same response every time, however she observed that this was confusing for some participants and may have led to incorrect responses when participants were not paying close attention to each question (see Appendix D). Furthermore, it would have been helpful to have some open-ended questions in the survey that asked hunters why they were not concerned about mining contaminants since the researcher can only speculate without this information.

Sixth, some participants felt that certain mental health and financial questions on the questionnaire were too personal and did not answer them, which reduced the sample size for some analyses. Seventh, the researcher found that former hunters had a tendency to pick and

choose which questions they answered. One person even said, "I don't hunt anymore and I don't remember what I used to do." This resulted in a lot of missing values for former hunters, which had an influence on statistical analyses. Finally, in regards to the statistical tests performed on the collected data, due to un-normally distributed data, the majority of the analyses took the form of non-parametric tests which can be said to be less powerful and robust than parametric tests (Warner, 2013).

Summary of Findings

Before discussing possible future research and implications of this study it is useful to summarize the main findings of this study. The literature review pointed to there being a strong relationship between hunting practices and both health and wellbeing. This study did not find any significant associations between hunting practices and perceived health, mental health, health conditions, or personal wellbeing. That being said, statistical analysis suggested significant negative associations between hunting near mines and two of the seven health and wellbeing measures: physical health and physical activity readiness. It is important to note that these associations do not reveal causation. However there was no association between hunting near mines and the number of physical health conditions commonly associated with mining contaminants nor were any of these health conditions prevalent amongst those who always or very frequently hunt near mines. Another noteworthy finding was that a larger percentage of hunters in Onaping Falls, in comparison to the other two mining communities, hunted closer to mines and also took action due to concern about mining contaminants. Therefore, the findings are inconclusive about the relationship between hunting near mines and physical health.

Furthermore, in terms of the effect of risk perception on hunting practices, health and wellbeing, few hunters are concerned about their health after hunting near mine and tailings sites.

Significant associations were found between hunting near mines and being concerned about contaminants being present in the animals that hunters shoot and eat as well as with discarding hunted animals. These associations point to hunters being concerned about mining contaminants however, in open-ended questions, the reasons given for discarding or giving away hunted animals did not include mining contaminants. In addition, few hunters reported taking actions with regards to mining contaminant risk perception however few hunters always or very frequently hunt near mines. Having said this, significant negative associations were discovered between mining contaminant worry and both mental health and personal wellbeing. These main findings of the study inform the future research and implications described in the following sections.

Future Research

The current study is one of few, if any, that have explored significant associations between hunting, health and wellbeing for non-Indigenous hunters living in northeastern Ontario communities. This study's large sample size and examination of non-Indigenous hunting practices rather than Indigenous hunting practices make it an original contribution to the scholarly literature. However, as was pointed out in the limitations of this study, there is much more to be studied in order to understand the intersection between non-Indigenous hunters and industrial activities like mining. Although there were only a few significant associations between the hunting practices of those who hunt near mines and hunters' health and environmental risk perception, this does not mean that further research should not be encouraged; the impact of these heavy metals are known to be detrimental to ecosystems in local environments and thus should still be assessed as part of continuing environmental risk assessments. First, future research could ask much more specific questions such as the number

of years hunters have been hunting near mines, the actual number of days they hunt near mines, the number of times per year that they eat animals shot near mines and the quantity of hunted meat that they eat. Second, using more sophisticated statistical analysis would be beneficial in understanding the complex relationships between numerous variables including hunting that influence health.

It would also be helpful to perform a study that examined a larger sample size of people who always or very frequently hunt near mine or tailings sites (i.e., in a community like Onaping Falls or another mining community where many hunters always or very frequently hunt near mine or tailing sites) in order to better understand the characteristics, motivations, and hunting practices of these hunters. In addition to asking more hunters who hunt in these toxic locations, it would also be beneficial to include questions on the survey that asked participants whether or not they are educated about the risks associated with hunting in these toxic locations, why they choose to hunt near mine or tailings sites if they do so, as well as why actions are taken or not taken regarding concern about consuming meat hunted near mine or tailings sites. These questions and others such as why some hunters have concerns about mining contaminants and how these concerns affect them could be explored through qualitative research such as in-depth interviews which allows for probing as well as results in rich and extensive data. Such research would help to develop a knowledge base that would help to answer questions that can only be speculated in this study (i.e., that hunters from Onaping Falls have a higher occurrence rate of hunting near mine or tailings sites because one must travel too far to get away from mining property which results in merely accepting the risk of toxic exposure).

