

Exploring the Differential Impact of COVID-19 on the Greater Toronto Area: A Literature Review

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SUMMARY

As a large urban centre, the Greater Toronto Area (GTA) was rapidly affected by COVID-19. Certain GTA communities, referred to as 'hotspots', suffered the most with greater disease transmission and confirmed cases. This literature review explores the differential impact of COVID-19 on GTA communities with regard to hotspot geography, sociodemographic and socioeconomic factors, minority groups, government action, and vaccine distribution. Geographical mapping of COVID-19 hotspots within the GTA revealed an unequal disease burden. These hotspots included individuals of vulnerable sociodemographic groups and lower socioeconomic status. COVID-19's impact on specific minority groups has highlighted social disparities. Furthermore, the Canadian government and its municipalities showed a lack of preparation when handling COVID-19. One key example of this involved rather unsuccessful attempts at establishing vaccine equity among hotspots. Current literature lacks standardization of case count data across the GTA regions, is limited to short time periods, lacks information on multiple sociodemographic factors, and focuses primarily on the City of Toronto. This review establishes how ongoing social inequities have contributed to the unequal burden of COVID-19. To effectively control this pandemic, policymakers should consider various social factors to implement equitable changes.

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INTRODUCTION

In late 2019, the first cases of coronavirus disease 2019 (COVID-19) were identified in Wuhan, China (Vaz, 2021). COVID-19 is a viral pneumonia caused by severe acute respiratory syndrome coronavirus 2 (SARS-CoV-2) (Ciotti et al., 2020). COVID-19 spreads mainly via respiratory droplets and causes acute respiratory distress, recognized by coughing, fever, and shortness of breath symptoms (Ciotti et al., 2020). Uniquely, COVID-19 has the potential to rapidly infect numerous individuals (Shariati et al., 2020).

Individuals aged 65 years and older have a greater risk of hospitalization and death due to COVID-19 infection (Mueller et al., 2020). This is hypothesized to be the result of multiple age-related differences such as comorbidity and immunity (Mueller et al., 2020). To date, COVID-19 has irreversibly impacted global health, the economy, and collective way of life (World Health Organization, 2020). As one of the largest urban centres in North America, the Greater Toronto Area (GTA) rapidly faced multiple COVID-19 cases (Wang et al., 2020). However, not all communities within the GTA were impacted in

the same way (Vaz, 2021). Geographic regions denoted as “hotspots” faced the worst of the pandemic with the highest COVID-19 case counts (Vaz, 2021).

The specific geography of these hotspots has exposed socio-spatial inequities and previously existing health disparities (Biglieri et al., 2020). With years of underinvestment in infrastructure and exponential population growth, structural social issues in the GTA have consistently increased (Lo et al., 2015). The pandemic has only exacerbated these issues, especially for vulnerable and minority groups (Biglieri et al., 2020). For instance, individuals of specific minority groups that are more likely to experience lower socioeconomic status (SES) generally report poorer health outcomes and higher rates of pre-existing health conditions, making them more vulnerable to COVID-19 infection and death (Choi & Denice, 2020). In fact, data from the City of Toronto demonstrated that Black and Latinx populations had COVID-19 case rates that were 6 to 11 times higher than the White population (McKenzie, 2021). The social and economic impacts of COVID-19 on minority groups have thus been immense (City of Toronto, 2021). Government interventions such as social distancing and lockdown protocols were put in place to reduce disease transmission, yet hotspot regions persistently had higher levels of COVID-19 (Brankston et al., 2021). Although the Canadian government provided financial assistance programs during COVID-19 lockdowns, such as the Canadian Emergency Response Benefit (CERB), some vulnerable groups were unable to qualify as their SES prevented them from meeting the eligibility criteria (Ahmed et al., 2021; Edmonds & Flahault, 2021). Similarly, vulnerable groups were found to be less likely to perform COVID-19 testing due to multiple reasons such as medical mistrust, financial conflicts, and testing accessibility (Ahmed et al., 2021; Choi & Denice, 2020). Also, the introduction of COVID-19 vaccines has shown promising success, but local results have varied within hotspot regions (Iveniuk & Leon, 2021).

The causes of increased disease transmission in hotspots are multifaceted and require a broader understanding of social systems (Biglieri et al., 2020). As such, the purpose of this literature review is to explore the differential impact of COVID-19 on GTA communities with regard to hotspot geography, sociodemographic and socioeconomic factors, minority groups, government action, and vaccine distribution.

