Dante's kindling box

The Fort McMurray forest fire

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BACKGROUND

Almost half of the Canadian landscape is made up of forests, but the amount of forest surface area burned every year has been growing steadily since 1960.¹ This can be problematic due to the effects that forest fires have not only on the local environment but also on the globe as a whole. A forest fire or vegetation fire is defined as any open fire of vegetation such as savannah, forest, agriculture, or peat that is initiated by humans or nature.² Vegetation fires contribute heavily to air pollution and climate change and are in turn exacerbated by them as well. Air pollution increases due to emissions from these fires, which contain 90-95% carbon dioxide and carbon monoxide as well as methane and other volatile compounds.² Emissions from forest fires also contribute to global greenhouse gases and aerosol particles (biomass burning organic aerosols),² leading to indirect and direct consequences to human health. In contrast to biomass burning for household heating and cooking, catastrophic events of forest fires and sweeping grassland fires result in unique exposures and health consequences. In this case report, the relationship between environmental hazardous air pollutants and the potential physiological and psychological health effects associated with the forest fire that affected Fort McMurray, AB in May 2016 are considered.

FORT MCMURRAY FOREST FIRE

The forest fire that affected Fort McMurray in May 2016 started on May 1st as a small and insignificant threat. However, by the evening, the fire had grown exponentially and the citizens of Beacon Hill, a neighborhood on the southwest of Fort McMurray, were asked to prepare to leave on short notice. On May 3rd, the fire became a serious threat to the residents of Fort McMurray, growing to 2,656 hectares and crossing the Athabasca River as it moved northwest towards town. A mandatory evacuation notice was issued at 2 PM that day, after which houses in the neighborhood of Abasand began to burn. By the evening of the 3rd, all of Fort McMurray was put on a mandatory evacuation as the fire continued to grow. Citizens fled either north to the oil sand camps or south to other communities such as Edmonton or Calgary. By May 21st, the fire expanded to greater than 500,000 hectares, and by June, the fire was contained through a combination of firefighter efforts and cool temperatures.³

PHYSICAL HEALTH EFFECTS

Forest fires can detrimentally impact human physiology, leading to an increased risk of short-term and long-term morbidity and mortality. Medium- and large-sized forest fires are associated with increased incidence of hospital visits and rates of mortality within

neighboring urban areas.⁴ There are four major exposure pathways through which humans can be impacted by forest fires: direct exposure to flames and radiant heat, exposure to smoke from burning materials, exposure to chemical pollutants within the land and soil, and exposure to contaminated water.⁵

Failing to evacuate neighboring regions can result in direct flame burns and thermal burns - potentially life-threatening conditions requiring immediate medical attention. Severe burns require multidisciplinary medical resources and expertise due to the risk of multi-organ complications.⁵ Extended periods of hot conditions can lead to elevated body temperatures and heat-related injuries. The severity of conditions such as exertional heat stroke range drastically, from benign states to fatal injuries.⁶

Wood smoke contains particulate matter and gaseous products of combustion, which adversely affect human health due to their inflammatory and cytotoxic effects. Respiratory morbidity is the predominant pathological consequence of inhalation of wood smoke, such as increased rates of chronic obstructive pulmonary disease (COPD) and adult asthma hospital admissions. Cardiovascular morbidities can also occur; increased concentrations of particulate matter from wood smoke have been associated with increased all-cause and cardiovascular mortality.⁵ Moreover, carbon monoxide is a major constituent of biomass smoke, reducing the body's ability to transport oxygen to tissues, further complicating medical conditions like atherosclerosis and coronary heart disease. Inhalation of wood smoke has been shown to negatively impact immune system functioning by increased prevalence of respiratory infections, pneumonia, and allergies in humans after wood smoke exposure.⁷ Ophthalmic morbidities such as eye irritation from ambient smoke can lead to restricted visibility, which is associated with fatal road traffic collisions during periods of evacuation. Firefighters are particularly vulnerable to wood smoke exposure, and thus suitable filters and breathing apparatuses are fundamental in reducing the risk of adverse health outcomes.⁵

A wide array of adverse health effects can stem from the spreading of land, water, and air pollutants from forest fires.⁵ There is significant evidence of the carcinogenic effects of forest fire toxin exposure, with a much higher incidence of lung cancer, sarcoma, non-Hodgkin's lymphoma, and liver cancer occurring after exposure.⁷ Ash debris contaminated with elevated levels of heavy metals can be found in land and water sources surrounding the area of the fire, including lead, mercury, copper, arsenic, and cadmium.⁵ Bioaccumulation of these toxins can occur in land and aquatic species, further increasing toxic exposure to humans by contaminated food sources. These altered stream flow characteristics result in increased microbial production, leading to an increased incidence of

infections from exposure to untreated water sources.⁷

PSYCHOLOGICAL HEALTH EFFECTS

Facing forest fires puts individuals at risk of experiencing negative short-term and long-term psychological effects. Depending on the characteristics of the forest fire, personal experiences, perceptions, interpretations, ethnicity, and pre-existing coping mechanisms, the reactions and attitudes of individuals or communities towards forest fires are varied, leading to differences in psychological health effects and intensities.⁷ Psychological conditions experienced during forest fires can improve or worsen the biophysical effects of fire, or may instead arise as a consequence of biophysical conditions.⁸ Grief and distress are two psychological factors that are affected by forest fires, as they are linked to the destruction of property, homes, or personal belongings. Damage to property that holds important social or personal value evokes a sense of helplessness.⁹ In addition, emotional states can be compromised and aggressive behaviour can be triggered by an exposure to ozone, a component of air pollution.¹⁰ Bad odours associated with air pollution following a forest fire have also been shown to cause cognitive deficits and behavioural disorders. Such sensory stress affects behaviour by decreasing personal control and increasing levels of frustration.¹¹ Forest fires are also able to induce more intense forms of stress and other psychiatric illnesses, particularly PTSD.

Psychological distress can either be mitigated or further worsened by aid organizations during forest fires.⁷ Emotional support that is provided by aid organizations can help victims cope with psychological stressors.⁹ In contrast, aid organizations can become a source of stress when individuals, materials, and equipment from outside the community are introduced.^{9,12}

It is important to note that although the spatial and temporal effects of forest fires are often far-reaching, individuals closest to the fire are especially vulnerable.⁷ Indeed, one of the most vulnerable populations in any forest fire is firefighters, as they experience amplified psychosocial health effects. Fox and Bowlus indicate a list of stress-inducers among wildland firefighters that includes line of duty deaths, traumatic injuries, injury or death of infants or children, life-threatening or emotionally upsetting close calls, excessive media interest, burn overs, falling dead trees, and burning debris.¹³ The main psychological stress symptoms of firefighters include frustration, irritability, anger, sadness, sleep disturbances, mood swings, avoidance of feelings, loss of enthusiasm, fatigue, relationship issues, anxiety, and depression.¹³

CONCLUSION

The Fort McMurray forest fire is considered to be the most devastating natural disaster in Canadian history - a financial burden that can be measured in billions of dollars.¹⁴ With the desolation that occurred throughout this town, it is incredible that there has not been a single immediate death associated with this colossal disaster. However, this was an unbelievable tragedy for the local residents as more than two thousand homes within the town were destroyed - an outcome that was potentially preventable had

improved structural changes and protocols been in place.¹⁵ The destructive and toxic effects of this fire on the urban environment will likely increase the susceptibility to long-term physical and psychological health consequences. With wildfires projected to increase dramatically due to climate change, it is of increasing importance for us to make the upstream changes required to reduce the incidence and impact of forest fires in Canada and throughout the world.

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