In addition, future research could include physiological testing. It would be beneficial to have a study that focuses on blood tests, urinalyses, and hair sampling to determine toxin levels

and to see if any reported physical health conditions typically associated with mining contaminants are a result of exposure to the toxic elements or whether they are a result of some other environmental or lifestyle issue. Dewailly and Nieboer (2013) performed a study that looked at Cree populations in a mining community and a non-mining community in order to compare health in a community that was exposed to mine tailing residues and a community that was not exposed to mine tailing residues. Their analysis was comprised of blood tests and urinalyses, which allowed them to see exactly how much of the toxic elements were present in participants' bodies. This analysis allowed them to determine the likelihood of reported health conditions being a result of the exposure to mine tailing residues versus alternative lifestyle choices like smoking or using lead shot-gun shells for example (Dewailly & Nieboer, 2013). Therefore, future research could include a study that looked at toxin levels in blood, urine and hair samples of those who always or very frequently hunt near mines in order to determine whether higher levels of toxins are associated with lower physical health and physical activity readiness levels of those who frequently hunt near mines.

It would also prove beneficial if research was done that could help to determine ways in which hunters could be prevented from accessing the highly toxic locations until the lands have been properly remediated and cleared of health risks. This research is needed since anecdotal stories that the researcher has heard have made it apparent that the use of current measures like warning signs and/or fencing have been found to be unsuccessful in deterring rural dwellers from staying away from contaminated sites.

Not only should researchers look at prevention methods but also at means of removing the toxins from the lands so that they no longer pose a threat to hunters who do not have alternative lands to hunt on. Presently, the aim of tailings management is to confine mine

tailings in order to provide a safe form of long-term disposal, however this is ineffective in improving the health of soils, plants, animals, and humans that use these lands in order to hunt (Natural Resources Canada, 2017). Mine operators have the ability to choose a variety of different methods of storage and remediation based on the variability of local conditions and these operators should perform more research in order to reduce and minimize toxin levels at mines and tailing sites.

Implications

This study did not find an association between hunting near mines or tailing sites and the physical health conditions, typically associated with mining contaminants, which hunters had. Furthermore, physical health conditions typically associated with mining contaminants were not prevalent amongst those who always or very frequently hunted near mines and tailings sites. However, there was a significant association between always or very frequently hunting near mines and lower levels of physical health and physical activity readiness. It is important to note that this association does not suggest causation. In addition, the study sample was based on non-probability purposive and convenience sampling and thus was not a representative sample. Therefore, any generalizations of the findings must be made with caution. The following implications, based on the associations found in the study, are of a precautionary nature. The most important implications arising from this study relate to education and finding alternatives to help hunters maintain their lifestyle without compromising their health or personal wellbeing. Specifically, the following implications for practice are recommended:

1. Health agencies and hunting associations should encourage hunters to hunt away from mine or tailings sites and provide them with opportunities to hunt in locations that are not destroyed by tailings but are still home to a viable animal population. This study found

that hunting near mine or tailings sites was negatively associated with physical health and physical activity readiness which are huge components of overall wellbeing and thus, ensuring that hunters are able to continue hunting without the risk of declining physical health is very important. This issue is of particular concern in communities like Onaping Falls where many hunters report hunting near mine or tailings sites. Hunters in Onaping Falls who hunt near mine or tailings sites, should be informed of other possible hunting locations. The very few hunters in Wawa and Porcupine who always or very frequently hunt near mines and tailings sites should be made aware of the locations where the vast majority of hunters in their communities hunt.

