

After the Dust Settles: A Qualitative Study of Underground Workers Exposed to an Aluminum
Dust Prophylaxis

by

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A thesis submitted in partial fulfillment
of the requirements for the degree of
Master of Arts (MA) in Interdisciplinary Health

The Faculty of Graduate Studies
Laurentian University
Sudbury, Ontario, Canada

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THESIS DEFENCE COMMITTEE/COMITÉ DE SOUTENANCE DE THÈSE
Laurentian Université/Université Laurentienne
Faculty of Graduate Studies/Faculté des études supérieures

Title of Thesis Titre de la thèse	After the Dust Settles: A Qualitative Study of Underground Workers Exposed to an Aluminum Dust Prophylaxis	
Name of Candidate Nom du candidat	Aubin, Danielle	
Degree Diplôme	Master of Arts	
Department/Program Département/Programme	Interdisciplinary Health	Date of Defence Date de la soutenance May 26, 2020

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Abstract

From 1943 to 1980, some underground gold and uranium workers in Ontario were required to inhale aluminum powder, up to approximately 30 minutes daily, for silicosis prevention.

This qualitative descriptive study explored the perceived impact of exposed workers to the aluminum powder. Sixteen respondents from Northeastern Ontario participated in interviews which were transcribed verbatim and analyzed thematically.

Themes that were constructed on a personal impact level included: 1) compulsory exposure, 2) hesitancy to complain, 3) feelings of betrayal, and 4) concern about health impact and dying. Themes on an organizational impact level included: 1) confidence and trust in company, 2) lack of knowledge, and 3) need for compensation and formal apology.

Workers' perceived that their long-term health was impacted by exposure on a personal and organizational level. The latest information from this study on McIntyre powder will enhance the knowledge within the occupational health and safety system.

Keywords

McIntyre powder, aluminum powder, aluminum dust, aluminum, workplace exposure, qualitative descriptive.

Co-Authorship Statement

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Aubin, D., Lightfoot, N., Gauthier, A., Côté, D., & Arrandale, V. (2020). A qualitative descriptive study of underground workers who received aluminum dust treatment and its organizational level impact. *Journal of Inorganic Biochemistry*, 204, 110935.

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Acknowledgments

In the completion of this thesis, I would like to first and foremost express my sincere gratitude to my thesis supervisor Professor Nancy Lightfoot who consistently supported me throughout the entire process. Her endless support, expertise and guidance have allowed me to grow professionally as a graduate researcher.

I would also like to thank the other members of my thesis committee, Dr. Alain Gauthier, Dr. Daniel Côté and Dr. Victoria Arrandale. Your continuous feedback, support and shared knowledge has helped me hone my research and writing skills. I feel so lucky to have worked with each and every one of you, and I really appreciate all the time you have dedicated to creating this project.

For financial support I would like to thank the Sudbury Ontario Health Clinic for Ontario Workers (OHCOW) in their ongoing support. OHCOW donated the five dollar Tim Hortons' gift cards for individuals who participated in the study. They also supported my travel to access archival documents about McIntyre powder at the Ontario Archives in Toronto. Without their ongoing support, this project would not have been possible. Also, I would like to personally thank David Lesbarrères for the financial support in translating documents into French. This has decreased the gap of inequality by giving French respondents the opportunity to respond in their mother tongue. Furthermore, I would like to express my sincere gratitude to Centre for Research in Occupational Safety and Health (CROSH) at Laurentian University. As a first recipient of the CROSH Occupational Health and Wellness scholarship, your continuous financial and knowledge support has widened my breadth of knowledge and have instilled many personal values.

A special thank you to Janice Martell, also known as the Erin Brockovich of McIntyre powder treatment. Your endless support professionally and personally has inspired me. Keep up the fight, you are truly respected by so many.

I would also like to especially thank my research assistants Michelle Bouchard and Gwen McCloskey for volunteering their time towards this research. Their assistance during the interview process and reviewing documents. Your help was greatly appreciated.

Finally, I would like to thank all those who reached out to participate in this research. Your contribution is something I will be forever grateful for. Thank you to everyone who was open to share your stories. I loved hearing everyone's stories.

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Chapter 1

1.1 Introduction

Occupational diseases are a major concern for the working population. Deaths from occupational diseases are difficult to enumerate, track, and determine causes (Herbert, & Landrigan, 2000). In 2015, it was estimated that over two million deaths were caused by work-related diseases globally (Hamalainen, Takala, & Kiat, 2017). During that period in high income countries, it was estimated that malignant neoplasms (n=225,939), circulatory disease (n=103,863), and respiratory disease (n=51,363) fatalities were the highest causes of work-related deaths (Hamalainen, Takala, & Kiat, 2017). In 2016, the Province of Ontario experienced 231 disease fatalities (Tucker & Keefe, 2018) and disease fatalities increased by 11% from 2015 to 2016, from 3.4 to 3.6 per 100,000 persons per year (Tucker & Keefe, 2018). Over 2015, 68% of fatality claims were from occupational diseases, higher than traumatic workplace fatalities (MOL, 2017). More specifically, between 2011 and 2015, the mining sector experienced 106 occupational disease fatalities (Ontario Ministry of Labour, 2015b).

Underground workers are exposed to chemical, biological and physical hazards (Ontario Ministry of Labour, 2015b). Occupational diseases experienced by underground workers may be attributed to a wide variety of exposures (e.g., diesel, silica, oil mists, asbestos, noise, heat, body vibration, drilling, blasting gases, and metal and non-metal dusts; Ontario Ministry of Labour, 2015b). Some diseases that they may develop include: silicosis, various cancers pneumoconiosis, asbestosis, various non-malignant lung diseases, cardiovascular disease, hearing loss, and skin diseases (Lightfoot, Berriault, & Semenciw, 2010; Ontario Ministry of Labour, 2015b). Ontario had the highest compensation rates in Canada for occupational cancers from 1997 to 2010 and

cancer mortality rates increased over that period (Del Bianco & Demers, 2013). During the same period, Canada demonstrated an increase in accepted occupational disease claims for mesothelioma, lung cancer, and other cancers (Del Bianco & Demers, 2013). Increasing rates of occupational diseases and deaths, and their causes, are a great concern for Ontario workers.

In the early 1900s, approximately 75% percent of miners were over-exposed to silica, which can result in silicosis (Paterson, 1961). Silicosis is a lung disease associated with inhaling silica particles that can lead to scarring of lung tissue and makes breathing difficult (American Lung Association, 2016). On average, silicosis takes 10 to 30 years to develop due to latency effects (American Lung Association, 2016). On April 8th, 1926 the Workmen's Compensation Act in Ontario was amended to make silicosis claims compensable (Paterson, 1961). The mineral industry recognized the risk of silicosis and aimed to reduce incidence and subsequent claims (Paterson, 1961).

From 1943 to 1980, mining companies in some locations in Canada, the United States, Australia, New Zealand, Africa, Mexico, England, and Peru required some underground gold and uranium miners to inhale aluminum dust to prevent silicosis (Newkirk, 1972). This process was referred to as the McIntyre powder treatment (Findlay, McKeown, & Kelley, 2016). In the late 1930s, Dr. W.D. Robson, a physician at the McIntyre Mine and an engineer J.J. Denny researched and created the aluminum dust treatment at the McIntyre Porcupine Mine in Timmins, Ontario (Newkirk, 1972). On a daily basis, groups of underground miners were confined in a sealed room for approximately 15 to 30 minutes for treatment (Newkirk, 1972). Employers instructed their workers to inhale deeply to coat their lungs with the powder (Newkirk, 1972).

This led to this particular research study that aimed to explore the perceived impact of McIntyre powder treatment (1943-1980) on underground gold and uranium workers in Northeastern Ontario.

1.2 Study Rationale

There is a noticeable gap in research about the McIntyre powder treatment and its related health outcomes. Previous research is limited, but has identified a possible weak association between aluminum powder treatment and Alzheimer's, cardiovascular, and cognitive impairments of underground workers (Rifat, Eastwood, McLaglan, & Corey, 1990; Peters, Reid, Fritschi, de Klerk, & Musk, 2013). Even though the study described here does not examine causal effects of exposure to the McIntyre powder treatment, this research will provide in-depth information regarding workers who were mandated to be exposed to McIntyre powder and how it impacted workers in the past and currently. The identified gaps in our understanding of McIntyre powder treatment have led to challenges in recognition and compensation for workers who were exposed and are now ill or who are already deceased. The practical implications of this research will help guide future needs of exposed workers and identify areas of improvement for government, unions and employers.

1.3 Literature Review

1.3.1 Physical Characteristics of Aluminum

Aluminum (Al) is a lightweight, silvery-white post-transition metal found in abundance in the earth's crust (Royal Society of Chemistry, 2017). It is the 13th element on the periodic table and

has an atomic weight of 26.981. A chemical reaction rate measures the rate at which a chemical changes property per unit time (Odufalu et al., 2017). Aluminum has high spontaneous reactivity rate (Odufalu, 2017). To decrease this reactivity rate, aluminum is usually found combined with other elements (Royal Society of Chemistry, 2017). Individuals are also exposed to aluminum on a daily basis in their own personal environment (Royal Society of Chemistry, 2017), and Al is commonly used in the construction industry, food industry, mechanical industry, pharmacology and cosmetics (Royal Society of Chemistry, 2017). Exposure limits of Al are implemented to protect their workers from the potential toxic effects (Royal Society of Chemistry, 2017).

1.3.2 Exposure Limits

The American Conference of Governmental Industrial Hygienists (ACGIH) currently identifies Aluminum (Al) and aluminum oxide's (Al_2O_3) time weighted average exposure limits to be $1\text{mg}/\text{m}^3$, respirable particulate matter (American Conference of Governmental Industrial Hygienists [ACGIH], 2008). ACGIH (2017) identifies that the Threshold Limit Values (TLV) are recommendations for occupational hygienist interpretation and should not be used as legal standards (ACGIH, 2017). TLVs refer "to airborne concentrations of chemical substances and represent conditions under which it is believed that nearly all workers may be repeatedly, day after day, over a working lifetime, without adverse health effects" (ACGIH, 2017). Threshold limit values of aluminum and compounds of Al were first proposed in 1977 (ACGIH, 2008). From 1979 to 1987, a TLV was set at $10\text{mg}/\text{m}^3$. In 2007, the ACGIH proposed to change the TLV limit to $1\text{mg}/\text{m}^3$ and that was accepted in 2008 (ACGIH, 2008). Compared to other metals, the exposure limit is set comparatively high (Ministry of Labour, 2016). Worldwide, time weighted average exposure limit of Al varies from 1.2 to $15\text{mg}/\text{m}^3$ of respirable particulate

matter (GESTIS, 2016). The United States of America, Australia, Canada and Spain have the highest limit value, compared to Poland and Germany (GESTIS, 2016). ACGIH (2008) classifies aluminum metal and insoluble compounds as non-carcinogenic, however, the process of making aluminum is considered carcinogenic due to exposure to polycyclic aromatic hydrocarbons (PAHs) (ACGIH, 2008). Additionally, Al is considered a neurotoxin (ACGIH, 2008).

1.3.4 McIntyre Powder Foundation

The McIntyre Research Foundation was established in 1939 as a non-profit organization to conduct research to prevent and to decrease occupational diseases. Formerly known as McIntyre Research Limited, the McIntyre Research Foundation was established in Timmins, Ontario at the McIntyre Porcupine Mine.

1.3.5 McIntyre Powder Treatment

In 1936, the McIntyre Research Foundation created an aluminum powder to protect underground workers from developing silicosis (Newkirk, 1972). Ninety-six percent of the aluminum particles were less than 1.2 microns. The powder was made up of 15% aluminum and 85% aluminum oxide (Newkirk, 1972).

The McIntyre Research Foundation advised that the aluminum powder be dispersed before the men entered the dry (i.e., the area where men put on clothes and gear up before going underground) to decrease psychological effects (Newkirk, 1972). Group treatments or exposure lasted approximately ten minutes, with a recommended inhalation concentration of 35.6mg/m^3 (Newkirk, 1972). In an associated standard of practice and procedure manual by Newkirk (1972)

stated “psychological effects are better if the dispersal is made before the miners come into the treatment room” (Newkirk, 1972, p.10). Inspection reports indicated the powder was released when the workers were inside the dry, which has the potential to affect the workers’ psychological health (Finkelstein, 1979). Furthermore, Heller and Heller’s (1992) report also noted that “it is recognized that the exposure of miners to clouds of a black dirty dust is psychologically not good” (Heller & Heller, 1992, p.7). The above remarks denote the possible association of workers being exposed to the McIntyre powder which may cause potential psychological health effects.

While exposed workers were employed, the Canadian mining companies paid one dollar per annum for the McIntyre powder treatment for each underground worker (Dix, 1980). Two types of canisters holding the powder were produced: 5 g and 10 g (Newkirk, 1972). One 5 g canister was required per 1,000 ft³ for a recommended aluminum concentration of 20,000 to 34,000 particles/cm³. If the workers used the lower dose canisters, the length of the treatment was doubled to 20 minutes.

1.3.6 Human Experiments

Aluminum powder exposure was selected because it was thought to increase phagocytosis of silica dust particles and eliminate silica particles from reaching via the bronchial tree (Crombie, Blaisdell, & MacPherson, 1944). From 1939 to 1943, Crombie, Blaisdell, and MacPherson (1944) tested this assumption and conducted a quasi-experiment with 102 participants from St. Mary’s Hospital silicosis clinic in Timmins, Ontario. Forty-one participants were selected to receive at least 200 aluminum powder treatments, and pulmonary disability was tested.

Pulmonary disability was measured the ratio residual air to total pulmonary capacity. Only 32 participants completed the treatment and a survey was administered at the end of the study to obtain data about perceived improvements of shortness of breath, fatigue, cough and sputum, and perceived chest pain. The authors concluded that seven participants showed definite improvement, 12 showed slight improvement and 15 showed no improvement and that aluminum powder was completely harmless for humans. The results were based primarily on the surveys because pulmonary tests had poor accuracy. The study did not include a control group.

1.3.7 Procedures and Regulations for Dispersing Aluminum Powder

The McIntyre Research Foundation identified three lines of defense against developing silicosis (Newkirk, 1972). Firstly, industries aimed to improve dust control, which was the stated major priority. Secondly, medical assessments were performed prior to employee hiring and for current employees to assess health status. Lastly, the McIntyre powder treatment was used to prevent silicosis. To approve the use of the McIntyre powder treatment, facilities needed to be equipped with a large treatment area to house all employees, good ventilation systems, medical examinations, good housekeeping, dust control measures, and health records. Treatment areas were either in change rooms (also known as the “dry”) or in tunnels. In the mines, the ideal change room consisted of a large room separated in two sections; one side was used for street clothes to protect against contamination and the other for work clothes. Aluminum prophylaxis was recommended to be delivered in the area where employee work clothes were kept. The McIntyre Foundation recommended that the area be large enough to hold the large group of workers being treated because the ventilation system would be turned off and adequate oxygen was necessary. They also suggested there should not be any areas to sit, to allow for deep

breathing. They proposed the ideal treatment room should have no windows to permit the aluminum powder to stay in suspension longer. Change rooms had to be equipped with ventilation prior to and following treatment.

The McIntyre Research Foundation manufactured a dispersal device to spray the aluminum powder for treatment (Newkirk, 1972). This device punctured the top and bottom of the canister which was attached to an air compressor, for an average compression of 80 to 100 lbs. This allowed for the dispersal of the aluminum powder. Multiple devices were installed inside the dries to allow for even distribution.

There were five requirements for good dispersal of aluminum powder mandated by the McIntyre Research Foundation (Finkelstein, 1979). Firstly, the mine official was responsible for dispersing the powder and ensuring that the recommended procedures were being followed. Secondly, any doors and windows had to be closed tightly to allow for a sealed-tight treatment room. Thirdly, ejectors needed to be cleaned to decrease moisture and vapor. Fourthly, to decrease psychological effects, the aluminum powder was sprayed before the workers entered the room and the device operated for approximately one minute after the canister was punctured. Lastly, ventilation was turned back on after the last worker had left the treatment room.

Aluminum powder treatment was given to workers at the start of their shifts (Finkelstein, 1979). They found this method to be most effective because miners spent more time in the change room before their shift started compared to the end of their shift. Many workers tended to shower after work and the increased humidity negatively affected the suspension of the McIntyre powder.

1.3.8 Prevalence of McIntyre Powder Usage

In 1943, the Ontario Mining Association recommended that Ontario mining companies introduce McIntyre powder for the prevention of silicosis (Dix, 1980). In 1943, at the McIntyre Mine, in Timmins, employees commenced exposure to the aluminum dust and this was followed by most gold mines in Ontario by 1945 (Dix, 1980). The annual report of the Ontario Mining Association in 1944 estimated that 11,700 workers across Canada received the aluminum powder prophylaxis (Robson, 1945). The report revealed that as early as 1944, the treatment was provided at 42 Ontario mines, 21 mines in Quebec, one mine in Manitoba, 12 mines in British Columbia, and two mines in the Northwest Territories, for a total of 78 Canadian mines. Furthermore, foreign countries such as Mexico, Chile, South Africa, England, New Zealand, Peru and Australia also implemented the treatment. In 1946, over 19,000 American workers received the McIntyre powder treatment in New York, New Jersey, Ohio, Pennsylvania, Indiana, Illinois, Michigan, Wisconsin, Missouri, Kansas, Oklahoma, Colorado, Tennessee and West Virginia (Robson, 1945). As of 1948, there was a huge increase in uptake, and more than 20,000 Canadians were estimated to be receiving daily treatments (Robson, 1949). By 1980, the Ontario Department of Health officials and the Ministry of Labour both confirmed that being exposed to the aluminum dust was harmful (Dix, 1980).

