Wildfire Health Risks in Relation to Local Senior Population’s CRD Incidence Rate in the Greater Toronto Area

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Abstract: Wildfires as one of the most common and frequent environmental disasters in North America, billions of government spending, public funds, resources, and personnel have been placed to cope with this natural disaster directly. The smoke, debris, particulates, ambient ultrafine particles, and other wildfire emissions have increasingly become a public health concern to which senior populations are particularly vulnerable, due to the populations’ general behaviour and their physical health conditions. This essay investigates the implications of wildfires on public health by identifying the relationship between the exposure of wildfire emissions and the incidences of chronic respiratory disease in the senior population in the Greater Toronto Area. This research estimates the effects of wildfire emission exposure by using the cross-examination of the relevant health factors, including the incidence of wildfire; particulate level, ambulance service operation log and reported respiratory emergency disease to the incidences of wildfires. The Geographic Information Systems (GIS) have been placed to estimate the effect range and proximity of CRD incidences to the wildfire location.

Keywords: Wildfire; Public Health; PM2.5; Aging Population; Municipal Health.

1. Introduction

Wildfires are fires that spread rapidly and consume vegetation and other flammable materials in their path. These natural disasters can be extremely destructive, causing dramatic risks to human life, and the environment. Recently, wildfires in Canada have increased its severity, expanding the sphere of influence and incidence frequency. With the intensified disaster, all 13 provinces and territories have reports of wildfire, 7 provinces issued evacuation orders and British Columbia and Alberta declared the State of Emergency of the provinces due to wildfire. Wildfires pose significant health risks to individuals and communities, affecting both physical and mental well-being. These dangers stem from various aspects of wildfires, including exposure to wildfire smoke, direct contact with flames or high-heat environments, and the secondary consequences of wildfires on air and water quality as well as infrastructure. [1,2] Wildfires can have particularly crucial effects on the elderly population, who are often more vulnerable to the health and social impacts of these natural disasters. Toronto's population in 2021 was approximately 2.9 million people, and within this diverse metropolis, seniors, typically defined as individuals aged 65 and older, constitute a significant demographic segment. In 2022, 19.0 Percent of Canada’s population was age 65 or older, in Toronto that is approximately Five Hundred and Fifty-One thousand (551,000) of the population. The presence of a senior population in a densely populated area like Toronto intensifies the potential public health risks associated with wildfires and their particulate matter.[3] When wildfires release vast amounts of smoke and airborne pollutants into the air, the impact on seniors can be particularly concerning.

The health risks of wildfire are mostly coming from its emissions, wildfire debris can release large amounts of particulate matter. The senior population's degraded immune system and respiratory cycles made them more vulnerable in coping with particulate matter. The senior population also possessed a higher incidence rate of Chronic respiratory disease (CRD). Wildfire pollution may cause and intensify Asthma, Chronic Obstructive Pulmonary Disease (COPD), internal organ infection and other diseases. With the ever-changing and inevitable anthropogenic climate change, aging population and limited healthcare budget, the study of wildfires’ impact on senior health is significant to the agenda-setting of provincial policy and the sustainable development of national healthcare. [3-7] The City of Toronto and its subordinate municipalities as the most densely populated area became the most suitable place to research the impact and the relationship. The main objective of the research study on the impact of wildfire on Toronto's senior population is to comprehensively assess the cause, health risks and consequences faced by seniors during wildfire events, with a focus on how these events can strain healthcare infrastructure.

2. Material and Methods

The Research Study will be using the following methodology to conduct research and necessary data analysis. For the data collection, the research will be acquiring health records from Public Health Ontario, including the Age-specific crude rate of Incidence of asthma and the incidence of Chronic obstructive pulmonary disease (COPD). Hospitalization for respiratory disease, asthma and COPD. Air quality monitoring data from the Ministry of the Environment, Conservation and Parks will be used to connect the relationship between the incidence of wildfire and air quality. Geographic Information Systems (GIS) are employed to map the distribution of senior populations in Toronto. The goal is to assess the range of wildfire-prone regions and their effect on public health and air quality.