2. Health agencies and hunting associations should educate hunters of the physical health conditions associated with consuming animals hunted near mine or tailings sites. It would be helpful for hunters to become familiar with the physical health conditions common to being exposed to high levels of heavy metals such as arsenic. Whether through workshops or information sessions, it would be important for these hunters to learn what they are risking by consuming animals that come into contact with heavy metals as a result of mining residues. For example, hunters should be made aware that consuming the organs of animals exposed to toxic mine residues should be avoided since this is where toxins typically persist and accumulate. It would also be important to avoid hunting animals at times or places where toxins tend to be higher in hunted animals. For example, an empirical study found that deer had higher contaminant levels during the summer and early fall as this is when they consume toxic mushrooms (Gall et al., 2015).
3. Health agencies and hunting associations should educate hunters who have always or very frequently hunted near mining activity for a period of years to have regular physical

examinations to determine if they have physical health conditions typically associated with mining contaminants.

4. Routine monitoring of commonly hunted animals in mining communities should be initiated and consumption guidelines for these animals should be based on the results of bio-monitoring. The bio-monitoring could be performed by environmental sectors of mining companies since these entities are already in place and have access to the toxic lands. In addition, other potential routes of human toxin exposure (i.e., water courses, vegetation, and soil) should also be sampled and monitored as these also pose a risk to hunters' physical health. The results of bio-monitoring and consumption guidelines should then be presented in workshops that could be held by health agencies and/or hunting associations. The aim of these workshops would be to ensure that residents of the mining communities are aware of the possibility of physical harm arising from exposure to toxic mine residues.
5. Worrying about mining contaminants being present in hunted animals was negatively associated with mental health and personal wellbeing. An attempt should be made by mental health agencies and hunting associations to properly educate residents of the mining communities so that they have a realistic understanding of the risks associated with hunting near mine or tailings sites. It is possible that some hunters worry about mining contaminants but there is no need to be worried based on their hunting practices while there are other hunters who do not worry or have no concern but should based on their hunting practices. Thus education about environmental health risks would put the hazards into their proper perspective. Developing a realistic understanding of the risks

might help to ameliorate mental health and wellbeing of those hunters who reported being worried about these mining contaminants.

6. Mine operators should be encouraged to follow all regulations regarding mine and tailings management and to adopt more effective management strategies as they become available.
7. Mine operators should post signs regarding the environmental health risks of engaging in activities on their properties.
8. Government agencies should enforce all environmental regulations regarding mine and tailings management.

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Appendix A
Health Impacts

Acute or Prolonged Exposure to Arsenic (greater than 2.0 μg/kg-bw/day)		
Encephalopathy	Hepatomegaly	Proximal tubule degeneration
Altered heme metabolism	Papillary/cortical necrosis	Peripheral neuropathy
Dark skin pigmentation	Skin growths	Distinct white lines on nails
Pain/numbing on foot soles	Headaches	Hallucinations
Seizures	Alzheimer's disease	Chronic coughing
Laryngitis	Fertility issues	Kidney disease
High blood pressure	Bronchitis	Ascites
Bone marrow depression	Type I diabetes	Neonatal death
Enlarged liver or spleen	Type II diabetes	Non-melanoma skin cancer
Chronic vomiting	Atherosclerosis	Anemia
Heart arrhythmia	Hypertension	Rhinitis
Ischemic heart disease	Immune suppression	Spontaneous abortion
Gastrointestinal cramps	Hyperthyroidism	Jaundice & cirrhosis
Liver cancer	Diarrhea	Dehydration
Excessive salivation	Burning Lips	Chronic Nausea
Blackfoot disease		
Acute or Prolonged Exposure to Mercury (50ug/L blood or 100ug/L urine)		
Anemia	Gastric disturbance (e.g., colitis)	Excessive salivation
Metal taste	Tenderness of the gums	Tremors
Insomnia	Irritability	Personality changes
Polyneuropathy	Headaches	Blurred vision
Dysarthia	Speech Impairment	Slowed mental response rate
Arrythmia	Cardiomyopathy	Acute tubular necrosis
Acute renal failure	Chronic coughing	Dementia
Acute or Prolonged Exposure to Copper		
Abdominal cramps	Nausea	Diarrhea
Liver damage (particularly in patients with Wilson's disease, Indian childhood cirrhosis and idiopathic copper toxicosis).		
Acute or Prolonged Exposure to Nickel		
Contact dermatitis	Eczema	Respiratory problems (e.g., lung inflammation)
Reduced sperm concentration		

Sources: Abdul et al., 2009; Agency for Toxic Substances and Disease Registry, 1997; Dewailly & Nieboer, 2013; Holmes et al., 2009; Yeganeh et al., 2013

Appendix B
Recruitment Flyer

WANTED!