1.3.9 Research on the Health Impact of McIntyre Powder

Between 1955 and 1979, Rifat et al. (1990) conducted a study which followed a clinical cohort of 29, 000 Ontario underground workers from three different Ontario chest clinics to determine if McIntyre powder had a neurotoxic effect, such as cognitive impairment. Data were collected by

interviewing workers in their homes about topics related to their personal life history, self-reported diagnosis of neurological disorders and cognitive testing. According to the authors, underground miners who were exposed to the McIntyre powder scored lower on cognitive tests, which led to the conclusion that individuals who received treatment had more cognitive deficits than those who were not exposed. Limitations of the study included exposure misclassification, as exposure data were only collected from existing data files. The study also had a large number of participants lost to follow up (n=380, 37%) (Rifat et al., 1990).

A retrospective cohort study conducted by Peters et al., (2013) analyzed the association between aluminum prophylaxis and Alzheimer's disease, cardiovascular disease, cerebrovascular disease and pneumoconiosis from 1970 to 2009. The cohort consisted of 2,294 Australian male gold miners compared to the general male population from Western Australia. The authors found that aluminum prophylaxis might have been linked to higher mortality rates related to cardiovascular disease and Alzheimer's disease. There were 508 and 16 deaths, respectively, and inhaling aluminum powder had no protective effects against silicosis. The standardized mortality rates (SMR) for cardiovascular disease were similar between aluminum exposed and non-exposed, 1.26 (95% CI: 1.12 to 1.41) and 1.38 (95% CI: 1.21 to 1.57), respectively. The full cohort SMR for cerebrovascular disease was 1.38 (95% CI: 1.16 to 1.63) and for pneumoconiosis was 16.1 (95% CI: 12.8 to 20.2). The SMR for Alzheimer's disease was not statistically significant, however the SMR was higher among the aluminum exposed group 1.08 (95% CI: 0.69 and 2.75) compared to the non-aluminum exposed group 0.89 (95% CI 0.44 to 1.78). The study had limitations such as the possibility of disease misclassification of Alzheimer's disease and exposure misclassification of aluminum powder treatment. A study strength was the long follow-

up period, which allowed for latent health effects to be identified. The next section will discuss how individuals were impacted from exposure to aluminum, not related to McIntyre powder.

1.3.10 Health Effects of Aluminum Exposure

A review by Exley (2014) identified aluminum and Al^{3+} as a neurotoxin and described several potential health impacts. With accumulation of aluminum toxicity in the human body, neuronal dysfunction, neurodegeneration, and neuronal cell death can occur. The author identified several effects from aluminum in the human body. Aluminum is a pro-oxidant and highly reactive oxidizing agent which can produce oxidative cellular damage. Aluminum is also an excitotoxin that affects the accumulation of intracellular calcium and phosphorylation which effect energy metabolism. In addition, aluminum is a mutagen that can cause genetic alterations and an immunogen, used to make vaccines. Aluminum may not be the direct cause of neurological diseases, however, it may be a potential contributor to disease etiology, such as the onset, progression and aggressiveness of neurological diseases, such as Alzheimer's disease, Parkinson's disease, and multiple sclerosis.

Mirza, King, Troakes, and Exley (2017) examined samples from the brains of 12 individuals diagnosed with familial Alzheimer's disease. Out of the 144 brain samples, all had mean aluminum concentrations ranging from 0.34 ug/g to 6.55 ug/g. The majority of the samples were considered pathologically concerning or significant. The aluminum appeared to be associated with neuronal death. However, further research was recommended to confirm areas of aluminum deposition in the brain (Mirza et al., 2017).

1.3.11 Perceived Health Impact of Mining

Markstrom and Charley (2003) conducted a qualitative literature review about the history of Navajo and uranium mining and discussed the psychological impact on underground workers (Markstrom & Charley, 2013). Main themes identified were: “human losses and bereavement, feelings of betrayal, fear about current and future effects, prolonged duration of psychological effects, anxiety and depression, and psychological impacts and exacerbating conditions of poverty and minority status” (Markstrom & Charley, p.28). Markstrom and Charley (2003) identified that traumatic bereavement does not allow individuals to properly experience the grieving process. Furthermore, the Navajo workers commonly felt betrayed or cheated by their employers. Also, they identified feelings of anxiety from uncertainty of possible health effects. The researchers identified that stress and anxiety were high amongst Navajo workers partially because they did not have any control over change in their work environment. Researchers also identified some themes that could be useful in assisting in making recommendations to help better support individuals in the future, such as having mental resources specifically for those who went through this trauma (Markstrom & Charley, 2013).

Malin and Petrzela (2010) conducted a case study on a small isolated community in Monticello in Utah, United States to determine community knowledge about environmental contamination, but issues of health impact were raised by participants. The researchers reviewed government documents and news media, and conducted in-depth interviews with seven victims exposed to mill tailings. Themes identified included: the history of the social context, contested illness, deception and powerlessness. Social context of gained employment was also discussed.

Members were happy to have been gainfully employed and did not think having a uranium mine in their community would cause any dangers to the workers and other community members. Interviewees stated that they participated in the research because “they were tired of seeing so much suffering around them and felt they deserved more honesty from the responsible party” (p.1193) and they “feel that the government needs to acknowledge their illnesses and accept responsibility” (p. 1193) from the damages due to the contamination from the mill. The health survey demonstrated very high numbers of incidences of cancers and respiratory diseases within the community. From a small town population of 1,958 people, they recorded 600 cancer cases and over 100 respiratory cases. Members requested that cancer screening and treatment facility be made readily available within the community and a federal trust fund be set up to pay for medical expenses. One member stated “the government is going to pay the bill, because it was negligent and it was their mess” (p. 1194). The community showed frustration for the lack of government support. The government continued to decline claims due to the lack of research that can prove causation of environmentally associated diseases. Other members felt deceived by their government. Members of the community found a government document stating that they were habitants of a “low-use segment of the population” (p.1195) and scientists needed to wait until the wind was in that direction before they tested bombs. Other governmental documents demonstrated that they were aware of the potential health risks, yet nothing was ever said or provided to the community members. (Malin & Petrzela, 2010).

In 1992, Dawson and Madsen (1995) undertook a case study with 68 American Indian uranium workers and 13 widowers to determine the perceived effects of uranium milling and mining living in Shiprock, New Mexico and Tonalea, Arizona (Dawson & Madsen, 1995). Workers had

to have worked at least one year in the uranium mining and milling industry. Data were collected by in-depth interviews, either at a community venue or the participants' residence. Information was collected about: work history, perceptions of working conditions, and health history. Approximately 65% were uranium millers only and 35% were both millers and miners. Dust and fumes were found to be the top workplace exposure hazards. Most workers mentioned that their employers did not inform them of workplace hazards regarding radiation. The most common reported physical health problems were respiratory problems (74.1%) and cancers (8.6%). Anxiety (34.6%) and depression (28.4%) were the most frequently reported emotional problems. Participants experienced anxiety from the lack of understanding from health care providers. When workers sought medical attention, health care providers were unsure if the issue was related to their workplace exposures. Researchers suggested that emotional health problems predominated for those who reported physical health problems which they attributed to their occupational hazard exposures. Medical screening, full health examinations, and health professionals better aware of the potential health issues were also recommended (Dawson & Madsen, 1995). Working in mining is a hazardous employment. Workers are exposed to several different hazards. Research has clearly identified that workers feel betrayed, lack knowledge, and are concerned about possible health effects and dying from hazardous exposures.

1.3.12 Psychological Well-Being

This section will further discuss mental health and psychological well-being given that Newkirk (1972) identified that exposed workers may potentially have negative mental health outcomes. The Public Health Agency of Canada (PHAC) defines positive mental health as “the capacity of each and all of us to feel, think, act in ways that enhance our ability to enjoy life and deal with

challenges we face” (PHAC, 2017, p.1). Ryff and Keyes (1995) identified six main constructs of psychological well-being: self-acceptance, personal growth, purpose in life, positive relations, environmental mastery and autonomy (Ryff & Keyes, 1995). Self-acceptance involves having a positive attitude towards oneself and one’s past. Personal growth is a feeling of continued development and improvement in oneself over time. Positive relations with others is another construct which describes positive and satisfying relationships with other individuals. Environmental mastery is the ability one has to feel competent in managing everyday affairs. Lastly, autonomy illustrates the ability one has to think and act independently without worrying about the social pressure from others. Evaluating the above constructs in the present study helps to consider the emotional or psychological well-being of underground miners who were exposed to McIntyre powder treatment (Ryff & Keyes, 1995).

1.4 Research Statement

This study focused on the psychological health of workers who were exposed to McIntyre powder. The study aimed to explore the perceived impact of McIntyre powder treatment (1943-1980) on underground gold and uranium workers in Northeastern Ontario. Secondary aims were to inform health and safety policies, industry practices and policies, and guide future research on McIntyre powder.

1.5 Theoretical Frameworks

Several theoretical frameworks were considered to guide this project. The researcher searched for theories that would help explain why workers went along with being regularly exposed to the McIntyre powder treatment. To better help understand why workers agreed and went along with

the aluminum prophylaxis, cognitive dissonance theory and effort reward imbalance model were chosen to help explain these behaviours.

1.5.1 Cognitive Dissonance

Cognitive dissonance originated from cognitive consistency (Harmon-Jones & Harmon-Jones, 2012). In 1957, Leon Festinger “theorized that persons are motivated by the unpleasant state of dissonance to engage in psychological work so as to reduce the inconsistency between cognitions” (Harmon-Jones & Harmon-Jones, 2012, p.72). The state of dissonance can be described as the discomfort when “individuals hold two or more elements of knowledge that are relevant to each other but inconsistent with one another” (Harmon-Jones & Harmon-Jones, 2012, p.71). It theorizes that one may find balance by altering cognitions through changing one’s attitude or behaviour, or by rationalizing the behaviour by changing the cognition, or by adding cognition. The most common way to reduce dissonance is through attitude change. One of the downfalls of cognitive dissonance is that it cannot be measured; it is purely subjective (Harmon-Jones & Harmon-Jones, 2012). Cognitive dissonance theory can aid in explaining why underground workers went along with receiving daily treatments of McIntyre powder.

1.5.2 Effort- Reward Imbalance Model

The effort-reward imbalance model theory specifically relates to occupational health. Cooper and Quick (2017) explained that the effort reward imbalance (ERI) model assists in explaining how stressful work environments can have negative health outcomes (Cooper & Quick, 2017). This is based on the sociological and social psychological equity theory and the human stress theory and how it may have negative impact on one’s health.

Sociological theory suggest that individuals have return expectancy (Cooper & Quick, 2017).

The exchange between employers and employees can have different rewards such as financial, status, and emotional rewards. When the return expectancy is low, employees may demonstrate anger and frustration, which in turn causes stress and long-term health effects (Cooper & Quick, 2017).

The social psychological equity theory consists of two tenets: overfitting and underfitting (Cooper & Quick, 2017). Overfitting occurs when an individual has invested little cost and received exceeding gains. Underfitting refers to when an individual invested an exceeded amount of cost and had little gain. The theory posits that the unbalanced state of overfitting and underfitting motivates individuals to change their behaviour or cognition. The equity theory is similar to the cognitive dissonance theory.

According to Cooper and Quick (2017), the human stress theory explains that the imbalance between effort and reward produces stress reactions, which in turn may harm the worker. When workers are fully committed to their work and due to different circumstances they fail to receive the appropriate reward, they in turn fall into the imbalanced state between effort and reward, and individuals will experience negative emotions. Negative emotions have been proven to activate certain areas of the brain, which in turn affects the neurotransmitters that control pleasurable emotions and one's ability to cope with stress. Research has shown that chronic exposure to stress is associated with physiological and mental health diseases.

1.6 Methods

1.6.1 Reflexivity

Carolan (2003) explained that reflexivity “acknowledges the roles and influences of the researcher on the research project” (Carolan, 2003, p.8). Reflexivity is important in qualitative research because it directs the choice of methods used for the research, which in turn will allow gaining trust from the interviewees during the research (Carolan, 2003). Upon reflection, I am aware that my educational background, work experience, and personal life have contributed to my interest on workers who have been exposed to McIntyre powder in the workplace. Having completed a bachelor’s degree in public health, I have acquired what I feel is a solid foundational knowledge about health and public health safety. Also, I’ve worked for the health care system for over 15 years, where I have gained first-hand experience about how individuals face health issues. More recently, I returned to my hometown in Northern Ontario, where I have learned that some individuals had been subjected to daily McIntyre powder treatment. Please refer to Appendix A for a more detailed explanation of how and why individuals exposed to McIntyre powder has resurfaced. Having learned more about this, I wanted to give a voice to the exposed vulnerable workers. I also learned that my father was subjected to McIntyre powder, fortunately for only a very short period. Living in Northern Ontario, I am surrounded by family and friends who work in underground mining. I hope to make a difference by increasing awareness of the unsafe and hazardous work environments that many underground miners work in everyday so that they can provide for their families in a healthy and safe manner. Furthermore, I believe that all individuals, should have the human rights to make an informed decision about their health and be able to work in safe environment every day.

1.6.2 Study Design

A qualitative descriptive study was conducted to examine the experiences of male underground workers who were exposed to the McIntyre powder treatment between 1943 and 1980.

Sandelowski (2000) describes the importance of using qualitative descriptive in health research because it allows individuals to explain how they feel about a specific event or issue, who is using a specific treatment, and assists in identifying barriers or facilitators for a specific event or health issue. A qualitative descriptive study allows for thoughtful exploration of aluminum dust treatment of underground miners and can give voice to those have been silent for many decades (Colorafi & Evans, 2016). A qualitative descriptive study is warranted for this study because it allowed workers to share their detailed personal experiences of being exposed to the aluminum dust treatment (Colorafi & Evans, 2016).

1.6.3 Setting

Sixteen individual interviews were conducted, by the researcher DA, in person or by telephone between February and April 2018. Participants interviewed in person were given the option to meet at the union hall, town library or their own home, and they all chose to have the interviews done in their residential homes. Interviews lasted on average 45 minutes. All participants were given a five dollar Tim Hortons gift card in person or by mail, which was sponsored by Sudbury Occupational Health Clinics for Ontario Workers (OHCOW) clinic.

1.6.4 Sample Inclusion

To be eligible for the study, the individual could be of any age with a minimum of one year working underground and with 15 to 30 minutes of daily exposure to McIntyre powder

treatment. They also had to live in Sudbury, Elliot Lake, or Timmins where several miners have been exposed and able to provide free and informed consent. This is consistent with the inclusion criteria provided in the Peters et al. (2013) study. By setting exposure rates at a minimum of one year, the study excluded short term contract underground workers and underground miners who were transient workers.

1.6.5 Recruitment

To decrease sampling bias, research participants were recruited using several techniques. Firstly, recruitment posters and letters (Appendix B and C) were mailed out with OHCOW correspondence. Their master list consisted of 370 clients. One hundred clients were removed because they were no longer living. From 270 clients, every 10th client was chosen at random, for a total of 27 letters mailed out by OHCOW's client service coordinator. Secondly, the researcher posted the recruitment poster on her Facebook page. Thirdly, the recruitment poster was posted on the McIntyre Powder Project website: <http://www.mcintyrepowderproject.com>. Fourthly, ten recruitment posters were posted in general grocery stores, community bulletin boards and dollar stores in Sudbury, Elliot Lake, and Timmins. Lastly, the researcher contacted the Elliot Lake Standard, Timmins Daily Press, the Sudbury Star and the Northern Business News to assist with recruiting participants. Each newspaper printed an article to assist with recruitment which was the most successful method to recruit. The Kirkland lake radio station, CKJL FM News also contacted the researcher to do a short audio interview to assist with recruitment. Sixteen participants were interviewed.

1.6.6 Questions/Instruments and Data Collections

After reviewing research about individuals who were exposed, both myself and my thesis supervisor had a meeting and created the interview questions for the exposed workers. Interviews were available in French and English. All participants chose to have the interviews in English. The interview process started with a very general question about workers' experience in mining which provided the opportunity of participants to become at ease with the interview process. After the ice breaker questions, more questions were asked about the McIntyre powder treatment process. A pilot interview was conducted on February 5th, 2018 with a participant who volunteered at the Sudbury intake clinic on October 3rd, 2016. Subsequent interviews were conducted between February and April 2018. Participants answered semi-structured interviews and demographic questions (Appendix D). Interviews lasted between 35 minutes to 60 minutes. The researcher allowed the interviewees to guide the interview by asking probing questions which enabled participants to provide additional detail about what was relevant to them. I also kept a hand-written journal describing thoughts and feelings after each interview to better reflect any additional nonverbal cues that would help assist analyzing data.

1.6.7 Data Analysis

Data were analyzed by thematic analysis as described by Braun and Clarke (2006). Braun and Clarke's (2006) thematic analysis consists of 6 clearly identified steps. To begin, the main researcher (DA) became familiar with the data by transcribing the data verbatim, which included every sound and pause. Then, the researcher (DA) actively read and re-read the transcriptions to search for meaning within the data collected. Next, (DA) started taking notes and marking down ideas. The second stage involved generating initial codes, once all transcriptions were completed.