GEOGRAPHY OF COVID-19 HOTSPOTS IN THE GTA

A hotspot is a geographic location with an elevated disease burden or high disease transmission (Lessler et al., 2017). COVID-19 hotspots are usually identified by above-average case counts in comparison to surrounding areas. Based on the higher probability of contact with infected individuals, those who reside within these hotspots are more susceptible to COVID-19 (Hamidi et al., 2020). The geography of COVID-19 hotspots in the GTA can be identified by looking at the municipal data on COVID-19 cases. In Canada, individual provinces are primarily responsible for healthcare services (Government of Canada, 2019). As seen in Figure 1, the GTA, located in the southern part of Ontario, is composed of 5 municipalities: Toronto, Durham, Halton, Peel, and York (Toronto Global, 2021).

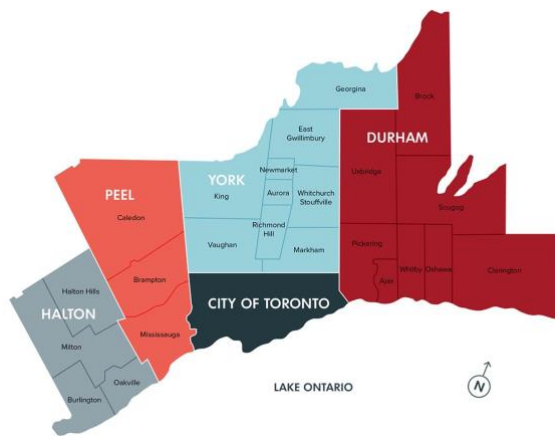


Figure 1: Map of the Greater Toronto Area.

This figure shows the locations of the 5 regional municipalities of the Greater Toronto Area and the subregions within them (Toronto Global, 2021).

Table 1 shows that, as of October 2021, a spatially unequal burden of COVID-19 was observed throughout the GTA. The municipalities of Toronto and Peel had the highest cumulative case counts, at over 100,000 (City of Toronto, 2021; Region of Peel, 2021). However, it is difficult to make comparisons of hotspots between GTA municipalities, as case count data was not represented in a standardized method. Data from the City of Toronto mapped case counts within small neighbourhoods (census tracts), whereas other GTA municipalities mapped case counts within variably broader regions (City of Toronto, 2021; Region of Durham, 2021; Halton Region, 2021; Region of Peel, 2021; York Region, 2021).

Table 1: GTA COVID-19 Hotspots Identified by Case Counts.

Hotspots were identified within each of the GTA regions as per higher confirmed COVID-19 case counts during October 2021. The City of Toronto and the Peel region had the highest case counts at 100,000+. Case count data was obtained from the public health units of the cities of Toronto, Durham, Halton, Peel, and York. The City of Toronto mapped case counts within small neighborhoods (census tracts). Other GTA municipalities mapped case counts within variably broader regions. This table was generated using Microsoft Excel (City of Toronto, 2021; Region of Durham, 2021; Halton Region, 2021; Region of Peel, 2021; York Region, 2021).

GTA Region: City of Toronto	
Total Confirmed Case Counts: 174,167	
Hotspot Area	% of Total Confirmed Case Counts
Woburn	3%
Downsview-Roding-CFB	3%
West Humber-Clairville	2%
Mount-Olive-Silverstone-Jamestown	2%
Malvern	2%
Rouge	2%
Glenfield-Jane Heights	2%
York University Heights	2%
GTA Region: Durham Region	
Total Confirmed Case Counts: 27,127	
Hotspot Area	% of Total Confirmed Case Counts
Ajax	27%
Oshawa	22%
Pickering	20%
Whitby	17%
GTA Region: Halton Region	
Total Confirmed Case Counts: 18,892	
Hotspot Area	% of Total Confirmed Case Counts
South Central Milton	9%
River Oaks	8%
Escarpment	7%
Upper East Milton	6%
Aldershot	5%
GTA Region: Peel Region	
Total Confirmed Case Counts: 116,003	
Hotspot Area	% of Total Confirmed Case Counts
Brampton	69%
Mississauga	37%
GTA Region: York Region	
Total Confirmed Case Counts: 56,653	
Hotspot Area	% of Total Confirmed Case Counts
Vaughan	42%
Markham	23%
Richmond Hill	14%

THE SOCIODEMOGRAPHIC AND SOCIOECONOMIC PATTERNS OF COVID-19 HOTSPOTS

The burden of COVID-19 throughout the GTA was noted to be ‘geographically unequal’ (Mishra et al., 2021). To further explore this and identify the groups at greatest risk of COVID-19, researchers attempted to identify the sociodemographic and socioeconomic patterns of residents within COVID-19 hotspots.