Hunters and Non-Hunters for Master's Research Study on Health

As a participant in this study, you would be asked to complete an anonymous questionnaire indicating your experience with hunting and health.

On (enter date), a table will be set up in front of (enter location) where both hunters and non-hunters can come and fill out a questionnaire. Paticipation will be on a first come/first serve basis.

In appreciation for your time, you will receive a raffle ticket to enter your name into the draw to win a **$300 gift certificate** from Cabela's Outfitters!

For more information about this study please contact:
Carly Andrews
Master's of Environmental Sustainability Student, University of Ottawa

This study has been reviewed by, and received ethics clearance

Appendix C
Letter of Information for Participant

Title of the study: The Intersection between Mining Contaminants and Hunting in Northern Ontario Communities

Principle Researcher: Carly Andrews
Masters of Environmental Sustainability Student
University of Ottawa
Ottawa, ON

Supervisor: Dr. Paul Heintzman
Associate Professor
Faculty of Health Sciences
University of Ottawa
Ottawa, ON
(613) 562-5800 ext. 4251

Invitation to Participate: you are invited to participate in the above mentioned research study conducted by Carly Andrews and supervised by Dr. Paul Heintzman.

Participation: If you wish to participate in this study, please complete the attached survey. Your decision to complete and return this survey will be interpreted as an indication of your consent to participate. The survey should take you approximately 10 minutes to complete. You do not have to answer any questions that you do not want to answer. You can withdraw from the study at any time. Once you have completed the survey, you will be given the option to enter your name in a draw to win a gift certificate to Cabela's Outfitters valued at $300. The draw is open to all research participants who enter their name in the draw, regardless of whether they decide to withdraw from further participating in the research project.

Upon completion of the study, a name will be randomly selected from those who have entered and the person whose name is drawn will be informed by phone. If the person cannot be reached within 14 days from the date of the draw, the prize will be awarded to the second name that is randomly selected and so on until the prize has been awarded. The odds of winning a prize will be 1 in 400 or less. The prize must be accepted as awarded or forfeited and cannot be redeemed for cash.

Your name and phone number that you provide when you enter the draw is collected for the purposes of contacting you if your name is selected in the draw. Your name and the contact information you have provided will be kept confidential and then destroyed once the prizes have been awarded.

We reserve the right to cancel the draw or cancel the awarding of the prize if the integrity of the draw or the research or the confidentiality of participants is compromised. The draw is governed by the applicable laws of Canada.

Purpose of the Study: From this research we wish to learn whether the health and hunting practices of non-Indigenous hunters are being affected or threatened by mining contaminants. This research is being conducted in five Northern Ontario communities, which include Onaping

Falls, Porcupine, Wawa, and Hearst. It is hypothesized that if hunting is an important activity that positively affects the health of non-Indigenous people living in Northern Ontario and if mining contaminants negatively affect hunting practices then the presence of mining contaminants on hunting grounds will negatively affect the health of these hunters.

Benefits: Your participation in this study will help to develop a better understanding of whether mining contaminants are having an effect on the health and hunting practices of non-Indigenous hunters. In the future, the results from this study can be used to inform industries of possible socio-cultural aspects not considered in previous development assessments.

Risks: Your participation in this study will consist of you anonymously answering questions concerning your health status and current and past hunting practices. Participating in this research may change your outlook on hunting near mining contaminants, which could result in negative emotions. The researcher will make every effort to minimize these risks

Confidentiality and Anonymity: The information that you will share will remain strictly confidential and will be used solely for the purposes of this research. The only people who will have access to the research data are the researcher, Carly Andrews, and the supervisor, Dr. Paul Heintzman. Your answers to open-ended questions may be used verbatim in presentations and publications but you will not be identified. Results will be published in pooled (aggregate) format. Anonymity is guaranteed since you are not being asked to provide your name or any personal contact information on the survey questionnaire.