From the observations of Age-specific rate (age 65-74) Mortality from respiratory disease in Toronto public health
region from 2003-2015. The results show that the mortality rate has not significantly increased over time. However, the result from the Porcupine Health Unit region shows a peak in the year 2014, with 18 deaths out of a total population of 7985 compared to Toronto with 161 death cases of 219,877 population. In corresponding to the Forest area burned and the number of forest fires from the National Forestry Database, there is also a peak in incidences of wildfires in 2013 and 2014. The database of Hospitalization for Respiratory Disease shows similar results, a data peak appeared in the year 2013 at Porcupine health regions. For Toronto, the trends are still flat, with no significant rise in incidents. [8]

In considering the geological spaces and environmental surroundings, the Porcupine region is considered a rural rather than an urban area like the GTA. And the wildfire incidence rate is higher in rural areas. Unfortunately, the Ministry of the Environment, Conservation and Parks only collects data after 2015. So new set of hospitalization data is required. Ontario government kept the data of hospitalization for respiratory till 2021. However, due to the COVID-19, the global respiratory epidemic. The data cannot accurately reflect the impact of wildfires on hospitalization. In this case, 2015 and 2016 have been chosen as the research data. The Toronto North and the City of Sudbury from the Porcupine region have been chosen as Air Quality Health Index (AQHI) data locations. [9]

In 2015, Sudbury reported 26 days of Moderate Risk AQHI and Hospitalization for Respiratory Disease (Age 65-74) Incidences of 209 cases out of 8027 population (2.6%). Toronto North reported 156 days of Moderate Risk AQHI and Hospitalization for Respiratory Disease (Age 65-74) Incidences of 2339 out of 218,229 population. (1.07%) In 2016 Sudbury reported 14 days of Moderate Risk AQHI and Hospitalization for Respiratory Disease (Age 65-74) Incidences of 198 cases out of 8260 population (2.39%). Toronto North reported 156 days of Moderate Risk AQHI and Hospitalization for Respiratory Disease (Age 65-74) Incidences of 2468 out of 225,120 population. (1.09%) [7-10]

If we look at the data from other age groups, for example, age from 20 to 44. Both mortality rates and hospitalization incidences are significantly lower than the group of seniors. The age group from 20 to 44 has a mortality case of 11 among the 1,094,109 population and had a mortality rate of 0.001% in 2014. The number of Hospitalization cases is 1104 of a population of 1,085,314 (0.1%) [8]

As shown in the GIS map above, the health units of mortality rate are gradually decreasing in the south toward Toronto, where the population is denser. The study results suggest that the geographic factors.

3. Results

This Research aimed to identify wildfire emissions and their relationship with CRD incidence within senior populations. Here are the results of the investigations. The Senior population (Aged 65-74) data did not reveal a significant rise in the mortality rate in Toronto from 2013-2015. However, in the rural areas, the Porcupine region presented a peak in mortality rate in 2014, coinciding with the wildfire incidence peak from 2013 to 2014. The Data on Hospitalization for Respiratory Disease appeared same trends, the Porcupine region presents a peak in comparison to Toronto’s relatively flat trends, with no significant rise in hospitalizations.

The AQHI, air quality data revealed a variation between Toronto North and Sudbury. From 2015 to 2016, Sudbury possessed fewer days of moderate risk than Toronto North. However, Sudbury exhibited a higher hospitalization rate. For the other age groups’ data analysis, age 20-44 has a significantly lower mortality rate and hospitalization rate in coping with respiratory disease. For the spatial element, based on the GIS mapping data, the mortality rate and hospitalization rate are gradually decreasing from the northern to the south. The GIS result may indicate that the proximity to the wildfire will effectively change the incidence rate of respiratory diseases.

4. Conclusion

The research estimates the impact of wildfire emission exposure on the CRD using a cross-examination of data collected and linked to geographical information. In general, this research finds that closer to the wildfire, that the incidence rate of CRD will be higher. However, the research did not observe clear evidence that supports a direct relationship between air quality and CRD incidences.

References