The main researcher (DA) began using open coding, which entailed the coding data line by line (Khandkar, 2009). (DA) used inductive analysis by not coding the data into already pre-identified codes, which allowed for new ideas to be identified (Braun & Clarke, 2006). All transcriptions were coded and identified extracts were gathered and linked with a code (Braun & Clarke, 2012). The third step in thematic analysis was searching for broader themes from the identified codes. Phase three ended with potential main themes, subthemes and extracts related to the research question (Braun & Clarke, 2012). Step four consisted of reviewing and refining potential themes of the study. Step four basically checked the quality of the themes to represent the entire data collected for this study (Braun & Clarke, 2012). In the fifth step, the researcher (DA) named and defined the themes identified from step 4 (Braun & Clarke, 2012). In step five, the essence of each theme were identified and the section of the data set it captured (Braun & Clarke, 2006). For each theme, a detailed written analysis was completed to explain the relationship with other themes and the research questions. At the end of this step, the themes were able to be described in a couple of sentences (Braun & Clarke, 2006). The last step involved a final analysis and produced a final report (Braun & Clarke, 2012). The themes and extracts were displayed in a manner that was meaningful and logical to allow the data to answer the research question (Braun & Clarke, 2006).

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2.0 Chapter 2

2.1 Abstract

A qualitative descriptive study of underground workers who received aluminum dust prophylaxis and its personal impact

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Background and Objectives

From 1943 to 1980, some underground gold and uranium workers in Ontario, Canada were required to inhale aluminum dust daily for silicosis prevention. This study explored the perceived personal impact of aluminum dust exposure for some Northeastern Ontario workers.

Methods

This qualitative descriptive study included 16 respondents who participated in individual semi-structured interviews. All respondents were Northeastern Ontario workers who were exposed to aluminum dust prophylaxis for at least one year. Interviews were transcribed verbatim and analyzed thematically.

Results

Themes that emerged included: 1) compulsory exposure, 2) hesitancy to complain, 3) feelings of betrayal, and 4) concerns about health impact and dying.

Conclusion

Exposed workers perceived that their long-term health was impacted on a personal level. The results will contribute to the literature about workplace aluminum dust exposures and better inform workers and companies about exposure impact and management of aluminum dust.

Keywords:

McIntyre powder, aluminum powder, aluminum dust, aluminum, underground workers, qualitative descriptive, mining.

2.2 Applying Research to Practice (Sidebar)

A limited amount of research has examined the perceived impact on underground workers who were exposed to aluminum dust as a preventative method to lung diseases. At the time, workers perceived that exposure to the aluminum dust was compulsory and they were hesitant to complain. Later, they experienced feelings of betrayal, concerns about their health, and became worried about dying due to the ill effects of the aluminum dust.

Health care professionals need to be aware of McIntyre powder exposure among workers in some gold and uranium mines, as well as its potential association to chronic diseases. Further research is needed about the potential role of causation of neurological diseases such as: Alzheimer's disease, Parkinson's, Amyotrophic Lateral Sclerosis (ALS), and other chronic diseases (e.g., various types of cancers, cardiovascular diseases, and cerebrovascular diseases). Health promotion programs should be developed and implemented for health care professionals, caregivers, and underground workers to increase awareness for those exposed to the aluminum dust and to better assist them with their future health care concerns. Assistance programs are needed to support workers with both physical and mental health needs and to address health concerns and worry about dying. Further qualitative and quantitative epidemiological research is needed to allow workers to feel comfortable enough to speak up and emotionally heal from the past trauma.

2.3 Introduction and Background

From 1943 to 1980, some gold and uranium mines across the globe mandated that their workers inhale aluminum dust daily, referred to as the McIntyre powder treatment or aluminum prophylaxis, to help prevent lung silicosis (Newkirk, 1972; Findlay, McKeown, & Kelley, 2016).

The McIntyre Research Foundation was led by Dr. W.D. Robson and an engineer J.J. Denny, who created the aluminum dust in Timmins, Ontario, Canada (Newkirk, 1972). The aluminum dust was made of 85% aluminum oxide and 15% aluminum (Newkirk, 1972). Underground workers were exposed to the aluminum dust, on a daily basis, prior to the start of the work day (Newkirk, 1972). During the treatment, workers were confined to a sealed tight tunnel or change room for approximately 15 to 30 minutes (Newkirk, 1972). The purpose of this study was to determine how being exposed to the aluminum dust impacted exposed workers on a personal level.

Aluminum dust exposure was introduced because it was thought to engulf silica dust particles before reaching the bronchial tree, leading to expulsion of the particles (Crombie, Blaisdell, & MacPherson, 1944). Others have suggested that the aluminum dust compounds coated the silica particles inside the lungs thereby inhibiting the development of silicosis (Peter et al, 2013; Sorenson, Campbell, Tepper, & Lingg, 1974).

From 1939 to 1943, Crombie, Blaisdell, and MacPherson (1944) conducted an experiment by exposing participants to aluminum dust in Timmins, Ontario, Canada. The researchers did not utilize a control group for comparison. They subjectively measured shortness of breath, fatigue, cough and sputum, and chest pain without using any standardized testing. From the 32 participants that completed the study, 19 participants showed definite and slight improvements. However, 15 participants showed no improvement. The researchers stated that the aluminum powder was harmless for humans and concluded that the aluminum powder was an effective

method to prevent lung silicosis. This was one of the main reasons the McIntyre Foundation started the aluminum dust treatment for underground workers exposed to silica dust particles.

2.4 Rationale and Possible Health Effects

There is a noticeable gap in research about the McIntyre powder treatment and its related health outcomes. Only a few studies have observed a possible weak association between aluminum powder treatment and Alzheimer's, cardiovascular disease, and cognitive impairment in underground workers (Rifat, Eastwood, McLaghlan, & Corey, 1990; Peters, Reid, Fritschi, de Klerk, & Musk, 2013). The current study described, here, will provide in-depth information about workers who were required to be exposed to McIntyre powder and how it has impacted them at the time and to date. The existing gaps in the research creates a challenge for recognition and compensation of workers who were exposed and became ill, as well as for their families. The practical implications of this research will help guide future needs of exposed workers and identify areas of improvement for government, unions and employers.

2.5 Perceived Health Impact of Work in Mining

While there is a limited amount of research specific to aluminum dust exposure, there are several examples of research conducted about the perceived impact by miners exposed to environmental contaminants. Markstrom and Charley (2003) conducted a qualitative literature review, about the history of the Navajo Native Americans and uranium mining, in which they discussed the psychological impact on underground workers in the American southwest (Markstrom & Charley, 2013). The main themes identified were: "human losses and bereavement, feelings of betrayal, fear about current and future effects, prolonged duration of psychological effects, anxiety and depression, and psychological impacts and exacerbating conditions of poverty and

minority status” (p.28). Markstrom and Charley (2003) found that traumatic bereavement did not permit individuals to go through the grieving process. Furthermore, the Navajo workers commonly felt betrayed or cheated by their employers. They also identified feelings of anxiety from uncertainty about possible health effects. The researchers identified that stress and anxiety were high amongst Navajo workers, in particular, as they did not have any control over change in their work environment. They also identified some themes that could be useful in assisting in making recommendations to help better support individuals in the future, such as having mental health resources specifically for those who experienced this trauma (Markstrom & Charley, 2013).

Malin and Petrzela (2010) performed a case study of a small isolated community in Monticello, Utah, in the United States (Malin & Petrzela, 2010) to determine the community knowledge about environmental contamination, but issues of health impact were also raised by participants. The researchers reviewed government documents and news media, as well as conducting in-depth interviews with seven residents who were exposed to mill tailings. Themes identified included: the history of the social context, contested illness, deception, and powerlessness. Social context of gained employment was also discussed. Members were happy to have been gainfully employed and did not think having a uranium mine in their community would cause any dangers to workers and other community members. Interviewees stated that they participated in the research because “they were tired of seeing so much suffering around them and felt they deserved more honesty from the responsible party” (p.1193) and they “feel that the government needs to acknowledge their illnesses and accept responsibility” (p. 1193) from the damages due to the contamination from the mill. The health survey demonstrated very high incident cancers

and respiratory diseases in the community. Members requested that cancer screening and a treatment facility be made readily available in the community and a federal trust fund created to pay for medical expenses. One member stated: “the government is going to pay the bill, because it was negligent and it was their mess” (p. 1194). The community displayed frustration with the lack of support from the government. The government continued to decline claims due to the lack of research proving causation of environmentally associated diseases. Other members felt deceived by their government. Members of the community found a government document stating that they were habitants of a “low-use segment of the population” (p.1195) and scientists were told to wait until the wind was in that direction before they tested bombs. Other government documents demonstrated that they were aware of the potential health risks and yet nothing was ever communicated to community members (Malin & Petrzela, 2010).

In 1992, Dawson and Madsen (1995) performed a case study with 68 American Indian uranium workers and 13 widowers to determine the perceived effects of uranium milling and mining living in Shiprock, New Mexico and Tonalea, Arizona (Dawson & Madsen, 1995). Participants worked at least one year in the uranium mining and milling industry. Data were collected by in-depth interviews either at a chapter house or at the participants’ home. Information about work history, perceptions of working conditions, and health history were collected. Approximately 65% were uranium millers, and 35% were both millers and miners. Dust and fumes were the top workplace exposure hazards. Most workers mentioned that their employers did not inform them of workplace hazards about radiation. The most commonly reported physical health problems were: respiratory problems (74.1%), and cancers (8.6%). Anxiety (34.6%) and depression (28.4%) were the most frequently reported emotional problems. Participants experienced anxiety

given lack of understanding from health care provider explanations. When workers sought medical attention, health care providers were unsure if the health issue was associated with their workplace exposure. The researchers suggested that emotional health problems were also present in those who reported physical health problems that they thought were related to their occupational hazard exposures. Medical screening, full health examinations, and health professionals being better aware of the potential health issues were recommended (Dawson & Madsen, 1995).

Clearly, working in the mining sector is a hazardous occupation. Workers are exposed to several different environmental hazards, unique to our study about McIntyre powder treatment was that exposure to the contaminant was mandatory and unavoidable. As such, we sought to contribute to this body of literature by examining the perceived personal impact the exposure treatment has had on the miners.

2.6 Research Objective

This study aimed to explore the perceived personal level impact of McIntyre powder treatment exposure (1943-1980) on some underground gold and uranium workers in Northeastern Ontario.

2.7 Theoretical Framework

The cognitive dissonance theoretical framework was used as a guiding perspective to interpret the results of this research. Cognitive dissonance originated from cognitive consistency (Harmon-Jones & Harmon-Jones, 2012). In 1957, Leon Festinger theorized that individuals are motivated to find balance in their cognition when they are in a state of psychological imbalance

(Harmon-Jones & Harmon-Jones, 2012, p.72). The state of dissonance can be described when there are conflicting attitudes, beliefs, or behaviours (Harmon-Jones, 2012, p.71). Leon Festinger theorized that one may find balance by altering cognitions, by changing one's attitude or behaviour, or by rationalizing the behaviour by changing the cognition, or by adding cognition. The most common way to reduce dissonance is through attitude change. One of the downfalls of cognitive dissonance is that it cannot be measured and is purely subjective (Harmon-Jones & Harmon-Jones, 2012).

2.8 Methods

For this study, a qualitative descriptive study design was used to explore the perceived personal level impact of exposure to McIntyre powder treatment in Northeastern Ontario. Semi-structured interviews were conducted with 16 exposed male underground miners from Timmins, Elliot Lake, and Sudbury, in Ontario, Canada. Snowball sampling was used for study recruitment, data were analyzed thematically (Braun and Clarke, 2006), and steered by cognitive dissonance theory (Harmon-Jones & Harmon-Jones, 2012).

2.8.1 Recruitment

To decrease sampling bias, research participants were recruited using several methods. Firstly, recruitment posters and letters were mailed out from the Sudbury Ontario Health Clinics for Ontario Workers. From the 2016 Occupational Health Clinics for Ontario Workers (OHCOW) client list, every 10th client from 270 were mailed a poster and letter by one of OHCOW's service coordinators. Secondly, the lead researcher (DA) posted the study recruitment poster on their Facebook page. Thirdly, the recruitment poster was posted on the McIntyre Powder Project website <http://www.mcintyrepowderproject.com> and Facebook page (Martell, 2013). Fourthly,

ten recruitment posters were posted in general grocery stores, community bulletin boards and dollar stores in Sudbury, Elliot Lake, and Timmins. Lastly, the lead researcher contacted various newspapers (i.e., the Elliot Lake Standard, Timmins Daily Press, the Sudbury Star, Northern Life and the Northern Ontario Business Newspaper) and they each published an article to assist with recruitment for this study.

2.8.2 Sample Inclusion

All participants required a minimum of one-year continuous daily exposure to the aluminum dust treatment for a duration of 15 to 30 minutes. Due to previous literature identifying a possible connection between McIntyre powder and cognitive deficits, participants had to be able to provide free and informed consent (Peter et al., 2003). The target population had to currently reside in Sudbury, Elliot Lake, or Timmins Ontario, Canada. Participants previous work experience had to include a minimum of one year continuously working in the mining industry to exclude any contract and transient workers.

2.8.3 Setting

Sixteen individual interviews were conducted in person or by telephone. Participants interviewed in person were given the option to meet at a local union hall, library, or their own home, and all participants chose to have the interviews conducted at their residences. Interview duration averaged approximately 45 minutes. To thank participants for their time, participants were given a five-dollar gift card for a popular local coffee shop. These gift cards were donated by the Sudbury OHCOW clinic. A pilot interview was conducted on February 5th, 2018 with a participant who volunteered at a Sudbury OHCOW intake clinic on October 3rd, 2016.

Occupational disease intake clinics comprises of individual interviews, physical examinations and a review of medical records which gathers information of workplace exposure and workers' health issues (OHCOW, 2016). Subsequent interviews were conducted between February and April 2018.

2.8.4 Data Analysis

Detailed thematic analysis was utilized to analyze the data in this research, which consisted of six steps (Braun & Clarke, 2006). During the first step, the researcher (DA) became familiar with the data by reading and re-reading the transcriptions and began looking for meaning in the data when transcribing all data verbatim (Braun & Clarke, 2006). Once all transcriptions were completed, the next step involved generating initial codes (Braun & Clarke, 2012). The researcher (DA) coded all data line by line, which consisted of open coding and used inductive analysis by not using pre-identified codes (Khandkar, 2009; Braun & Clarke, 2006). During the third step, the researchers (DA & NL) searched for and identified broader themes and extracts related to the research question (Braun & Clarke, 2012). Step 4 consisted of reviewing themes by re-reading the entire data set, verifying codes and checking for quality of themes (Braun & Clarke, 2006). In step 5, the main themes were defined and the essence of each theme were captured (Braun & Clarke, 2006). The last step consisted of grouping the themes and extracts for final analysis (Braun & Clarke, 2006).

2.9 Results

2.9.1 Participant Characteristics

From the 16 interviews, the majority of participants were recruited from the McIntyre Powder Project and Newspapers (n=5 for each respectively). Other recruitment consisted of from the Sudbury OHCOW intake clinic (n=1), the researcher's (DA) personal Facebook page (n=2), a poster from a dollar store (n=1), and snow ball sampling (n=2). All study participants were male. Participants ranged in age from 60 to 88 years-of-age, with an average age of 67 (s.d. 7.09). Participants interviewed lived in Sudbury, Elliot Lake, and Timmins (n=7, n=5, n=5, respectively). Workers' daily exposure duration to aluminum dust averaged seven years (s.d. 5.9), and ranged from 2 to 27 years.

The four main themes derived from the participants interviewed who were exposed, on a daily basis, to McIntyre powder were: 1) compulsory exposure, 2) hesitancy to complain, 3) feelings of betrayal by union, employers, and the Canadian government, and 4) concern about health impact and dying.

2.9.2 Compulsory Exposure

A predominant theme noted by participants was that the exposed workers did not consent to the aluminum dust treatment. Workers did not provide their employers with any type of written or verbal consent for treatment. They were not given the opportunity to make an informed decision to consent to treatment. They believed they had no choice in the matter, one exposed worker stated: "(...) we just had to do it -- well then, they (the employer) didn't ask me, (...), want to go

in there and get gassed before every shift, -- no they didn't ask me that" (Elliot Lake Underground Worker #9). Another underground worker stated: "My god there's so much stuff out nowadays they warn you for this and that and then, but there was nothing, to breathe that for 10 minutes for god sake forced to do it" (Timmins Underground Worker #13). Another worker explained:

It was done without our permission and without our knowledge. It was a medical treatment that was invasive and they shouldn't have done it without, that's still 77, that's still fairly modern. That's not like in the 1800s, right it's still at the modern age where they should have let people know. You know they just went ahead and done, and I don't think that was right (Elliot Lake Underground Worker #10).

The above quotes demonstrate that the exposed workers were required to be exposed to the daily aluminum dust treatment. Exposed workers did not provide any type of consent for the treatment and felt they had no choice at all in the matter.

2.9.3 Hesitancy to Complain

Workers who were exposed to the McIntyre powder did not complain about the aluminum dust treatment because they were afraid of losing their jobs. They were also hesitant to complain as they were the primary source of financial support for their families at the time and their families' stability was dependent on their jobs. They did not feel respected enough as workers to be able to speak with supervisors and discuss concerns about being exposed to the McIntyre powder on a

daily basis. They worried they might lose their jobs if they mentioned it. A few examples illustrate this point:

It wasn't voluntary, it was mandatory. So, I mean you could look back now, and say well I would have done this or I would of done that but at the time no. You did what they told you because they in Elliot Lake mining, mining companies where they ruled everything in this city town then. You work for the mines or you didn't work really, and if you didn't do what the mine tells you, you have no job (Elliot Lake Underground Worker #14).