Conservation of data: The surveys will be kept in a locked filing cabinet at the University of Ottawa for a period of five years at which time they will be destroyed.

Voluntary Participation: You are under no obligation to participate and if you choose to participate, you may refuse to answer questions that you do not want to answer. Completion and return of the questionnaire by you implies consent.

Information about the Study Results: The research findings can be made available to you if you wish. If you are interested, please indicate your e-mail address on the sheet provided (separate from the questionnaire) and the researcher will send you a copy of the results.

If you have any questions or require more information about the study itself, you may contact the researcher or her supervisor at the numbers mentioned herein.

If you have any questions with regards to the ethical conduct of this study, you may contact the Protocol Officer for Ethics in Research, University of Ottawa, Tabaret Hall, 550 Cumberland Street, Room 154, Ottawa, ON K1N 6N5, tel.: (613) 562-5387 or ethics@uottawa.ca.

Please keep this letter for your records.

Thank you for your time and consideration.

Carly Andrews DATE

Appendix D
English Questionnaire

The Intersection between Mining Contaminants and Hunting in Northern Ontario Communities

By completing this paper questionnaire and then submitting it to me, you will be indicating that you freely consent to participate in this study. This means that you have read the information letter, been informed of the requirements of the research, understand that you have the opportunity to ask questions and discuss the study, and have been assured that your information will remain confidential.

Part 1 – HUNTING PRACTICES

Based on your hunting experiences, please check the most appropriate box.

1. Do you hunt animals?

Yes	☐	1
No	☐	2
I used to hunt but no longer do so	☐	3

If you answered "No" to the above question please skip to Part 2 of the questionnaire.
If you answered "I used to hunt but no longer do so" please skip to question #3.

2. How many days have you spent hunting in the bush in the last year?

	Spring	Summer	Fall	Winter	
0-10					1
11-25					2
26-50					3
50+					4

3. What types of animals do, or did you hunt? Check all that apply.

Partridge	☐	1
Rabbits	☐	2
Waterfowl	☐	3
Deer	☐	4
Bear	☐	5
Moose	☐	6
Other (please specify): _____	☐	7

4. Do you use hunting to supplement your income (e.g., to help feed yourselves)?

Yes	☐	1
No	☐	2

5. Do/did you consume the animals that you hunt? If no, please explain why in the space provided below.

Always	Very Frequently	Occasionally	Rarely	Very Rarely	Never
☐	☐	☐	☐	☐	☐
1	2	3	4	5	6

_____

_____

6. What are your motivations for hunting?

	Definitely True		Mostly True		Don't Know		Mostly False		Definitely False	
I hunt because I do not like to consume store bought foods	☐	1	☐	2	☐	3	☐	4	☐	5
I hunt because I find the practice of hunting enjoyable	☐	1	☐	2	☐	3	☐	4	☐	5
I hunt in order to provide for my family	☐	1	☐	2	☐	3	☐	4	☐	5
I hunt because I like to hang trophy animals on my wall	☐	1	☐	2	☐	3	☐	4	☐	5
I hunt because I do not like animals	☐	1	☐	2	☐	3	☐	4	☐	5
I hunt because it is a family tradition	☐	1	☐	2	☐	3	☐	4	☐	5
I hunt because it is a form of stress relief for me	☐	1	☐	2	☐	3	☐	4	☐	5
I hunt because I like the taste of hunted food better than store-bought food	☐	1	☐	2	☐	3	☐	4	☐	5

7. How often do you eat hunted animals? If you no longer hunt, when you did hunt, how often did you eat hunted animals?

0-3 times per month	☐	1
4-10 times per month	☐	2
11+ times per month	☐	3

8. Do you currently or have you in the past, hunted close (within 10 km) to a local mine or tailings site?

Always	Very Frequently	Occasionally	Rarely	Very Rarely	Never
1	2	3	4	5	6

9. Have you ever discarded or given away the animal you hunted because you did not want to eat it? If yes, please explain why in the space provided.