A study of COVID-19 hotspot regions from April 2020 found that most COVID-19 cases arose within the 50-to-59-year age group, occurred in females, and resulted from close contact with a pre-existing case (Vaz, 2021). In comparison to the general City of Toronto, the average salary within these hotspot regions was 22% lower while the poverty level was 4% higher (Vaz, 2021). Furthermore, there were significantly fewer individuals with a university-level education or above, and the residents included significantly more immigrants and children up to 14 years of age (Vaz, 2021).

This data is supported by a Canadian occupational review conducted in July 2020 (St-Denis, 2020). Women are more likely to have occupations with a greater risk of COVID-19 exposure than men (St-Denis, 2020). The review also revealed that elderly workers (55-65+ years) in health occupations are at higher risk of COVID-19 exposure than their younger counterparts (St-Denis, 2020). Furthermore, low-income workers have occupations that put them at greater risk of COVID-19 exposure than other workers; this is especially evident in immigrants and visible minority groups (St-Denis, 2020). Lastly, except for those engaged in the healthcare industry, workers with a bachelor’s degree or higher education had a significantly reduced risk of occupational exposure to COVID-19 compared to those without at least a bachelor’s level education (St-Denis, 2020).

Another study completed in August 2020 explored the relationship between the major SES of individual neighbourhoods in Toronto and COVID-19 cases (Choi & Denice, 2020). Figure 2 shows that between April 2020 to June 2020, lower-income neighbourhoods suffered a greater proportion of COVID-19 cases than higher-income neighbourhoods.

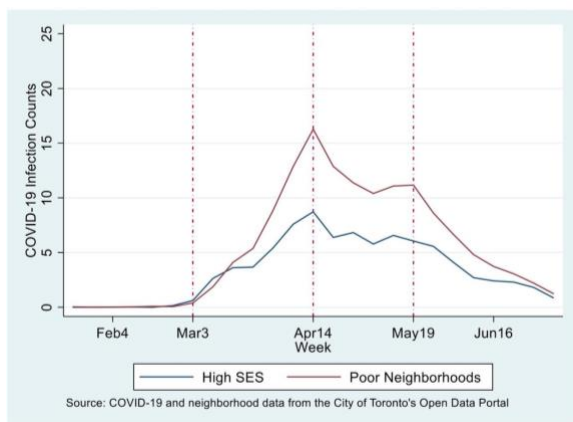


Figure 2: The City of Toronto COVID-19 Case Counts by Neighbourhood SES.

This graph displays neighbourhood-specific COVID-19 infections reported in the City of Toronto from January 2020 to July 2020, with neighbourhoods categorized by socioeconomic status (SES). Specifically, between April 2020 and June 2020, lower-income neighbourhoods suffered a greater proportion of COVID-19 cases than higher-income neighbourhoods. Note that 140 neighbourhoods in the City of Toronto were assessed (Choi & Denice, 2020).

Even prior to the pandemic, residents of lower-income neighbourhoods reported higher rates of unmet healthcare needs and more pre-existing conditions, making them more susceptible to severe COVID-19 outcomes (Choi & Denice, 2020). In addition, lower-income neighbourhoods are more likely to host long-term care facilities that house elderly members who are more susceptible to COVID-19 (Choi & Denice, 2020). Also, a higher proportion of lower-income neighbourhood residents are essential workers (Choi & Denice, 2020). Essential workers are defined as those whose occupations are considered essential towards maintaining life, health, and basic societal functioning, including but not limited to first responders, infrastructure workers, and essential good transporters (Government of Canada, 2021). These workers tend to receive lower wages, lack the option of remote work, and can have unclear labour rights that prevent them from receiving paid sick leave (Rao et al., 2021). Furthermore, lower-income neighbourhoods are found to be densely populated with fewer transit services; since most of these neighbourhoods are located on the city periphery, residents tend to have commutes of at least 60 minutes, increasing their risk of COVID-19 exposure (Choi & Denice, 2020). These residents were also less likely to perform COVID-19 testing at the start of the pandemic than individuals from higher-income neighbourhoods (Choi & Denice, 2020). The combination of these multiple factors can contribute to the increased

COVID-19 transmission observed in lower-income neighbourhoods.