Another underground worker stated: "Well you know the only thing I can say with the mining companies and stuff like that they're self-serving and they're going to do whatever they want and the little guys mean nothing" (Elliot Lake Underground Worker #15). To further explain workers' hesitancy to complain, another worker stated:

[...] you go down on the first day, we were wondering what's going on and this is, [...] this is what we had to do and I guess as (the) new man. The old guys they all knew they were doing it for years. But it was as a new man you just, you were happy to have a job and you just did whatever you were told to do (Elliot Lake Underground Worker #15).

The above quotes illustrate that exposed underground workers were hesitant to complain about several issues. They were hesitant to complain due to following

direction from authority members from the mining companies, normalization with coworkers, and due to financial obligations.

2.9.4 Feelings of Betrayal from Union, Employers and Canadian Government

Participants felt betrayed, tricked, and deceived by mining companies, the government, and their unions for allowing the companies to have exposed them to a treatment that had little evidence of any health benefit. They felt that they were used as guinea pigs as part of an experiment to determine if the aluminum dust could actually help prevent lung silicosis. They expressed feelings of betrayal in various ways. One participant stated:

There's the element of trust that you're being taken care of. Then many years after it's almost like a violation you know like a break and enter kind of thing where something has happened that you oh I don't know just makes you feel, -- betrayed, or whatever (Elliot Lake Underground Worker #9).

Another worker illustrates feelings of betrayal:

I feel they fooled us. [...] Yeah. They lied. -- They did not know, it was gonna be good for us they don't know they just believed it because somebody just made it and sold those little things. That, McIntyre dust or whatever they call that. I remember that, those little cans (Elliot Lake Underground Worker #8).

One deceived exposed worker stated:

Well today, in today's standards, I feel that I was deceived -- Back then you didn't say much right well like I said maybe it's okay that's why they're doing it, they're protecting us right. -- But today, you know, I don't think they could, the law says you can't do anything medical to a person without their knowledge. But back then, well that's 40 years ago right. So, different laws different standards (Elliot Lake Underground Worker #10).

The above quotes revealed how the workers felt deceived by their employers, government, and unions.

2.9.5 Concern About Health Impact and Dying

Another theme identified was that participants were concerned about their own health impact and dying. Some participants feared that even though they were currently healthy, they were unsure about future health implications that could result from exposure. They were concerned with the fear of the unknown health consequences and the possibility of an early death. One participant stated: "My friends, -- they're in worse shape than me [...] Yeah they're all dead" (Elliot Lake Underground Worker #9). Other examples of these concerns included: "And especially there's so many people that were exposed to it probably longer than I have and they're not here no more and they didn't even get to see their retirement or nothing. That's what really bugs me now" (Timmins Underground Worker #13). Another concerned worker stated: "It's kinda scary. I know

now and I'm not in that great of shape but, I'm afraid to get Alzheimer's or Parkinson disease, you know, it's scary" (Elliot Lake Underground Worker #15).

From the participants' experiences, it was clear that exposed workers were currently concerned about their future health implications from the aluminum dust treatment.

In summary, the main results revealed that at the time of exposure, exposed workers felt they were mandated to being exposed to the McIntyre powder treatment and were hesitant to complain to authority figures. At the time of the interviews, exposed workers felt betrayed by their unions, employers, and Canadian government. Today, exposed workers are still concerned about future health implications associated with being exposed to the aluminum dust treatment.

2.10 Discussion

2.10.1 Theoretical Framework

Cognitive dissonance theory helped explained the main findings in this research. Cognitive dissonance can impact individuals in the workplace and can have several negative effects (Prvulovic, 2015). Some workers may have been exposed to certain situations that are in direct conflict with their beliefs and personal values and still chose to execute tasks that are in direct internal conflict (Prvulovic, 2015). Internal justification methods can include positional obedience, normalization, and emotional trading. Positional obedience occurs when a worker justifies their action because it came from a person of authority in the workplace. Normalization occurs when workers follow suit because other workers are doing it (Prvulovic, 2015).

Emotional trading occurs when workers foresee future reward for their behaviour even though it compromises their beliefs and personal value (Prvulovic, 2015). Negative impact from cognitive

dissonance in the workplace can include: increased absenteeism, withdrawal and disengagement, significant reduction in performance, negative and inappropriate behaviour, high staff turnover, workplace stress claims, and adverse health effects, such as depression, fatigue, and anxiety (Prvulovic, 2015).

In relation to cognitive dissonance theory, participants explained that they felt being exposed daily to the McIntyre powder was mandatory. Some participants explained that direction to undergo McIntyre powder treatment came from mining authority personnel who they trusted at the time. Furthermore, some workers went along with the treatment because other workers were doing it and they believed that their health would benefit from it in the future. Participants were also concerned about having been exposed to McIntyre powder and its effect on their future health and were concerned with developing various illnesses and premature death. These concerns may cause chronic stress leading to additional adverse health effects for exposed workers. As such, our findings confirm the workers were hesitant to complain due to internal justification, such as positional obedience, normalization, and emotional trading as reported by Prvulovic (2015).

2.10.2 Main Themes

Workers exposed to McIntyre powder felt that the treatment was compulsory. They did not remember consenting to the aluminum dust prophylaxis treatment and were hesitant to complain about the treatment at the time out of fear for losing their job. Interviewed workers explained that they felt they had no choice about receiving aluminum prophylaxis and it was a condition of their employment. In that era, men were the prominent financial supporters for their families. Several

interviewed workers explained that they felt they had no other options for employment and they felt obligated to financially support their family regardless of hardships. To relate these findings to cognitive dissonance theory, workers found balance by rationalizing their daily behaviour of aluminum treatment by changing their thinking. Workers internalized their thoughts about not wanting to be exposed to the McIntyre powder, by rationalizing that they needed their jobs to support their families.

Workers felt that they were betrayed by the government, employers, and unions. They did not understand why these groups encouraged workers to be exposed to McIntyre powder without providing proper information or giving workers the choice to be exposed, or not. They also felt betrayed that the government did not act sooner to stop the production of the aluminum powder when they learned that it did not show any health benefits to exposed workers.

Workers were also concerned about their health and that of their coworkers, as well as the possibility of dying prematurely. Exposed workers learned that being exposed to the aluminum powder did not have any protective effect and that it may have had a negative impacted their health. Many felt that they were the only survivors of all their co-workers. In terms of theoretical aspects, exposed workers who are concerned about future health impact are in a state of cognitive dissonance which may contribute to negative health effects and well-being.

2.10.3 Similar Findings

To our knowledge, no other qualitative research has been conducted on exposure to a harmful element that was originally meant to protect workers. Similar to the current research on McIntyre powder, Markstrom and Charley (2003) found that underground workers felt betrayed by their

employers and had feelings of anxiety regarding the uncertainty of possible health effects from working in the Navajo mining industry. Malin and Ptrlzka (2010) studied a community in Monticello where residents were exposed to an environmental uranium contamination from a mill felt they were deceived and powerless, and also concerned with the uncertainty of future health impacts. Dawson and Madsen (1995) interviewed American Indian uranium workers and widowers and also found that workers were concerned with their coworkers' illnesses and deaths. Thus, individuals have been concerned in other settings about the potential health implications from being exposed to harmful elements in the workplace.

2.10.4 Strength and Limitations

The main goal of this study was to explore the perceived impact of McIntyre powder exposure on workers who were exposed. Due to the lack of research on McIntyre exposed workers, this qualitative research study may help fill a knowledge gap by providing more information about how being exposed has impacted workers. This study is the first qualitative study that has been conducted with individuals exposed to the McIntyre powder. This research brings new insight on this issue and will continue to guide future research about the potential health impact of McIntyre powder. Another strength to this study was that exposed workers showed great interest in participating in this research.

Despite study strengths, sampling bias is a limitation for this research because there was no master list of all workers who were exposed the McIntyre powder. To minimize this, participants were recruited by several methods and convenience and snowball sampling was utilized. The possibility of recall bias is also present in this study as participants were asked to recall events

that happened over 30 years ago. In addition, selection bias may have occurred given who ultimately participated in the study. The results from this study also provided only perspectives from those who participated and reside in Northeastern Ontario.

Nevertheless, the study findings offer an important and unique perspective of workers who were required to be exposed to aluminum powder treatment, under the illusion of the treatment being protective for their health.

2.11 Conclusion and Recommendations

Exposed workers to the aluminum dust treatment perceived that their long term health was impacted on a personal level. There is some research on McIntyre powder exposure that has identified a possible association with neurological disorders, cardiovascular diseases, and cognitive impairment (Rifat, Eastwood, McLaghlan, & Corey, 1990; Peters, Reid, Fritschi, de Klerk, & Musk, 2013). However, to our knowledge this the first qualitative study to examine the perceived impact of the treatment on individuals. The main findings from this research identified that exposed workers felt they were obligated to receive the aluminum powder daily at work, were hesitant to complain about undergoing daily treatment, felt betrayed by their union, employers, and the Canadian government, and are still concerned about future health implications and the possibility of premature death. These results may be used to inform workers, companies, unions, governments, and health care professionals about workers who were exposed to McIntyre powder, as well as potential health concerns. Even though McIntyre powder is currently not in use, workers continue to be exposed to hazardous chemicals and elements in the mining environment. A thorough review of exposures is necessary to protect our

workers from unnecessary harmful exposures. Furthermore, more research is required to minimize barriers for workers so that they feel more comfortable in raising workplace exposure concerns. Also, to assist exposed workers in minimizing their feelings of betrayal from their union, employers and government, a formal apology should be provided and information sessions should be offered to address concerns about future health implications.

2.11.1 Implications for Practice

McIntyre powder was used globally and is not only a Northeastern Ontario concern. These findings can be used in clinical practice and for educating clinicians who are primary care providers for exposed workers. Results can also be used to plan educational interventions about McIntyre powder exposure for medical professionals. Occupational health research must continue to focus on the potential health impacts for these exposed workers. Further qualitative research could include interviewing workers about compensation experiences, spouses or partners of exposed workers, health care workers, compensation and regulatory government workers, and employers who used the aluminum dust.

2.12 Declaration of Conflicting Interests

The author(s) declared no potential conflicts of interest with respect to the research, authorship, and/or publication of this article.

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3.0 Chapter 3

3.1 Abstract

A qualitative descriptive study of underground workers who received aluminum dust treatment and its organizational level impact

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From 1943 to 1980, some underground gold and uranium workers in Ontario, Canada were required to inhale aluminum dust for silicosis prevention. Workers were exposed to the dust for up to 30 minutes daily. This study explored the perceived organizational impact on workers exposed to the aluminum dust treatment in Northeastern Ontario. This qualitative descriptive study included 16 respondents who participated in individual semi-structured individual interviews. All respondents were Northeastern Ontario workers who were exposed to aluminum dust treatment for at least one year. Interviews were transcribed verbatim and analyzed thematically. Themes that emerged were: 1) confidence and trust in companies, 2) lack of participants' and health care providers' knowledge, and 3) need for compensation and formal apology. Workers' perceived that their long term health was impacted by exposure. The results will be used to help workers, companies, and unions address workplace exposures. The latest information about McIntyre powder will enhance the knowledge about the impact of the exposure.

Keywords:

McIntyre powder, aluminum powder, aluminum dust, aluminum, workplace exposure, qualitative descriptive.

3.2 Introduction

From 1943 to 1980, some mining companies in some locations in Canada, the United States, Australia, New Zealand, Africa, Mexico, England, and Peru required some underground workers to inhale aluminum dust to prevent silicosis [1]. This process was referred to as the McIntyre powder treatment [2]. In the late 1930s, Dr. W.D. Robson and an engineer J.J. Denny researched and created the aluminum dust treatment at the McIntyre Porcupine Mine in Timmins, Ontario [1]. On a daily basis, underground workers were confined mostly in a sealed change room or tunnel for approximately 15 to 30 minutes for treatment [1]. The length of treatment varied depending on the size of the group, the mining company, and the type of powder canister used for treatment. Employers instructed their workers to inhale deeply in order to coat their lungs with the powder [1].

3.2.1 Physical Characteristics of Aluminum and Aluminum Oxide

Aluminum (Al) is a lightweight, silvery-white metal found in abundance in the earth's crust [3]. Aluminum has high spontaneous reactivity rates [4]. To decrease this reactivity rate, aluminum is usually found combined with other elements [3]. Individuals are also exposed to aluminum on a daily basis in their own personal environment (e.g., from daily diet, antiperspirants, and adjuvant for vaccination) [3]. Al is commonly used in the construction industry, food industry, mechanical industry, pharmacology and cosmetics [3]. Exposure limits of Al are implemented to protect the workers from potential toxic effects [3].

Similar to Al, Aluminum oxide (Al_2O_3) is a white, insoluble, odorless powder [5]. Al_2O_3 is made up of two aluminum atoms and three oxygen atoms and has a molecular weight of 101.96 g/mol

[5,6]. In contrast with Al, Al₂O₃ is an electrical resistor and does not react with most material except with chlorine trifluoride and ethylene oxide, thus causing a potential fire [5]. Al₂O₃ has mechanical properties of low corrosion and high temperature stability, with an extremely high melting point of 1982 degrees Celsius [5]. In summary, Al₂O₃ is more durable and stable compared to Al alone [6].

3.2.2 Exposure Limits

The American Conference of Governmental Industrial Hygienists (ACGIH) currently identifies Aluminum (Al) and aluminum oxide's (Al₂O₃) daily average exposure limits to be 1 mg/m³, respirable particulate matter [7]. The threshold limit value and time-weighted average base their average exposure limits on individuals who work eight hours per day and a 40-hour work week [7]. The Ontario Ministry of Labour identifies that the exposure limit of aluminum is set comparatively high to other metals [8]. Worldwide, the exposure limit of Al varies from 1.2 to 15 mg/m³ of respirable particulate matter [9]. The United States of America, Australia, Canada and Spain have the highest limit values, as compared to Poland and Germany [9]. ACGIH (2017) identifies that the Threshold Limit Values (TLV) are recommendations for occupational hygienists to interpret and should not be used as legal standards [10]. TLV provides safe airborne concentrations limits of chemical substances under which workers may be repeatedly exposed daily without any adverse health effects [10]. Threshold limit values of aluminum and compounds of Al were first proposed back in 1977 [7]. From 1979 to 1987 a TLV was set at 10mg/m³. In 2007, the ACGIH proposed to change the TLV limit to 1 mg/m³ and was accepted in 2008 [7]. ACGIH (2008) classifies aluminum metal and insoluble compounds as non-carcinogenic, however, the process of making aluminum is considered carcinogenic from the

combustion of polycyclic aromatic hydrocarbons during the smelting process [7,11].

Additionally, Al is considered a neurotoxin [7].

3.2.3 McIntyre Powder Characteristics

In 1936, the McIntyre Research Foundation in Timmins created an aluminum powder to protect underground workers from developing silicosis [1]. 96% of the aluminum particles were less than 1.2 microns. The powder was made up of 15% aluminum and 85% aluminum oxide [1].

Group treatments lasted approximately ten minutes with the recommended inhalation concentration during treatment of 35.6 mg/m³ [1]. Canadian mining companies paid one dollar per annum to the McIntyre Research Foundation for each underground exposed worker [12].

Two types of canisters holding the powder were produced: 5 mg and 10 mg [1]. One canister was required per 1,000 ft³ for a recommended aluminum concentration of 20,000 to 34,000 particles/cm³[12]. If the workers used the lower dose canisters, the length of the treatment was doubled to 20 minutes [1].

3.2.4 McIntyre Powder Human Experiment

From 1939 to 1943, Crombie, Blaisdell, and MacPherson (1944) conducted a quasi-experiment with 102 participants from St. Mary's Hospital silicosis clinic in Timmins, Ontario. Forty-one participants were selected to receive at least 200 aluminum powder treatments and pulmonary disability was tested [13]. Pulmonary disability was measured by residual air to total pulmonary capacity. Only 32 participants completed the treatment and a survey was administered at the end of the study to obtain information about perceived improvements of shortness of breath, fatigue, cough and sputum, and perceived chest pain. The authors concluded that seven participants

showed definite improvement, 12 showed slight improvement, and 15 showed no improvement and that aluminum powder was completely harmless for humans. The results were based primarily on the surveys because the pulmonary tests had poor accuracy. The study did not include a control group to compare results [13]. Furthermore, all testing was subjective and did not include any standardize testing. Administration of McIntyre powder treatment on thousands of workers was mostly based on this research.

3.2.5 Prevalence

In 1943, the Ontario Mining Association recommended that Ontario mining companies introduce McIntyre powder for the prevention of silicosis [12]. The McIntyre Mine in Timmins started exposing their employees to the aluminum dust in 1943, followed by most gold mines in Ontario by 1945 [12]. In 1944, it was estimated that 11,700 workers across Canada were receiving aluminum powder treatment [14]. As early as 1944, the treatment was provided at 42 Ontario mines, 21 mines in Quebec, one mine in Manitoba, 12 mines British Columbia, and two mines in the Northwest Territories, for a total of 72 Canadian mines [14]. Foreign countries such as Mexico, Chile, South Africa, England, New Zealand, Peru, and Australia also implemented the standardized treatment [14]. In Canada, workers were also exposed at aluminum processing plants, not only in mining industries [15]. As of 1948, there was a huge increase in uptake, and over an estimated 20, 000 Canadians were receiving daily treatments [16]. In 1946, over 19,000 American workers were receiving the McIntyre powder treatment in New York, New Jersey, Ohio, Pennsylvania, Indiana, Illinois, Michigan, Wisconsin, Missouri, Kansas, Oklahoma, Colorado, Tennessee, and West Virginia [14]. By 1980, the Ontario Department of Health

officials and the Ministry of Labour both confirmed that being exposed to the aluminum dust was harmful [12].