Always	Very Frequently	Occasionally	Rarely	Very Rarely	Never
1	2	3	4	5	6

_____

_____

10. Have you ever been concerned about your health because you consume(d) animals that were shot near mine tailings?

Yes	1
No	2

11. Have you ever been worried that there are mining contaminants in the meat that you hunt and eat, or if you no longer hunt, that you used to hunt and eat?

Always	Very Frequently	Occasionally	Rarely	Very Rarely	Never
1	2	3	4	5	6

12. If you answered yes to question #11, have you done any of the following as a result of your concern about mining contaminants? Check all that apply.

Stopped hunting	1
Started hunting in other places	2
Don't hunt as much	3
Started researching possible effects	4
Gave meat away	5
Contacted Ministry of Natural Resources	6
Other (please specify): _____	7

Part 2 – HEALTH STATUS

Please answer the following questions by placing a checkmark in the appropriate boxes.

1. In general, would you say your health is:

Excellent	1
Very good	2
Good	3
Fair	4
Poor	5

2. How much truth is there in the following statements about your general health?

	Definitely True	Mostly True	Don't Know	Mostly False	Definitely False
I seem to get sick easier than others	1	2	3	4	5
I am as healthy as anybody I know	1	2	3	4	5
I expect my health to get worse	1	2	3	4	5
My health is excellent	1	2	3	4	5

3. How much truth is there in the following statements about your physical health?

	Definitely True	Mostly True	Don't Know	Mostly False	Definitely False
I have no problem walking around	1	2	3	4	5
I can easily bend	1	2	3	4	5
I can go up and down stairs easily	1	2	3	4	5
I find it hard to reach for things	1	2	3	4	5
I find it hard to stand for a long time	1	2	3	4	5
I need help to walk on uneven ground	1	2	3	4	5
I often feel out of breath	1	2	3	4	5
I need to take breaks when walking far	1	2	3	4	5
I'm tired all the time	1	2	3	4	5
I often run out of energy	1	2	3	4	5

4. Please read the following questions and answer each one by checking YES or NO.

	YES	NO
Has your doctor ever said that you have a heart condition and that you should only do physical activity recommended by a doctor?	1	2
In the past month, have you had chest pain when you were not doing physical activity?	1	2
Do you lose your balance because of dizziness or do you ever lose consciousness?	1	2
Do you have a bone or joint problem that could be made worse by a change in your physical activity?	1	2
Is your doctor currently prescribing drugs for your blood pressure or heart condition?	1	2
Do you know of any other reasons why you should not do physical activity?	1	2

5. How much truth is there in the following statements about your mental health?

	Definitely True		Mostly True		Don't Know		Mostly False		Definitely False	
Things often get me down		1		2		3		4		5
I've forgotten what it's like to enjoy myself		1		2		3		4		5
I often feel on edge		1		2		3		4		5
I lose my temper easily		1		2		3		4		5
I often feel like I'm losing control		1		2		3		4		5
Worry keeps me awake at night		1		2		3		4		5
I often wake up feeling depressed		1		2		3		4		5
I feel lonely		1		2		3		4		5
I find it hard to make contact with people		1		2		3		4		5
I find it hard to get along with people		1		2		3		4		5

6. Do you have or commonly experience any of the following health conditions? Check all that apply.

☐	Dark skin pigmentation	☐	Skin growths	☐	White lines on nails
☐	Pain/numbing on foot soles	☐	Headaches	☐	Hallucinations
☐	Seizures	☐	Alzheimer's disease	☐	Chronic coughing
☐	Laryngitis	☐	Bronchitis	☐	Rhinitis
☐	High blood pressure	☐	Type 1 diabetes	☐	Type 2 diabetes
☐	Heart arrhythmia	☐	Atherosclerosis	☐	Blackfoot disease
☐	Ischemic heart disease	☐	Hypertension	☐	Anemia
☐	Bone marrow depression	☐	Prone to infections	☐	Non-melanoma cancer
☐	Enlarged liver or spleen	☐	Hyperthyroidism	☐	Nausea
☐	Vomiting	☐	Diarrhea	☐	Burning lips
☐	Gastrointestinal cramps	☐	Dehydration	☐	Excessive salivation
☐	Swallowing problems	☐	Jaundice	☐	Ascites
☐	Liver cancer	☐	Spontaneous abortion	☐	Kidney disease
☐	Fertility issues	☐	Neonatal death	☐	Metal taste
☐	Insomnia	☐	Polyneuropathy	☐	Dysarthia
☐	Arrhythmia	☐	Colitis	☐	Tender gums
☐	Irritability	☐	Personality changes	☐	Blurred vision
☐	Slowed mental response rate	☐	Acute tubular necrosis	☐	Dementia
☐	Speech impairment	☐	Cardiomyopathy	☐	Excessive salivation
☐	Tremors	☐	Liver damage	☐	Contact dermatitis
☐	Eczema	☐	Lung inflammation	☐	Low sperm count

Part 3 – PERSONAL WELL-BEING

Please rate your personal well-being based on the scale provided. The following ten questions ask how satisfied you feel, on a scale from zero to 10. **Zero** means that you feel no satisfaction at all and **10** means that you feel completely satisfied. Please circle the number that corresponds to your level of satisfaction for each question.

No satisfaction at all										Completely satisfied
0	1	2	3	4	5	6	7	8	9	10

Questions

1.	**How satisfied are you with your standard of living?**	1 2 3 4 5 6 7 8 9 10
2.	**How satisfied are you with your health?**	1 2 3 4 5 6 7 8 9 10
3.	**How satisfied are you with what you are achieving in life?**	1 2 3 4 5 6 7 8 9 10
4.	**How satisfied are you with your personal relationships?**	1 2 3 4 5 6 7 8 9 10
5.	**How satisfied are you with how safe you feel?**	1 2 3 4 5 6 7 8 9 10
6.	**How satisfied are you with feeling part of your community?**	1 2 3 4 5 6 7 8 9 10
7.	**How satisfied are you with your future security?**	1 2 3 4 5 6 7 8 9 10
8.	**How satisfied are you with your spirituality or religion?**	1 2 3 4 5 6 7 8 9 10
9.	**How satisfied are you with the amount of time you have to do the things that you like doing?**	1 2 3 4 5 6 7 8 9 10
10.	**How satisfied are you with the quality of your local environment?**	1 2 3 4 5 6 7 8 9 10

Part 4 – SOCIO-DEMOGRAPHIC INFORMATION

Please place a checkmark in the most appropriate box.

1. What is your gender?

Male	☐ 1
Female	☐ 2
Other (please specify): _____	☐ 3

2. How old are you?

18-25	☐ 1
26-50	☐ 2
51+	☐ 3

3. What is the highest level of schooling you have completed?

No formal schooling	☐	1
Some years of elementary school	☐	2
Elementary school completed	☐	3
Some years of secondary school	☐	4
Secondary school completed	☐	5
Partial training in community college	☐	6
Completed community college	☐	7
Some university (not completed)	☐	8
University degree(s) completed	☐	9
Graduate degree(s) completed	☐	10

4. Which of the following best describes your current work situation?

Student	☐	1
Work full time	☐	2
Work part time	☐	3
Work occasionally	☐	4
Income Security Program	☐	5
Housework	☐	6
Retired or on pension	☐	7
Unemployment insurance	☐	8
Social welfare	☐	9
Not working for health reasons	☐	10
Other (please specify): _____	☐	11

5. Which of the following best describes your type of work?

Manager	☐	1
Professional	☐	2
Work part time	☐	3
Technician	☐	4
Clerical support worker	☐	5
Service or sales worker	☐	6
Skilled agriculture, forestry or fishery worker	☐	7
Trades worker	☐	8
Plant or machine operator	☐	9
Armed forces	☐	10
Other (please specify): _____	☐	11