3.2.6 Ontario's Workplace Safety and Insurance Board (WSIB)

WSIB is a government-based insurance company to which Ontario workers can apply for compensation when they have loss of earnings and health coverage due to work-related injuries and diseases [17]. In 2018, WSIB provided insurance to over five million workers and 300,000 workplaces [18]. In 2017, WSIB had approximately 240,000 Ontario worker claims registered and paid \$2.4 million in benefits to injured workers [18].

In 1993, WSIB created a policy stating that occupational exposure to aluminum does not cause any neurological health disorders which would lead to automatic claim denials and this has since been rescinded and removed [19]. More recently, WSIB commissioned a review from a consulting firm to conduct a systematic review of the literature on aluminum exposure and concluded that there was insufficient scientific evidence to establish a relationship between aluminum exposure and any adverse health effects [20]. However, WSIB is committed to determining any possible links of aluminum exposure and health effects [19]. The WSIB have also engaged the Occupational Cancer Research Centre (OCRC) at Cancer Care Ontario to conduct an independent study to determine if there is an association between exposure and neurological disorders, based on data from the Ontario Mining Master File (MMF) [19]. The MMF contains medical information and mining work histories on 93, 526 Ontario workers who were employed between 1951 and 1987 [19,21]. Currently, several individuals who were exposed to McIntyre powder have pending claims with WSIB, however no decisions have been

made regarding the claims [19]. Decisions about claims will be made pending the OCRC study results [19].

3.3 Research Objective

This study aimed to explore the perceived organizational impact of McIntyre powder treatment (1943-1980) on underground gold and uranium workers in Northeastern Ontario.

3.4 Theoretical Framework

The effort reward imbalance theory is based on sociology theory, the psychological equity theory, and the human stress theory [22]. Sociological theory theorizes that individuals have return expectancy. The exchange between employers and employees can have different rewards such as financial, status, and emotional rewards. When the return expectancy is low employees may demonstrate anger and frustration, which in turn can cause stress and long-term health effects [22]. For example, this can occur when employees have no choices in the labor market due to the job competition or by being an overly committed worker. These stressors may cause anger and frustration within the workplace.

The psychological equity theory consists of two tenets: overfitting and underfitting [22].

Overfitting occurs when an individual's invested little cost and received exceeding gains.

Underfitting refers to when an individual invests an exceeded amount of cost and has little gain.

The theory posits that the unbalanced state of overfitting and underfitting motivates individuals to change their behaviour or cognition [22].

The human stress theory explains that the imbalance between effort and reward produces stress reactions, which in turns may harm the worker [22]. When workers are fully committed to their work and, due to different circumstances, they fail to receive the appropriate reward, they in turn fall into the imbalanced state between effort and reward and can experience negative emotions. Negative emotions activate certain areas of the brain, which in turn affects the neurotransmitters that control pleasurable emotions and one's ability to cope with stress. Research has shown that chronic exposure to stress is associated with various physiological and mental health diseases [22].

3.5 Methods

3.5.1 Study Design and Setting

A qualitative descriptive study was conducted to examine the experiences of underground workers who were exposed to the McIntyre powder treatment between 1943 and 1980. Sixteen interviews were conducted in person or four by telephone.

3.5.2 Recruitment

Participants were recruited through several methods. Firstly, posters and letters were mailed out with Occupational Health Clinics for Ontario Workers' (OHCOW) correspondence. Their master list consisted of 370 clients. One hundred clients were removed because they were no longer living. From 270 clients, every 10th client was chosen, for a total of 27 letters mailed out by OHCOW's client service coordinator. Secondly, the researcher (DA) posted the recruitment poster on their Facebook page. Thirdly, the recruitment poster was posted on the McIntyre Powder Project website: <http://www.mcintyrepowderproject.com> . Fourthly, ten recruitment

posters were posted in general grocery stores, community bulletin boards, and dollar stores in Sudbury, Elliot Lake, and Timmins. Lastly, the researcher contacted the Elliot Lake Standard, Timmins Daily Press, the Sudbury Star and the Northern Business News to assist with recruiting participants.

3.5.3 Sample Inclusion

To be eligible for the study, an individual could be of any age, or gender, with a minimum of one year working underground, and who experienced 15 to 30 minutes of daily exposure to McIntyre powder treatment. They also had to live in Sudbury, Elliot Lake, or Timmins where several miners were exposed and had to provide free and informed consent. This is consistent with the inclusion criteria provided in the Peters et al. (2013) study who analyzed the association between aluminum powder treatment and Alzheimer's disease, cardiovascular disease, cerebrovascular disease, and pneumoconiosis from 1970 to 2009 [23]. By setting exposure duration at a minimum of one year, the study excluded short term contract underground workers and underground miners who changed jobs frequently.

Participants interviewed in person were given the option to meet at the union hall, town library, or in their own home. They all chose to have the interviews done in their residential homes. On average, interviews lasted 45 minutes. Participants received a five-dollar gift card, sponsored by Sudbury OHCOW clinic.

3.6 Data Analysis

Data were analyzed by thematic analysis as described by Braun and Clarke (2006). Braun and Clarke's (2006) thematic analysis consists of six steps [24]. To begin, the researcher (DA) became familiar with the data by transcribing the data verbatim, which included every sound and pause [25]. The researcher (DA) actively read and re-read the transcriptions to search for meaning within the data collected [24]. The researcher (DA) started taking notes and marking down ideas [24].

The second stage involved generating initial codes, once all transcriptions were completed [25]. The researcher (DA) began by using open coding, which entailed the researcher coding data line by line [26]. The researcher (DA) used inductive analysis by not coding the data into already pre-identified codes, which allowed for new ideas to be identified [24]. All transcriptions were coded and identified extracts were gathered and linked with a code [25]. The third step in thematic analysis was searching for broader themes from the identified codes [25]. Phase three ended with potential main themes, subthemes and extracts related to the research question [25]. Step four consisted of reviewing and refining potential themes of the study [25]. Step four basically checked the quality of the themes to represent the entire data collected for this study [25]. The fifth phase named and defined the themes identified from phase 4 [25]. Phase five identified the essence of each theme and the section of the data set it captures [24]. For each theme, a detailed written analysis was completed to explain the relationship with other themes and the research question [24]. The last phase involved a final analysis and produced a final report [25]. The themes and extracts were displayed in a manner that was meaningful and logical to allow the data to answer the research question [24].

3.7 Results

3.7.1 Participant Characteristics

Participants were recruited from: OHCOW intake clinic (n=1), Facebook (n=2), McIntyre Powder Project (n=5), newspapers (n=5), poster (n=1), and snow ball sampling (n=2). The pilot participant was acquired at the Sudbury intake clinic held by OHCOW. The most successful recruitment method was through local newspapers. All participants were male and their age ranged from 60 to 88 years' old (s.d. 7.09). Participants lived in Sudbury (n=7), Elliot Lake (n=5), and Timmins (n=4). Their exposure duration ranged from 2 to 27 years, with an average length of exposure of approximately 7 years (s.d. 5.9).

3.7.2 Main Themes

Participant results generated three main themes: 1) confidence and trust in companies, 2) lack of participants' and health care providers' knowledge, and 3) need for compensation and formal apology.

3.7.3 Confidence and Trust in Companies

At the time of exposure, mine workers had the utmost confidence and trust in the mining companies. They believed their employers had their best interests at heart when it came to their health. They assumed that the aluminum dust treatment they were receiving was safe and was protecting them against silicosis of the lungs. For example, participants shared:

Well we went underground and you have to understand, [...] they tell you something and of course you believe them. They said and now you're protected. So, the guys didn't take as much precautions as they normally would have. Like you didn't wet down the muck as much as you would have. They're drilling on

the face and you're breathing in all this mist and crap but nobody cared because we're protected. It's like having an invisible armor on you (Elliot Lake Underground Worker #14).

But some guys used to sneak around outside and go in the head frame. But we never, we never did that because we believe what they were telling us you know. Just like a little kid if you tell the little kid those candies are good for you they'll eat them and same principle. Company said that it was going to protect us and our lungs so we were young then too. So, we believed what they told us. Unfortunately, it wasn't true (Elliot Lake Underground Worker #14).

So, the men would bend over backwards and do things whenever he [manager] requested and I think that's what it was when you have a good relationship with your boss you don't want to let him down in anyways. So, if he's told by someone else that this is what you've got to use and he suggested the guys are going to do it, because they respect the boss and they trust him and his judgement, and you don't think that he's going to do anything that's going to cause them any grief, and I think that's what you're going to find with a lot of those, those old timers and that. But we became loyal to the man, whatever it was you did it and you and it was part of the job that's why when I worked in the acid dump that was part of the job. We did what we had to do (Elliot Lake Underground Worker #15).

Participants believed that the McIntyre powder protected them from dangerous exposures underground because they were following their bosses' directions.

Participants never asked questions about credibility of the treatment because they trusted the companies were providing them with a protective treatment against silicosis of the lungs. Due to the treatment, some workers wore less personal protective equipment because they thought the aluminum dust was protecting them. Workers respected their bosses and assumed that management was provided with information about the benefits of the treatment.

3.7.4 Lack of Participants' and Health Care Providers' Knowledge

At the time of their first exposure, participants felt that they were not fully informed of the aluminum dust treatment and its possible effects. The mining companies, unions, and government did not provide them with any type of information explaining what they were receiving and the benefits or harm of the treatment, and is illustrated by the following quotes:

Nothing, we didn't even know anything about it. Union didn't say nothing, company never said nothing till that day they called us in the conference room and said today starting this morning you have to sit in the tunnel and breathe this dust it's going to protect you and that was the first time we heard about it. There were no discussions, there was no union never approached and said this is what they're going to do (Elliot Lake Underground Worker #14).

We had no union at (the mine) and when I was at (a different mine) we had a union there but they never said anything. You just went to work and the first day you were in there all of a sudden door shut and they blast this stuff out. We questioned it but nobody just told you, you get over it (Elliot Lake Underground Worker #15).

And further illustrated by: "Well in the past, they should have let us know more about it before doing this you know, you know. I just think they should have had more information out there" (Elliot Lake Underground Worker #10).

From the above quotes, it appears that the participants don't recall receiving any explanations of the aluminum dust treatment or any more information posted in their work areas. Participants felt that they should have been provided with the type of treatment they were receiving, the benefits, the consequences, and the ability to make an informed decision to undergo treatment.

Participants found that when they seek current medical care, the physicians lack knowledge about McIntyre powder exposure and its potential health effects. Currently, there is still a basic lack of awareness about McIntyre powder from health care providers. Participants desire more knowledgeable health care providers to help support their needs. An Elliot Lake underground worker stated that: “Even if I go and see my doctor, she’s not sure what it is (Elliot Lake Underground Worker #2).” The following quotes further illustrate this:

You start thinking back you know what really happened to our bodies when we breathe that in and nobody can give us an answer. Nobody can say how it affected you. Um I don’t know it’s, I thought about it quite a bit after but when you mention it to doctors or, they don’t even seem to understand what you’re talking about McIntyre powder. They asked you what happened what was the purpose of it and it’s just like talking to that apple there. That’s the kind of response you get. They can’t fathom what this powder did to people (Elliot Lake Underground Worker #14).

And also said that: “The doctor said nothing about, this aluminum, didn’t even mention. They’re putting all of these things listen you know all this, they don’t even ask if you’ve had aluminum dust, they don’t know (Elliot Lake Underground Worker #8).”

Participants felt that our healthcare providers are not educated when it comes to the awareness of McIntyre powder. They believed that healthcare providers in Northeastern Ontario should be aware of what they were exposed to in order to assist them in diagnosing their health issues and being more supportive when they talk mention aluminum dust exposure.

3.7.5 Need for Compensation and Formal Apology

At the present time, participants' that are in need of medical assistance felt the need to be compensated and financially supported to help them so that they don't have financial worries. Most participants had medical problems with their lungs and had trouble breathing. Examples of medical devices deemed necessary by interviewees to support their needs were: stair lifts, portable oxygen, and assistive walking devices. Some participants expressed their needs for compensation as follows:

Compensation. Through workmen's comp if ummm if you can deem it that it came from McIntyre powder, that's ummm lets compensate them for it. Same as our service force, they get compensated if something happens, here let's compensate us. Well -- the workers (Elliot Lake Underground Worker #7).

They should give something cause um, they let it go through, that dirt you know, - - We didn't ask for that stuff, they forced us to breath that that stuff eh. And they were bullshitting us breath heavy to coat it's good for you (Elliot Lake Underground Worker #6).

And also: "What you need is for the government to step in and say yes it was wrong and then they should allow you to put a claim in for it. -- That's what I'd like to see, people to be able to put claims for it" (Timmins Underground Worker #12).

Some participants felt the need to be financially compensated because they were forced to undergo treatment without consent. The financial support would alleviate some financial stress for their everyday needs. For example, a chair lift would help them go up and down stairs and home oxygen would help with their breathing difficulties. Some participants felt they should be compensated similar to governmental workers, such as police officers or military workers, when they are injured on the job.

Participants' felt that they deserved a formal apology from mining companies, unions, and the government who allowed them to be exposed to such a traumatizing treatment for several

decades. They felt an apology would go a long way. The following quotes portray their needs for the government, unions, and mining companies to own up to what they exposed their workers to and give them a formal apology.

Tell the truth -- Cause Rio said it was good for you, and it's not. Stop using well I know they've stopped using it now, but ummm just tell the truth and if for their employees well if they had gone through it, take care of them (Elliot Lake Underground worker #7).

They should probably get a hold of all of us, who did work there at the time. You know I'm sure a lot of them are not living, it's been that long but, at least the remainder of us that are still living umm they should at least acknowledge us. Talk to us, you know do something, I don't know what but, rather than walk away and try to hide it. Come out in the open (Elliot Lake Underground Worker #4).

Well just to be upfront with all the people who worked there over the years -- you know; I don't think it was any good for anybody but I'm not a scientist or a doctor [...] But if that was the case, umm you know that it should have never been used then I think an apology. I think the big mining corporations should say we made a mistake we apologize (Timmins Underground Worker #11).

Participants felt that they need the government, mining companies, and/or unions to acknowledge what has happened to them and provide them with a formal apology.

Participants felt that government officials tried to hide this event and an apology would go a long way and would help alleviate hard feelings.

In summary, the main results indicated that at the time workers were exposed, workers had the utmost confidence and trust in the companies and they would have done what the companies recommended because the workers believed they had their best interests at heart. Furthermore, lack of information was present at the time of the workers first treatment. Workers were not provided with enough information to make a sound decision to accept the aluminum dust treatment. Currently, exposed workers worried

about the potential impact it will have on them. There is not enough research in this field to provide workers with research explaining the impact it will have on their health. Lastly, most workers interviewed also had chronic health issues and believed that they should be financially compensated to help cover their health costs, to improve their current daily lives. Workers also suggested that a formal apology from the government, companies, and/or unions would give them some closure on being exposed to the aluminum dust without consenting to the treatment in the past.

3.8 Discussion

The three main themes derived from the participants' interviewed who were exposed to the McIntyre powder daily included: 1) confidence and trust in companies, 2) lack of participants' and health care providers' knowledge, and 3) need for compensation and formal apology. During the period of exposure, all workers interviewed had the utmost confidence and trust in the companies. They trusted that they knew what they were doing and had their best interests at heart. They assumed that the companies were providing them with a protective treatment against underground mining diseases, such as silicosis of the lungs. At the time of first exposure, participants believed that companies, unions, and government did not provide them with sufficient information about McIntyre powder which could assist them in making an informed decisions about treatment. Presently, participants felt that their current health care providers lacked the historical knowledge of workers being exposed to McIntyre powder during their previous work experience in underground mining. When they seek current medical attention for their needs, their health care providers appear to lack knowledge of what workers were exposed to and knowledge about potential physical health effects. Nowadays, participants felt that they

should be compensated for being exposed to such traumatizing treatment. At the time of exposure, interviewees did not provide their employers with any type of consent for the aluminum powder treatment. Participants also felt that they deserved a formal apology. They feel that companies, unions, and the government are trying to hide what was done to them, and would like them to acknowledge what was done.

3.8.1 Similar Findings

Malin and Petrzela (2010) conducted a case study on a community in Southeastern Utah where there was a uranium mill and discussed its ill effects to the surrounding communities [27]. One of their main themes was deception and powerlessness, similar to this study's finding for the need of compensation and formal apology, and a participant stated that the government needed to acknowledge what they did and be accountable for the what happened. They also mentioned that the government keeps denying compensation claims which makes individuals feel unsupported and deceived by their government [27]. The lack of accountability by companies and government does not provide our workers with a safe work environment. The inability to have trust that companies and government will provide the workers with a safe work environment needs to be addressed.

Dawson and Madsen (1995) conducted a case study with American Indian uranium millworkers about their perceived effects of occupational exposure [28]. Participants reported physical health problems such as cardiovascular, respiratory, and renal system diseases. Emotionally, 48.1% of participants experienced psychological health problems associated with their physical health problems such as anxiety and/or depression. Other emotional issues reported by participants

included their frustration, concern in developing future health problems, and withdrawal from their social environments. This study discussed lack of communication and found employers did not inform workers of workplace hazards regarding radiation exposure. Similar to these findings, lack of participant and health care knowledge was observed [28]. Companies, unions, and governments need to have better methods to educate workers about potential workplace hazards and provide workers with environmental protection. Additional qualitative studies are warranted to address occupational health and safety exposures in hazardous workplaces. Having well informed workers about potential harmful exposures at work and being well educated on how to protect one's self could decrease the rate of occupational diseases and increase their mental health well-being.