6. In the year 2015, what was the combined income of your household before taxes?

☐	Less than $20,000	☐	$20,000 - $50,000
☐	$50,000 - $70,000	☐	$70,000 - $100,000
☐	$100,000 - $150,000	☐	More than $150,000

Appendix E
Participants' Reported Health Conditions in Hearst and Mining Communities

Health Condition	Hearst		Mining Communities	
	Frequency	Percentage (%)	Frequency	Percentage (%)
Dark skin pigmentation	2.0	2.2	12.0	4.0
Pain/numbing on foot soles	4.0	4.4	17.0	5.7
Seizures	1.0	1.1	2.0	0.7
Laryngitis	2.0	2.2	0.0	0.0
High blood pressure	21.0	23.3	28.0	9.4
Heart arrhythmia	0.0	0.0	5.0	1.7
Ischemic heart disease	0.0	0.0	0.0	0.0
Bone marrow depression	0.0	0.0	0.0	0.0
Enlarged liver or spleen	1.0	1.1	2.0	0.7
Vomiting	7.0	7.8	4.0	1.3
Gastrointestinal cramps	3.0	3.3	10.0	3.3
Swallowing problems	0.0	0.0	3.0	1.0
Liver cancer	0.0	0.0	0.0	0.0
Fertility issues	0.0	0.0	6.0	2.0
Insomnia	12.0	13.3	15.0	5.0
Arrhythmia	0.0	0.0	3.0	1.0
Irritability	2.0	2.2	10.0	3.3
Slowed mental response rate	0.0	0.0	1.0	0.3
Speech impairment	1.0	1.1	0.0	0.0
Tremors	3.0	3.3	2.0	0.7
Eczema	1.0	1.1	9.0	3.0
Skin growths	1.0	1.1	1.0	0.3
Headaches	17.0	18.9	40.0	13.4
Alzheimer's disease	0.0	0.0	0.0	0.0
Bronchitis	5.0	5.6	3.0	1.0
Type 1 diabetes	1.0	1.1	1.0	0.3
Atherosclerosis	1.0	1.1	1.0	0.3
Hypertension	7.0	7.8	8.0	2.7
Prone to infections	0.0	0.0	4.0	1.3
Hyperthyroidism	0.0	0.0	2.0	0.7
Diarrhea	8.0	8.9	10.0	3.3

Dehydration	2.0	2.2	6.0	2.0
Jaundice	0.0	0.0	0.0	0.0
Spontaneous abortion	0.0	0.0	1.0	0.3
Neonatal death	0.0	0.0	0.0	0.0
Polyneuropathy	0.0	0.0	0.0	0.0
Colitis	0.0	0.0	0.0	0.0
Personality changes	0.0	0.0	2.0	0.7
Acute tubular necrosis	0.0	0.0	0.0	0.0
Cardiomyopathy	0.0	0.0	1.0	0.3
Liver damage	0.0	0.0	1.0	0.3
Lung inflammation	3.0	3.3	1.0	0.3
White lines on nails	2.0	2.2	7.0	2.3
Hallucinations	0.0	0.0	2.0	0.7
Chronic coughing	2.0	2.2	2.0	0.7
Rhinitis	0.0	0.0	1.0	0.3
Type 2 diabetes	5.0	5.6	12.0	4.0
Blackfoot disease	0.0	0.0	0.0	0.0
Anemia	2.0	2.2	3.0	1.0
Non-melanoma cancer	0.0	0.0	0.0	0.0
Nausea	2.0	2.2	4.0	1.3
Burning lips	0.0	0.0	4.0	1.3
Excessive salivation	0.0	0.0	1.0	0.3
Ascites	1.0	1.1	0.0	0.0
Kidney disease	1.0	1.1	4.0	1.3
Metal taste	1.0	1.1	0.0	0.0
Dysarthia	0.0	0.0	0.0	0.0
Tender gums	1.0	1.1	7.0	2.3
Blurred vision	2.0	2.2	2.0	0.7
Dementia	0.0	0.0	0.0	0.0
Excessive salivation	1.0	1.1	2.0	0.7
Contact dermatitis	0.0	0.0	1.0	0.3
Low sperm count	2.0	2.2	3.0	1.0