3.9 Effort reward Imbalance Model

As previously mentioned in section 3.4, when the return expectancy is low, employees may demonstrate anger and frustration, which in turn causes stress and long term health effects [22]. When applied to this current study, underground workers who were exposed to the aluminum powder mentioned feelings of anger, frustration and betrayal by their government, companies, and unions from being exposed to the aluminum dust treatment. These negative emotional effects may be linked to a long term health effects.

Furthermore, as mentioned in section 3.4, the theory posits that the unbalanced state of overfitting and underfitting motivates individuals to change their behaviour or cognition [22]. Exposed underground workers to aluminum powder justified their behaviour by finding balance because they needed a job to support their families financially. Section 3.4 also mentioned,

research has shown that chronic exposure to stress is associated with physiological and mental health diseases [22]. Every underground worker that was interviewed for this research loved working underground. However, many demonstrated negative emotions such as anger, frustration, and betrayal with being exposed daily to the McIntyre powder treatment. These negative emotions may further explain possible associations with physical and mental health diseases.

3.10 Strengths and Limitations

This study is the first qualitative study that has been conducted with individuals exposed to McIntyre powder. This research has brought new insight on this matter and will continue to guide future research about McIntyre powder. These results could also help guide future research in the environmental health realm. More qualitative research is warranted with widowers of deceased workers, health professionals who work with the Occupational Health Clinic for Ontario Workers, governmental workers, union representatives, and management and workers at mining companies.

To minimize sampling bias, participants were recruited using various sampling methods because there is no master list of underground miners that identifies every individual that has been exposed to the McIntyre powder treatment. Participants were asked to recall events that happened over 30 years ago, thus recall bias was possible. While interviewing participants, some workers could not recall specific details about work processes. Furthermore, response bias was also possible. However, to minimize response bias, participants were told to answer most

truthfully, no matter what the answer was. They were instructed that there was no right or wrong answers to the questions.

3.11 Conclusion

Workers who were exposed to the aluminum dust treatment perceived that they were impacted at an organizational level. Limited research has found a possible weak association between Aluminum Powder treatment and Alzheimer's, cardiovascular disease, and cognitive impairments of underground workers [29,23]. The main findings portray workers' confidence and trust in their companies, a lack participants' and healthcare providers' knowledge, and a need for compensation and formal apology. These results can be used to help educate workers, unions, and companies about the impact of workplace exposures. The latest information about McIntyre powder may inform the occupational health and safety system. Additional education is needed for those who adjudicate claims for McIntyre powder. There is limited research that can directly associate exposure to McIntyre powder to chronic diseases, such as different types of cancer and neurological diseases, and hence additional research is needed to explore possible associations. Workers need to be made aware of possible workplace exposures and their health effects and need to provide informed consent for any preventive intervention. Workers have suggested that companies should be more transparent when it comes to workplace hazards and educate their employees. Health care providers also require further awareness of exposed workers' feelings to better understand what the workers experienced in terms of their physical and emotional health and to understand potential health impact. Most importantly, impacted workers have repeatedly stated that companies, unions, and the government should step up and acknowledge that thousands of workers across the globe were exposed to a neurotoxin and

researchers do not yet know the potential emotional and health implications. Affected workers have identified that an apology would give them some relief, closure and would be beneficial.

3.12 Declarations of Interest: None.

3.13 Acknowledgement

I would like to thank all those who reached out to participate in this research. Your contribution is something I will be forever grateful for. Thank you to everyone who was open to share their stories.

3.14 Funding

For financial support I would like to thank the Sudbury Occupational Health Clinic for Ontario Workers (OHCOW) in their ongoing support. OHCOW donated the five-dollar gift cards for individuals who participated in the study. They also supported me researching archival documents about McIntyre powder at the Ontario Archives in Toronto. Without their ongoing support, this project would not have been possible. Also, I would like to personally thank David Lesbarres for the financial support in translating documents into French. This has decreased the gap in inequality by including French speaking individuals in this study. Furthermore, I would like to express my sincere gratitude to Centre of Research in Occupational Health (CROSH) at Laurentian University. As a first recipient of the CROSH Occupational Health and Wellness scholarship, your continuous financial and knowledge support has widened my breadth of knowledge and have instilled many personal values.

3.15 Abbreviations

ACGIH	American Conference of Governmental Industrial Hygiene
TLV	Threshold Limit Value
WSIB	Workplace Safety and Insurance Board
OCRC	Occupational Cancer Research Centre
MMF	Mining Master File
OHCOW	Occupational Health Clinics for Ontario Workers
CROSH	Centre of Research in Occupational Health

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4.0 Chapter 4: Discussion

4.1 Introduction

This section will discuss the main findings of the study and how they align with the existing literature. Strengths and limitations of the study will be identified, as well implications for health professionals and conclusions.

This study included 16 individual, semi-structured interviews with exposed workers to McIntyre powder who currently live in Sudbury, Elliot Lake and Timmins, Ontario. The study provided an opportunity for workers to share their experiences about being exposed to McIntyre powder treatment and how they were impacted. After conducting the interviews, it was evident that these participants often shared similar experiences. The exposed workers identified how being exposed in the past has impacted their life previously and currently.

As this is the first qualitative study about McIntyre powder exposure, this descriptive study may be valuable to several stakeholders, including mining companies, Ontario's Workplace Safety and Insurance Board, the Occupational Health Clinics for Ontario Workers, various unions, the McIntyre Powder Project, the federal government, the Ontario Ministry of Long Term Health, health care providers, and most importantly, the thousands of exposed workers.

4.2 Discussion of Results by Themes

The individual interviews provided an opportunity for participants to share their stories about being exposed to the McIntyre powder. Seven main themes were identified based on participant interviews: 1) compulsory exposure, 2) hesitancy to complain, 3) feelings of betrayal by unions,

employers, and the government, 4) concerns about health impact and dying, 5) confidence and trust in companies, 6) lack of participants' and health care providers' knowledge, and 7) the need for compensation and formal apology. Given this is the first qualitative study that explored the impact of McIntyre powder, this will provide personal insight about the effects on exposed workers.

4.2.1 Compulsory Exposure

Underground workers exposed to McIntyre powder not only were exposed to a hazardous work environment, but they received a mandatory aluminum dust treatment regularly as part of their work requirements. No participants interviewed recalled providing consent for such treatment, either verbally or in writing. They believed they had no choice in the matter so they were unable to take part in making a choice about an exposure that could have health implications.

Participants did not recall employers providing them with any type of informed consent, or information leaflets or posters were not posted in their work environments. Participants did not recall experiencing any communication processes with either their employers, a union representative, or a government official to discuss treatment options. Exposed workers were also not provided with any type of information discussing the benefits of treatment or any possible acute or long term health effects. In summary, participants felt they were not provided with detailed information about the reason for McIntyre powder treatment, other than telling them they had to take the treatment on a daily basis. Compulsory workplace exposures can have great impact on the health of the workers who were exposed to toxic agents (OHCHR, 2020).

Similar to this study, workers in developing and developed countries are frequently exposed to physical workplace hazards, such as solvents, toxic chemicals, and biological agents, etc. (OHCHR, 2020). Much research has been conducted to examine various workplace exposures for potential risk factors associated with neurological and other chronic diseases (Feychting et al., 2003; Ng et al., 1990; Park et al., 2005). Feychting, Jonsson, Pedersen, and Ahlbom (2003) conducted a prospective cohort study that included 4,812,646 Swedish workers from January 1981 to December 1995 and found that exposure to electromagnetic fields (EMF) might increase the risk of early onset Alzheimer's disease, might influence the disease etiology, and could also have latent health effects. In addition, Ng, Ong, Lam, and Jones (1990) conducted a cross sectional study and recruited Chinese printing and paint workers (n= 78) from eleven different factories that were involved in printing or spray painting processes where they were exposed regularly to organic solvents. The exposed group reported higher symptoms of fatigue, irritability, depression, and poor memory, and also sleep disturbances (Ng, Ong, Lam, & Jones, 1990). The researchers found that workers exposed to organic solvents demonstrated neurobehavioral deficits (Ng, Ong, Lam, & Jones, 1990).

In addition, Park et al. (2005) conducted a case-control study in 22 states, between 1992 and 1998, to identify occupational exposure associations with various types of mortality. Mortality odds ratios were generated for neurodegenerative diseases in four different categories, presenile dementia, Alzheimer's disease, Parkinson's disease (PD), and Motor Neuron disease (MND), across 46 occupations. The mortality odds ratio for presenile dementia was statistically significantly increased for pest control workers, physicians, and dentists, at 2.96 (95% CI, 1.34-5.59), 1.69 (95% CI, 1.19-2.60), and 1.69 (95% CI, 1.08-2.80), respectively. The mortality odds

ratio for Alzheimer's disease was significantly increased for production testers, dental assistants, and veterinarians, at 2.25 (95% CI, 1.38-3.45), 1.80 (95% CI, 1.30-2.43), and 1.77 (95% CI, 1.07-2.75), respectively. For Parkinson's disease, several occupations displayed statistically significant associations, with biological and medical scientists having an odds ratio of 2.04 (95% CI, 1.37-2.92). For motor neuron disease, the odds ratio was statistically significantly for food counter and fountain workers and for dental assistants, at 3.38 (95% CI, 1.04-7.96) and 3.18 (95% CI, 1.36-6.63), respectively. These results demonstrated that workers were exposed to harmful environments (i.e., solvents, welding, magnetic fields, and pesticides) which might be associated with neurodegenerative diseases (i.e. Alzheimer's disease, Presenile dementia, Parkinson's disease, and Motor Neuron disease; (Park et al., 2005).

Workers continue to work in harmful environments where they don't make informed decisions and consent to work in those harmful situations which could pose substantial health risks (Shrestha, 2005). In the medical realm, informed consent is an ethical and legal obligation, where a physician has to communicate with their patient to ensure they understand the information provided to them in order to permit patients to make an informed decision to participate in the choices about their health care treatments (Shrestha, 2005).

4.2.2 Hesitancy to Complain

Participants who were exposed to McIntyre powder were afraid to complain about the aluminum dust treatment due to the fear of job loss. Another reason for their hesitancy to complain was that men were predominantly the financial supporters for their families at that time and needed their jobs to financially support their families. Some participants did not feel respected enough as

workers to be able to speak with supervisors and discuss concerns about being exposed to the McIntyre powder. One participant suggested that companies did not do their research prior to administering the aluminum dust treatment and felt they did not have enough power to mention anything to management. In summary, participants hesitated to complain about being exposed to the McIntyre powder treatment due the fear of losing their jobs, financial instability, inability to support their family, and lack of respect from workplace supervisors.

Farbenblum and Berg (2018) conducted an Australian survey that included 4,322 migrant workers and focused on underpayment and wage recovery. Results identified barriers about why some workers would not try and recover their unpaid wages. They included: they did not know what to do, there was too much work, their coworkers did not complain, they did not want to lose their job, their English was not good enough, etc. (Farbenblum & Berg, 2018). Similar barriers were identified in this study. Underground workers identified that the lack of knowledge from health care providers hindered the health care they received. Similarly, people around them had similar situations and not doing anything in response. In the same way, exposed McIntyre powder workers identified they went along with the aluminum treatment because their coworkers were undergoing the same treatment and nobody raised any questions.

In the Australian survey (Farbenblum & Berg, 2018), fear of losing one's job was raised in response to wage theft for migrant workers. Similarly, exposed underground workers also feared job loss if they mentioned, or questioned why, they were being exposed to such treatment. Furthermore, some immigrant workers in the Australian survey were grateful to their employers and did not want to cause trouble. Similarly, exposed aluminum workers enjoyed working

underground and demonstrated they trusted their employers to have their best interests at heart. Difficulty with communicating in a different language was identified as a barrier in the Australian national survey (Farbenblum, & Berg, 2018). Along the same line, some participants in this study stated that their first language was French and they worked for an English mining company. One participant mentioned that he did not understand the work contract he signed and went to work and did what he was told to do. The Australian national survey also mentioned that participants felt embarrassed if they tried to retrieve their unpaid wages (Farbenblum, & Berg, 2018). Similarly, an underground worker in this study mentioned that he was embarrassed that he went through the aluminum treatment without raising any concerns. Even though the participants did not undergo the same event, they shared similar barriers as to why they were reluctant to complain about their work environment.

Another qualitative study by Campbell, Tranfaglia, Tham, and Boese, (2019) included 15 Italian temporary migrant workers who worked in food services and farm work in Australia on temporary visas. The study aimed to describe the reluctance of temporary migrant workers to complain about their jobs. The authors found that active complicity and time and effort inefficiency were not supported by this research. Fear of reprisal was the most prominent theme in this that study, followed by relative insignificance of low pay (Campbell, Tranfaglia, Tham, & Boese, 2019). Similar to that research, this study provided evidence that vulnerable workers were hesitant to complain in the fear of losing their employment which helped to financially support their families (Campbell, Tranfaglia, Tham, & Boese, 2019).

4.2.3 Feelings of Betrayal by Unions, Employers', and the Government

Workers exposed to McIntyre powder felt betrayed, fooled and deceived by mining companies, the government and their unions, for allowing companies to have exposed them between 1943 and 1980 to a treatment that had poor validation of benefit. They felt that they were used as guinea pigs as part of an experiment to determine if the aluminum dust could actually help prevent lung silicosis. One participant mentioned that there were no laws nor workplace standards at the time to help protect workers from being exposed to McIntyre powder treatment. They felt the government should have stepped in and stopped the production and dispersion of the McIntyre powder at the commencement of its use. Some participants felt that companies kept the treatment a secret and misinformed them, which made them feel like they were fooled. Some participants also felt deceived by the government because their Ontario Workplace Safety and Insurance Board (WSIB) health claims were not accepted leaving them without assistance for everyday needs.

Markstrom and Charley (2003) conducted a qualitative literature review about the history of Navajo and uranium mining and discussed the psychological impact on underground workers in New Mexico, Arizona, and Utah. Similar to the McIntyre exposed workers, the Navajo workers commonly felt betrayed or cheated by their employers because the exposures were caused by humans and were preventable. Participants felt deceived because they were misinformed of the potential harm it could cause and the environmental contamination (Markstrom, & Charley, 2003). Later, Malin and Ptrizelka (2010) conducted a case study with an activist group of seven individuals referred to as Victims of Mill Tailings Exposure (VMTE), who resided in a community in Monticello, Utah, where residents were exposed to an environmental uranium

contamination from a mill. One interviewee was frustrated with the government because the government contested the exposed members' health claims, even though studies have shown that there were increased rates of cancers in that area. The government continued to ignore the problem and denied a problem. However, various cancers were observed in every neighborhood and every other house (Malin & Ptrzelka, 2010, p.1194). Another major cause for feeling of betrayal for community members was that they uncovered governmental studies and documents that showed they were aware of the risks of uranium exposure and chose not to inform the community. The government's failure to act and protect community members was the biggest factor for feelings of betrayal (Malin & Ptrzelka, 2010). These experiences were similar to the results in this study.

4.2.4 Concerns About Health Impact and Dying

A main theme from this research was that participants were concerned about their own health and dying. Some participants feared that even though they were healthy today, they were unsure about future health implications from being exposed to the McIntyre powder. The majority of interviewees mentioned they had current lung diseases. Some participants worried that they would suffer from neurological diseases such as Alzheimer's or Parkinson's diseases in the future. Others were concerned about how fast the onset of diseases might occur. Furthermore, participants also had fatalistic views as they raised the fear of the unknown health consequences and the possibility of an early death. They were also worried about their coworkers' survival. Some participants mentioned that most of their coworkers were currently dead today and they remained the only ones alive. They also feared that they would be the next ones to die.

In 1992, Dawson and Madsen (1995) conducted a case study with 68 American Indian uranium workers and widowers to determine the perceived effects of uranium milling and mining living in Shiprock, New Mexico and Tonalea, Arizona. They found that most participants had fatalistic views about being exposed to radiation and the inevitability of contracting an illness within time (Dawson & Madsen, 1995). Other participants mentioned that they were in constant state of worrying about what may happen to them and their families (Dawson & Madsen, 1995)., Dawson (1993) also conducted a community case study with Navajo uranium workers and family members who had uncompensated illnesses from being exposed to high levels of radon while working in the uranium industry. The United States government withheld exposure hazard information from workers which led workers to continuously work in hazardous environments without taking the necessary precautions (Dawson, 1993). Due to the harmful exposures, workers had fatalistic views stating that they would not live as long as their other tribal members and were concerned about unknown future illnesses (Dawson, 1993). In summary, similar to the current study, most exposed workers and community members worried about future health effects in relation to the hazardous exposure and had fatalistic views (Dawson, 1993).

4.2.5 Confidence and Trust in Companies

The most striking theme in this study was that underground workers had the utmost confidence and trust in the mining companies when they were working. They believed their employers had their best interests at heart, including their health. They assumed that the aluminum dust treatment they were receiving was safe and protected them from lung silicosis. Participants believed that the McIntyre powder protected them from dangerous underground exposures because that is what they were told, and they complied with, management directives. The

majority of participants interviewed were young at the time of exposure and had been led to believe that the treatment would be beneficial to their health. Participants never asked questions about the treatment's credibility because they trusted the companies provided them with a beneficial protective treatment. One participant mentioned that a few workers tried to avoid getting treatments, however the majority of them accepted the treatments because they thought it would prevent them from developing lung silicosis. Due to the treatment, some workers used less personal protective equipment (e.g. masks and ventilators) because they thought the aluminum dust protected them. Workers respected their bosses and assumed that management would only provide them with beneficial treatments. Participants mentioned that the mining companies' management were unaware of the effects of exposure to the McIntyre powder and continued with McIntyre powder treatments. In summary, exposed workers assumed that the aluminum dust treatment was beneficial and trusted the companies that it would provide protection against silicosis of the lungs.

Reina and Reina (2006) wrote about trust and betrayal in the workplace. They explained that when trust in a relationship is broken, some individuals may feel betrayed. The authors explained that betrayal can be seen on a continuum from major or minor, and intentional or unintentional events. Betrayal is defined as "a breach of trust or the perception of such breach (Reina & Reina, 2006, p. 108). Intentional betrayal is defined as "a self-serving action committed with purpose of hurting, damaging, or harming another person (Reina & Reina, 2006, p.108).

Exposing workers to McIntyre powder without any certainty that it would protect them can be considered a major event. An example of a minor event was when a worker repeatedly shows up

late to work. The authors further explained the importance of having utmost trust between the employers and employees to increase function and thrive as a company. However, once that trust is broken, it can have hurtful and negative consequences, such as damaging confidence and self-esteem, leaving workers feeling powerless and vulnerable. To rebuild that trust, the authors compared that broken trust to death because most do not know how to deal with negative consequences of betrayal. Similar to the grieving steps to death, Reina and Reina (2006) suggested seven steps to healing from broken trust. The first step is observing and acknowledging what happened. One needs to be aware and acknowledge what they experienced, such as their thoughts and feelings and identify they were impacted. Secondly, the most central part of the healing process was that one must allow their feelings to surface. This step can only be undertaken by the individual feeling the betrayal. They require time to be reflective, such as writing in a journal or through physical activity. The third step is that one should get support to be able to understand the feelings that have surfaced from the betrayal. This can be done in several ways, such as talking with friends or colleagues, support groups, and/or a counsellor. The fourth step enables individuals to take a step back and look at the larger picture. This occurs when one looks for a greater purpose, gains inner strength and becomes more resilient. The fifth step specified that individuals have to take responsibility for their own actions in the healing process. In step six, individuals need to forgive themselves, as well as others who were involved in the betrayal. The final step involves letting go and moving on. This occurs once the person gains clarity about their experience and becomes more aware. The authors mentioned that everyone heals in their own way, that individuals can take longer with certain steps and the process could be cyclical (Reina & Reina, 2006). This reveals that workers who were exposed to the McIntyre powder may require additional support to work through this healing process.

4.2.6 Lack of Participants' and Health Care Providers' Knowledge About Effects

At the time of their first exposure, participants felt that they were not fully informed of the aluminum dust treatment and its possible effects. Other participants felt they should have been provided with more information regarding the aluminum powder. The mining companies, unions and government did not provide them with any type of information explaining what they were receiving and the benefits or harm of the treatment. The participants did not recall any type of information being posted in their workplaces. Most participants remembered being sat down in the dry on their first day and having their coworkers telling them to take deep breaths in so that the aluminum dust would protect them from lung silicosis. In summary, participants felt that they should have been provided with detailed information of the type of treatment they were receiving, the benefits, any side effects, and the ability to make an informed decision to undergo treatment.

Dawson, Madsen, and Spykerman (1997) interviewed uranium mill workers in the Navajo Reservation in Arizona and New Mexico and gathered information on their perceived work environment and personal health. The majority of respondents stated they were never informed about the possible health effects of radiation exposure. One participant noted that there were no hazard signs posted in their work areas and only heard about their effects of radiation 25 to 30 years afterwards (Dawson, Madsen, & Spykerman, 1997).

Participants in the current study found that when they seek current medical care, physicians lack knowledge about McIntyre powder exposure and its potential health effects. Currently, there is still a basic lack of awareness about McIntyre powder by health care providers. Participants

desired more knowledgeable health care providers to help support their needs and to assist with diagnosis of health related problems that could be related the aluminum dust. Participants felt that healthcare providers are not educated when it comes to the awareness of McIntyre powder. They felt that healthcare providers in Northeastern Ontario should be aware of what they were exposed to, which may assist in diagnosing their health issues and desired more interest and support from them. Most participants wanted health care providers to understand what they went through and to be knowledgeable about the risks of exposure in order to provide appropriate care.

Haug (1997) conducted a meta-analysis about American and Canadian physicians' preferences of seeking information about clinical practice. The author concluded that the most frequent sources that physicians access are academic journals and books, followed by consultations with colleagues. Thus, more research publications about McIntyre powder is required to help educate physicians and health professionals that are working closely with McIntyre powder exposed patients.

4.2.7 Need for Compensation and Formal Apology

At present, participants' in need of medical assistance felt the need to be compensated and financially supported so that they do not incur financial worries. Most participants had medical problems with their lungs and trouble breathing. Examples of medical devices deemed necessary by interviewees to support their daily needs were stair lifts, portable oxygen, and assistive walking devices. Some participants wanted to be financially compensated because they were forced to undergo treatment without consent. The financial support could alleviate some current

financial stress help with assistive devices (e.g., a chair lift and home oxygen). Some participants felt they should be compensated, similar to governmental workers, such as police officers or military workers, when job-related injuries or conditions occur. Others mentioned that they encountered barriers to having a claim accepted by Workplace Safety and Insurance Board.

Participants' and also felt that they deserved a formal apology from mining companies, unions, and the government who allowed them to be exposed to such a traumatizing treatment for decades. They felt an apology would go a long way in helping them. They felt that they need the government, mining companies, and/or unions to acknowledge what happened to them and provide them with a formal apology. Some felt that government officials may be trying to hide what happened and possible side effects such that would help alleviate hard feelings.

A case study was conducted by Malin and Ptrlzelka (2010) that focused on victims of mill tailings exposure in Monticello, Utah. They found the need for exposed workers to be compensated and for a formal apology. One participant stated that the government needed to acknowledge what they did and be accountable for the what happened. Participants also mentioned that the government keeps denying compensation claims which makes individuals feel unsupported and deceived by their government (Malin & Ptrlzelka, 2010).

Byrne, Barling, and Dupré (2014) mentioned that an apology from a leader can promote forgiveness, repair relationships, improve trust and enhance well-being. When leaders provide an apology, it demonstrates good leadership qualities (Byrne, Barling, & Dupré, 2014). Furthermore, Marler, et al. (2011) conducted a quasi-experimental design and determined that a professional

hand shake, or pat on the back from a workers' supervisor may influence a worker's perception of sincerity and support for the supervisor's apology (Marler, et al., 2011). Dupré (2014) and Marler, et al. (2011) recommended that a comprehensive apology would be beneficial for exposed workers. Byrne, Barling, and Dupré (2014) mentioned that one of the key components of an apology is that the supervisor should take accountability for their actions if the offence was intentional or not. Most participants in this study stated that they would like the government, mining companies, and the unions to be accountable and recognize what occurred. The lack of accountability by the government, companies, and unions does not provide exposed workers with a positive outcome and could have negative effects on their well-being.

Lewicki and Brinsfield (2017) constructed a review of trust repair and identified short and long-term strategies to repair trust. They identified verbal statements, apologies, and compensation as strategies to repair trust (Lewicki & Brinsfield, 2017). An apology is similar to a verbal statement, however, it includes emotional content which makes the trust repair more successful. Some research has shown that apologies, along with compensation, are effective in repairing trust relationships (Lewicki & Brinsfield, 2017). Moreover, these authors noted that an apology is a key factor that can promote forgiveness (Lewicki & Brinsfield, 2017). It may be beneficial for exposed workers to have the government, unions, and mining officials provide an apology and compensation to allow exposed workers to start healing and repairing their trust.

4.3 Discussion of Findings in Relation to Theoretical Frameworks

4.3.1 Cognitive Dissonance

Dissonance can be described as the discomfort when “individuals hold two or more elements of knowledge that are relevant to each other but inconsistent with one another” (Harmon-Jones & Harmon-Jones, 2012, p.71). The most common way to reduce dissonance is through attitude change (Harmon-Jones & Harmon-Jones, 2012). Cognitive dissonance theory can aid in explaining why underground workers complied with receiving daily treatments of McIntyre powder.

Cognitive dissonance theory can be used to understand compliance with compulsory exposure and hesitancy to complain. Even though exposed workers did not want to receive the treatments, they had no choice about receiving the McIntyre powder treatments and rationalized that they needed their jobs to support their family, which brought them back to a state of dissonance because they complied with the treatments. To provide balance, exposed workers changed their thoughts about the aluminum to be positive and helpful, which brought them to a state of dissonance.

Feelings of betrayal by unions, employers, and the Canadian government and concern about health impact and dying suggest exposed workers were not in a state of dissonance. The negative feeling of betrayal produced a negative relationship between workers and the government, mining corporations, and the unions. Furthermore, exposed workers’ concerns about health impact and dying resulted in unstable cognitive state. To find balance, exposed workers need to

add cognition, which may be done by receiving compensation, a formal apology, and receiving efficient health care by knowledgeable and understandable health care providers.

Cognitive dissonance can impact individuals in the workplace and can have several negative effects (Prvulovic, 2015). Some workers may have been exposed to certain situations that are in direct conflict with their beliefs and personal values and still chose to execute tasks that are in direct internal conflict (Prvulovic, 2015). Internal justification methods can include positional obedience, normalization, and emotional trading. Positional obedience occurs when a worker justifies their action because it came from a person of authority in the workplace. Normalization occurs when workers follow suit because other workers are doing it (Prvulovic, 2015).

Emotional trading occurs when workers foresee future reward for their behaviour even though it compromises their beliefs and personal value (Prvulovic, 2015). Negative impact from cognitive dissonance in the workplace include, increased absenteeism, withdrawal and disengagement, significant reduction in performance, negative and inappropriate behaviour, high staff turnover, workplace stress claims, and adverse health effects, such as depression, fatigue, and anxiety (Prvulovic, 2015).

Cognitive dissonance theory helped explain the main findings in this research. Participants explained that they felt being exposed to the McIntyre powder daily was mandatory. Workers were hesitant to complain due to internal justification, such as positional obedience, normalization, and emotional trading. Some participants explained that direction to undergo McIntyre powder treatment came from mining authority personnel. Furthermore, some workers went along with the treatments because other workers underwent treatments and believed their health would benefit from it in the future. Participants were also concerned about being exposed

to McIntyre powder and its effect on their future health and concerned with dying an early death. These concerns may be linked to chronic stress and may have adverse health effects on exposed workers.

4.3.2 Effort-Reward Imbalance Model Theory

The Effort-reward Imbalance (ERI) Model Theory is related to occupational health (Cooper & Quick, 2017). Cooper and Quick (2017) explained that the effort reward imbalance model assists in explaining how stressful work environments can result in negative health outcomes (Cooper & Quick, 2017). Exchanges between employers and employees can have different rewards such as financial, status, and emotional rewards (Cooper & Quick, 2017). When the return expectancy is low, employees may demonstrate anger and frustration, which can result in stress and long-term health effects (Cooper & Quick, 2017). The imbalance between effort and reward produces stress reactions which may harm workers (Cooper & Quick, 2017). When workers are fully committed to their work, and due to different circumstances they fail to receive the appropriate reward, they fall into the imbalanced state between effort and reward and experience negative emotions (Cooper & Quick, 2017). Negative emotions activate certain areas of the brain which affects neurotransmitters that control pleasurable emotions and one's ability to cope with stress (Cooper & Quick, 2017). Research has shown that chronic exposure to stress is associated with physiological and mental health diseases (Cooper & Quick, 2017). The ERI theory posits that the unbalanced state of overfitting and underfitting motivates individuals to change their behaviour or cognition (Cooper & Quick, 2017). Underground workers exposed to aluminum powder justified their behaviour by finding balance because they needed a job to support their families financially.

Most underground workers that were interviewed for this research enjoyed working underground. However, many demonstrated negative emotions such as anger, frustration, and betrayal with being exposed daily to the McIntyre powder treatment. These negative emotions may further explain possible association with physical and mental health diseases.

4.4 Reflexivity

Carolan (2003) explained that reflexivity allows researchers to acknowledge their roles and influences throughout a research project. To better situate myself and gain a deeper understanding of what it was like working underground, I was fortunate enough to have the experience to undergo an underground mining tour in Sudbury, Ontario. I geared up with all protective equipment including overalls, boots, helmet, safety glasses, safety belt, and coat. While I was in the dry and tunnels, I thought to myself, I wonder how the workers felt to get sprayed with the aluminum dust every day before their descent underground. The underground mining tour was an eye opener for me. I realized how dangerous underground mining work really is. Even though the occupational standards are much higher today compared to the 1940s, it made me think how different it could have been in the past. The tour gave me a great appreciation for the stories the participants shared with me.

More recently, I returned to my hometown in Northern Ontario, where I have learned that some individuals had been subjected to daily McIntyre powder treatment. After talking with friends and family, I found out that several of my friends' fathers and grandfathers were exposed to the treatments. More shockingly, I learned that my own father was exposed to the McIntyre powder

for at least one week. Finding out that people I know were exposed gave me an added incentive to conduct this research.

During the course of the interviews, participants felt comfortable enough to share their stories with me about their work experiences in underground mining and how being exposed to the McIntyre powder had impacted them. After each interview I took the time to reflect and most of the time my heart just sank and sitting there in disbelief, with what they had just shared with me. Each story increased my motivation to finish this research and share the results with others.

4.5 Study Strengths and Limitations

This study explored the perceived impact of workers who were exposed to McIntyre powder in Northeastern Ontario. There is a lack of research on McIntyre exposed workers and this qualitative research study will help fill this gap by providing more information on how being exposed impacted workers. This study is the first qualitative study that has been conducted with individuals exposed to McIntyre powder. This research brings new insight and will guide future research about McIntyre powder. Another strength to this study was that exposed workers showed great interest in participating in this research.

To minimize sampling bias, participants were recruited using various sampling methods. The possibility of recall bias also may have occurred in this study as participants were asked to recall events that happened over 30 years ago. In addition, selection bias may have occurred given who ultimately participated in the study. The results from this study provide only perspectives of those who reside in Northeastern Ontario, though thousands of workers across the globe were

exposed to the aluminum powder. Another possible limitation to this study was that some participant interviews only lasted 30 minutes. A two stage interview process may have helped some participants to provide more information.

4.6 Validation

Shenton (2004) identifies four strategies to improve trustworthiness of a study by its credibility, transferability, dependability and conformability. Credibility of this study was addressed by clearly identifying and recording the research methods and analysis. The researcher used triangulation which involved using different data collection methods, such as semi-structured interviews, a reflective journal and a demographic questionnaire. To ensure credibility of data collected, participants were encouraged to be blunt and open and were informed that there was no right or wrong answer. The researcher had regular debriefing sessions with her thesis supervisor, allowing for other interpretations and considerations. To address transferability of the results, the researcher provided as much detail as possible about the phenomena to enable readers to make a sound judgment to see if the results could be transferred to other settings. This research clearly targeted Northeastern Ontario workers in Sudbury, Elliot Lake and Timmins. Transferability of results could have been enhanced by allowing all Ontario residents to participate in this research by widening the geographical study area. Dependability of the study was conveyed by describing in detail the study design and processes to allow other researchers to replicate the study with similar results. Confirmability addresses the degree as to which the researcher stays neutral and does not portray their beliefs on to the results of the study. During the interviews, the researcher listened and allowed the participants to speak freely and listened carefully as to what they had to say. The researcher also frequently used probing questions. By

using such probing questions, participants were able to give provide more details on how being exposed impacted them personally. Reflexivity also contributed to this study's confirmability by staying neutral when collecting and analyzing data.

4.7 Policy Implications

Today, working underground is still hazardous. Workers experience various occupational exposures and health outcomes (e.g. fires, heat exhaustion, standing water, operating equipment and line of site falls, slips and trips, mental health issues, muscular skeletal injuries, risk of occupational diseases, ground instability, and long term effects of silica exposure; Ontario Ministry of Labour, 2015; Center for Disease Control and Prevention, 2005). The workplace safety culture needs to be reviewed to ensure that workers understand and retain knowledge that workplace training is supposed to provide. Companies should be transparent with their workers and ensure that they are provided with information which will allow them to make safe decisions at work. In addition, communication between employers and workers need to be regularly reviewed to enable workers to speak more freely about workplace issues and minimize barriers for workers to raise concerns about workplace hazards.

Furthermore, mining companies, the Canadian and Ontario governments, and mining unions should improve communication with McIntyre powder exposed workers to allow them the opportunity to discuss what has occurred and what may happen in the future, to minimize the effects of feelings of betrayal. Further policy recommendations include additional education for those who adjudicate workers' compensation claims for McIntyre powder. Workers need to be made aware of possible workplace exposures and their health effects and their right to provide

informed consent for any preventative intervention. Education is definitely needed about the meaning and implications of informed consent. Workers have suggested that companies should be more transparent when it comes to workplace hazards and educate their employees. Health care providers also require further awareness of exposed workers to better understand what the workers experienced in terms of their physical and emotional health, and to be aware of potential health impacts. Most importantly, impacted workers have repeatedly stated that companies, unions, and the government should publicly acknowledge that thousands of workers across the globe were exposed to an aluminum dust and researchers do not yet know the potential emotional and health implications. Affected workers have identified that an apology would give them some relief, closure and would be beneficial.

4.8 Recommendations for Future Research and Practice

There is limited research that can directly link exposure to McIntyre powder to chronic diseases, such as different types of cancer and neurological diseases and hence additional research is needed to continue to explore possible health effects of exposure. Further research should include mixed methods approached and the wives of the exposed workers would also be interviewed about their thoughts, experiences, and impact. There is also a need for a more comprehensive historical and political analysis of McIntyre powder documents that are held at the Ontario Archives, in Toronto, Ontario, Canada, to provide a better understanding of this event.

4.9 Conclusion

Workers who were exposed to the aluminum dust treatment perceived that they were impacted at both an individual and organizational level. Previous research is limited, but has found a possible association between aluminum powder treatment and Alzheimer's, cardiovascular, and cognitive impairments of underground workers (Rifat, Eastwood, McLaghlan, & Corey, 1990; Peters, Reid, Fritschi, de Klerk, & Musk, 2013). The main findings of this study portray workers' compulsory exposure, hesitancy to complain, feelings of betrayal, confidence and trust in their companies, a lack participants' and healthcare providers' knowledge, and a need for compensation and a formal apology. These results may also be used to help educate workers, unions, governments, and companies about the impact of workplace exposures. The latest information about McIntyre powder may inform changes to the occupational health and safety system as well as the compensation system in Ontario, Canada.

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5.0 Appendix

5.1 Appendix A- Janice Martell

Health information associated with aluminum dust exposure and health issues of Canadian underground miners is being collected by the McIntyre Powder Project led by Janice Martell (Martell, 2013). Janice Martell, worked as a psychotherapist for over 29 years and holds a bachelor degree of arts in law and psychology and a certificate in addictions (J. Martell, personal communication, November 28th, 2018). She founded the McIntyre Powder Project because her late father, Jim Hobbs, was an underground miner who was exposed to the McIntyre powder in Elliot Lake and who died from Parkinson's disease in 2017 (J. Martell, personal communication, May 23rd, 2017; Martell, 2013). Her father demonstrated Parkinson symptoms in 2000 and was officially diagnosed in 2001 (J. Martell, personal communication, November 26th, 2018).

A friend of the family mentioned to Janice's mother about workers being exposed to an aluminum dust and Janice asked her father about the experience (J. Martell, personal communication, November 28th, 2018). Janice was shocked to learn that her father and several other underground workers experienced the treatment (J. Martell, personal communication, November 28th, 2018). Janice recalled seeing her father spitting up black and grey phlegm when she was a child. She started doing research about aluminum exposure from mining-related work and wondered if there was a possible association between aluminum dust and Parkinson's disease. Janice learned that aluminum is an inorganic substance and a well-established neurotoxin (J. Martell, personal communication, November 28th, 2018). She offered to represent her father for his workmen's compensation claim, that was eventually rejected in 2011 (J. Martell, personal communication, November 28th, 2018). The denial was due to the dearth of

research with minimal association between aluminum dust and neurological disorders (J. Martell, personal communication, November 28th, 2018). After several denials, the case was heard at the tribunal level (J. Martell, personal communication, November 28th, 2018). In 2014, in preparation for the case, she realized that it would be almost impossible to win the case at the individual level in the Canadian court system (J. Martell, personal communication, November 28th, 2018).

Martell also started speaking to underground workers who had experienced McIntyre powder treatment (J. Martell, personal communication, November 28th, 2018). In 2015, Martell went public when the first radio coverage was aired and an official website was created (J. Martell, personal communication, November 28th, 2018). Thereafter, workers started calling Janice and she started a registry to identify potential health issues possibly associated with the treatment (J. Martell, personal communication, November 26th, 2018). This voluntary registry aims to assemble a database of histories to determine if aluminum powder exposure is associated with health outcomes such as: Parkinson's disease, Alzheimer's' disease, Amyotrophic Lateral Sclerosis (ALS) and several types of cancers (i.e., lung, throat, stomach, bowel, prostate, and bladder cancers; Martell, 2013; J. Martell, personal communication, May 23rd, 2017). Currently, the registry has collected information for 500 underground miners in Ontario who were exposed to the McIntyre powder (J. Martell, personal communication, November 26th, 2018). Limited published research also suggested a possible weak association between aluminum prophylaxis and Alzheimer's, cardiovascular, and cognitive impairments of underground workers (Rifat, Eastwood, McLaglan, & Corey, 1990; Peters, Reid, Fritschi, de Klerk, & Musk, 2013). However, Rifat et al., (1990) did not find an association with aluminum dust treatment and pneumoconiosis or cerebrovascular diseases.

Janice Martell is now working for the Occupational Health Clinic for Ontario Workers (OHCOW). OHCOW is a not-for-profit clinic, funded by the Ontario Workplace Safety and Insurance Board (WSIB) and is led by the Ministry of Labour (OHCOW, 2016). OHCOW has been open for over 25 years, and consists of eight different clinics in Hamilton, Toronto, Windsor, Sudbury, Sarnia, Thunder Bay and most recently Ottawa (OHCOW, 2016). OHCOW's vision promotes health and well-being in the workplace to eliminate occupational injuries and diseases (OHCOW, 2015, p.7). OHCOW provides five different types of services to Ontario workers and is the only organization in Ontario that offers a variety of services (i.e., clinical services, prevention services, education, inquiries and research) to their community free of charge (OHCOW, 2016). The occupational intake clinics were facilitated by health professionals, such as occupational hygienists, registered occupational health nurses, ergonomists, occupational health physicians, client service coordinators, information technicians, and administrative staff who collect information about clients' work and health histories as well as recording possible workplace hazards (OHCOW, 2016).

OHCOW in Northern Ontario is collecting data on underground miners who were exposed to the McIntyre powder treatment by hosting occupational disease intake clinics (Ontario Health Clinics for Ontario Workers [OHCOW], 2016). The Sudbury and Timmins intake clinics were held in October 2016 and May 2016, respectively (Martell, 2013). OHCOW provided free transportation for individuals to travel to, and from, Elliot Lake.

The interview process was lengthy (OHCOW, 2016). OHCOW has approximately 500 underground miners in their client list who were exposed to the McIntyre powder treatment (J. Martell, personal communication, May 23rd, 2017).

5.2 Appendix B – English Poster



Université **Laurentienne**
Laurentian University

SEEKING

* STUDY PARTICIPANTS *



WHAT IS YOUR STORY?

Have you been exposed to the McIntyre Powder Treatment (aluminum dust) between 1943-1980? Did you work underground for a minimum of 1 year? If you are interested in sharing your story in an interview, please contact **Danielle Aubin** at dx_aubin@laurentian.ca or Dr. Nancy Lightfoot at nlightfoot@laurentian.ca or 1-800-461-4030 ext. 3972

5.3 Annexe B- Affiche Français



Besoin de Participants



Avez-vous été exposé à la poudre d'aluminium (McIntyre Powder treatment) entre les années 1943 et 1980 pour une période minimale d'un an? Avez-vous travaillé sous terre pour un minimum d'un an? Si vous êtes intéressé à partager votre expérience dans le cadre d'une entrevue avec une étudiante à la maîtrise de l'Université Laurentienne, communiquez avec Danielle Aubin : dx_aubin@laurentian.ca ou 1-800-461-4030, poste 3972. Cette étude a été approuvée par le Comité d'éthique de la recherche de l'Université Laurentienne.

5.4 Appendix C- Participant Letter

Dear Potential Participant,

I, Danielle Aubin, a Laurentian University student in the master's program in Interdisciplinary Health, invite you to become a participant in the research project called "After the dust settles: A qualitative study of underground miners who were exposed to an aluminum dust treatment". The goal of the study is to learn about experiences with the aluminum dust treatment and how it may have impacted you.

You have been asked to participate in this research because you were exposed to the aluminum dust treatment between 1943 and 1980 and have worked in a Northern Ontario Mine for at least 1 year. If you decide to participate in this study, you will receive a study summary at the end of the study. I will also be writing journal articles with potential publications in academic journals. Study summaries will also be sent to: the Occupational Health Clinics for Ontario Workers (OHCOW) in Sudbury, the McIntyre Powder Project website, various mining unions, the Ministry of Labour, Workplace Safety and Insurance Board (WSIB), Work Place Safety North, the Centre for Research of Occupational Health (CROSH) and study participants.

This study will be useful to educate health professionals to be better informed about your needs, help shape future industry policies and practices, and help guide future research on aluminum dust treatment.

The study participation is voluntary and you can withdraw from the study at any time without consequence by notifying myself (Danielle Aubin) or my thesis supervisor (Dr. Nancy Lightfoot). Information will be collected by performing individual interviews that will be audio recorded, in person or by telephone, which could last 1 to 2 hours. Your name and location will be kept confidential throughout the entire project and onward. Any personal information or identifying factors will not appear on any documents. Please note that the researchers are not in a position to provide any legal advice.

We would greatly appreciate if you would consent in participating in this important project. If you would like to participate in this study, please fill out the consent form and return to myself (Danielle Aubin) by mail with the pre-paid postage envelope that has been provided to you. Questions about the study may be directed to me, by email (dx_aubin@laurentian), or to my supervisor, Dr. Nancy Lightfoot, School of Rural and Northern Health, Laurentian University, by email (nlightfoot@laurentian.ca) or you can call 1-800-461-4030 ext. 3972.

Sincerely,

Danielle Aubin BPH (Hons.), MA Interdisciplinary Health student
Laurentian University
935 Ramsey Lake Rd,
Sudbury, ON
P3E 2C6

5.5 Annexe C- Lettre de participant

Monsieur,
Madame,

Je me nomme Danielle Aubin et je suis une étudiante inscrite à la maîtrise du programme de santé interdisciplinaire de l'Université Laurentienne. Je désire vous inviter à participer à un projet de recherche intitulé « Une fois la poussière retombée : une étude qualitative des travailleurs de mines souterraines qui auraient été exposés à la poudre d'aluminium. » Le but de cette étude est d'apprendre au sujet de votre expérience d'exposition à la poudre d'aluminium et de connaître l'impact qu'elle pourrait avoir eu sur vous.

Nous vous avons demandé de participer à cette étude, car vous avez été exposé à la poudre d'aluminium entre les années 1943 et 1980 dans une mine du nord de l'Ontario pour une durée minimale d'un an. Si vous avez décidé de participer à cette étude, vous recevrez un sommaire de l'étude à la fin de celle-ci. Je compte aussi rédiger des articles de journaux pour potentiellement les publier dans des revues académiques. De plus, des sommaires seront envoyés au Centre de santé des travailleurs de l'Ontario (CSTO) de Sudbury, le site Web du McIntyre Powder Project, plusieurs syndicats miniers, le ministère du Travail, la Commission de la sécurité professionnelle et de l'assurance contre les accidents du travail (CSPAAT) de l'Ontario, Sécurité au travail dans le Nord, le Centre de recherche en santé et sécurité au travail (CRSST) et les personnes qui ont participé à l'étude.

L'étude sera fort utile puisqu'elle informera les professionnels de la santé au sujet de vos besoins et aidera à concevoir des politiques et des pratiques de l'industrie pour l'avenir ainsi que guider les recherches portant sur l'exposition à la poudre d'aluminium à l'avenir.

Votre participation est entièrement volontaire ; vous pouvez vous retirer de l'étude en tout temps sans répercussion en communiquant avec moi (Danielle Aubin) ou ma superviseure de thèse (Nancy Lightfoot, Ph. D). Les renseignements seront récoltés par l'entremise d'entrevues en personne ou par téléphone qui pourront durer entre une et deux heures. Votre nom et votre emplacement demeureront confidentiels tout au cours de l'étude et après la conclusion de celle-ci. Aucune information qui pourrait permettre de vous identifier n'apparaîtra dans aucun des documents publics. Veuillez noter que les chercheurs ne sont pas en mesure de donner des conseils légaux.

Nous vous serions immensément reconnaissants si vous contentiez à participer à cet important projet. Si vous désirez participer à cette étude, nous vous demandons de remplir le formulaire de consentement et de le retourner à mon attention (Danielle Aubin) par courrier dans l'enveloppe affranchie que nous vous avons fournie. Si vous avez des questions au sujet de l'étude, vous pouvez communiquer avec moi par courriel (dx_aubin@laurentian.ca) ou avec ma superviseure de thèse, Dr Nancy Lightfoot de l'École de santé dans les milieux ruraux et du nord de l'Université Laurentienne par courriel (nlightfoot@laurentian.ca) ou par téléphone en signalant le 1-800-461-4030, poste 3972.

Veuillez accepter nos salutations les plus cordiales.

Danielle Aubin BSH (spécialisé),
Étudiante à la maîtrise en santé interdisciplinaire
Université Laurentienne
935, Ch. du lac Ramsey
Sudbury (Ontario) P3E 2C6

5.6 Appendix D- Interview Questions

Hi my name is Danielle Aubin and I will be asking you some questions for the McIntyre powder study for which you recently received information.

We will use the findings from these interviews to better inform health professionals about your needs, help shape future industry policies and practices, and guide future research on aluminum dust treatment.

I will ask you about when you were exposed to the aluminum dust, also known as McIntyre powder treatment.

Before we start the interview, I will give you a consent for to sign (complete consent form). Can I just check you are comfortable with the interview being recorded? (If over the phone, I will read the consent form to the participant, and get verbal consent)

Today is (Date _____, Time _____). I am interviewing participant number _____ (in person/by telephone) at _____ in _____.

1. Tell me about your work experience in mining?
 - a. Prompts:
 - i. When did you start working in mining? Where? How long?
2. How did you find out about this study?
3. Tell me about your experience of being exposed to the aluminum dust treatment?
 - a. Prompts:
 - i. When? How long? How often? Under what conditions? How did it make you feel? Did the company get your consent for treatment?
4. Before you were exposed to the aluminum dust treatment, what did the company and union say about it?
 - a. Prompts
 - i. Notifications? Warnings?
5. I have a picture of exposure to aluminum dust, here. What comes to mind when you see this picture?
6. Do you think the aluminum dust had any impact on you?
 - a. Prompts:
 - i. Physically? Emotionally?

7. How do you feel now about having been exposed to the aluminum dust in the past?
8. How do you feel when you see information about aluminum dust treatment in the media, now?
9. Do you have any advice for others who might have been exposed to McIntyre powder?
10. Do you have any suggestions for mining companies that used McIntyre powder in the past?
11. Do you have any suggestion for your friends/ co-workers that were exposed to McIntyre powder in the past?
12. Is there anything that you would like companies and/or unions to do now for those exposed to McIntyre powder?
13. Is there anything that you would the government to do now for those exposed to the McIntyre powder?
14. Is there anything else you would like to share?
15. Demographic questions
 - a. What is your gender?
 - b. How old are you?
 - c. Where do you live now?

Thank you.

5.7 Annexe D- Questions d'entrevue

Bonjour. Je me nomme Danielle Aubin et je vais vous poser quelques questions au sujet de l'étude sur la poudre d'aluminium (McIntyre powder) pour laquelle vous avez reçu des renseignements récemment.

Nous utiliserons les informations obtenues à l'aide de ces entrevues pour mieux informer les professionnels de la santé au sujet de vos besoins et pour aider à concevoir des politiques et des pratiques de l'industrie pour l'avenir ainsi que pour guider les recherches portant sur l'exposition à la poudre d'aluminium à l'avenir.

Je vais vous demander quand vous avez été exposé à la poudre d'aluminium qu'on appelle aussi le « McIntyre powder treatment ».

Avant de commencer l'entrevue, je vais vous remettre un formulaire de consentement que vous devez remplir et signer. Je dois vérifier : êtes-vous à l'aise avec le fait que j'enregistre notre entrevue ? (Si c'est au téléphone, je lirai le formulaire au participant et obtiendrai son consentement verbal).

Aujourd'hui, c'est (date _____, heure _____) je passe le participant numéro _____ en entrevue (en personne/au téléphone) à _____ dans la ville de _____.

1. Parlez-moi de votre expérience dans le secteur minier.
 - a. Questions supplémentaires :
 - i. Quand avez-vous commencé à travailler dans la mine ? Où ? Combien de temps ?
16. Comment avez-vous entendu parler de cette étude ?
17. Parlez-moi de votre expérience d'exposition à la poudre d'aluminium ?
 - a. Questions supplémentaires :
 - i. Quand avez-vous été exposé ? Combien de temps ? Combien de fois ? Dans quelles conditions ? Comment vous êtes-vous sentis ? La compagnie a-t-elle obtenu votre consentement avant de vous exposer à ce produit ?
18. Avant d'avoir été exposé à la poudre d'aluminium, qu'est-ce que la compagnie ou le syndicat disait à son sujet ?
 - a. Questions supplémentaires :
 - i. Notifications ? Avis ? Avertissements ?
19. J'ai ici une photo d'exposition à la poudre d'aluminium. À quoi pensez-vous quand vous voyez cette photo ?

20. Croyez-vous que la poudre d'aluminium a eu un impact sur vous ?
 - a. Questions supplémentaires :
 - i. Sur le plan physique ? Sur le plan émotif ?
21. Comment vous sentez-vous maintenant face au fait que vous avez été exposé à la poudre d'aluminium dans le passé ?
22. Comment vous sentez-vous quand vous entendez parler de la poudre d'aluminium dans les médias, maintenant ?
23. Avez-vous des conseils à donner aux autres personnes qui auraient été exposées à la poudre d'aluminium — la McIntyre powder ?
24. Avez-vous des suggestions à donner aux compagnies minières qui ont utilisé de la poudre d'aluminium (McIntyre powder) dans le passé ?
25. Avez-vous des suggestions pour vos amis et collègues qui auraient été exposés à la poudre d'aluminium (McIntyre powder) dans le passé ?
26. Croyez-vous que les compagnies ou les syndicats devraient faire quelque chose de particulier maintenant pour les personnes qui ont été exposées à la poudre d'aluminium (McIntyre powder) ?
27. Y a-t-il quelque chose que vous voudriez que le gouvernement fasse pour les personnes qui auraient été exposées à la poudre d'aluminium (McIntyre powder) ?
28. Y a-t-il autre chose que vous voudriez partager avec moi ?
29. Questions démographiques :
 - a. Quel est votre genre ? (Êtes-vous un homme ou une femme ?)
 - b. Quel âge avez-vous ?
 - c. Où habitez-vous maintenant ?

Merci !