Furthermore, after essential healthcare workers, Peel Region saw the highest proportion of cases among essential transportation and manufacturing workers (Region of Peel, 2021). This line of work involves many physical interactions between people, potentially increasing viral transmission risk (Murti et al., 2021). Likewise, assembly line set-ups in many warehouses make social distancing difficult (Murti et al., 2021). Job insecurity in these industries also pose the risk of COVID-19 test result falsification, impairing contact-tracing efforts (Berry & Weikle, 2020).

COVID-19 IMPACT ON SPECIFIC MINORITY GROUPS

GTA minority groups greatly impacted by COVID-19 include Indigenous peoples, racialized groups, immigrants and refugees, undocumented people, women, youth, LGBTQ2S (lesbian, gay, bisexual, trans and non-binary, queer, and Two-spirit) people, homeless and under-housed individuals, and the elderly (City of Toronto, 2021).

Toronto Public Health (TPH) conducted a longitudinal review from May 2020 to May 2021 and reported that members of racialized, Indigenous, immigrant, and refugee communities consistently had higher rates of COVID-19 infections (City of Toronto, 2021). The review highlights that racialized and immigrant communities are more likely to perform low-wage, front-line, and essential work, increasing their risk for COVID-19 (City of Toronto, 2021). For example, immigrant, Black, and Filipino, women were most likely to work in front-line health care and social assistance industries as nurse aides or orderlies (City of Toronto, 2021). Furthermore, COVID-19 outbreaks commonly occurred in food service industries of which the largest proportion of workers are Korean, Filipino, and Southeast Asian (City of Toronto, 2021).

A study conducted in 2020 which interviewed local community health leaders of racialized communities within the GTA, supports these findings (Ahmed et al., 2021). Interestingly, due to the precarious nature of many jobs worked by racialized groups, many of these individuals work multiple jobs, increasing their risk of COVID-19 exposure and transmission within their communities (Ahmed et al., 2021). Moreover,

Black communities showed reluctance to COVID-19 testing due to misunderstandings of how painful the test would be and fears of contracting the virus at the testing centre (Ahmed et al., 2021). Individuals who test positive for COVID-19 are obligated under the Canada Labour Code to take time off work to prevent transmission (Government of Canada, 2022). As such, Black communities report feeling worried about testing positive since the temporary loss of income could bring further financial difficulties (Ahmed et al., 2021). In fact, many racialized individuals lost their source of income during the pandemic yet did not qualify for CERB, exacerbating income inequality (Ahmed et al., 2021). Individuals who were unable to prove an income of \$5,000 CAD in the last 12 months or were unable to legally work in Canada were ineligible for CERB (Edmonds & Flahault, 2021). As such, individuals from disadvantaged Black and refugee communities, known to have low employment rates, report not qualifying for CERB (Ahmed et al., 2021; Edmonds & Flahault, 2021).

Similarly, Peel Region data as of October 2021 showed that 45% of all confirmed COVID-19 cases occurred in South Asian groups (Region of Peel, 2021). As mentioned, many of these individuals are essential transportation/distribution workers at a higher risk of contracting the virus (Berry & Weikle, 2020). It is also a cultural norm for South Asian families to have multi-generational homes, especially since there is a lack of culturally or linguistically appropriate long-term care homes for their elderly family members (Berry & Weikle, 2020). A study performed in England from March 2020 to November 2020 found that residing in a multi-generational household was associated with an increased risk of COVID-19 infection and death (Nafilyan et al., 2021).

Data also shows that the elderly are disproportionately impacted by COVID-19. Elderly individuals tend to have healthcare challenges due to high rates of multiple comorbidities, social isolation, low mobility, low health literacy, and limited internet access (Pirrie & Agarwal, 2021). Elderly individuals living in social housing often reside in apartment buildings with shared facilities, increasing disease exposure risk (Pirrie & Agarwal, 2021). A study within the GTA found that elderly individuals living in long-term care homes had a 64-fold higher chance of contracting COVID-19 than the general population (Wang et al., 2020).

Data also shows that homeless populations are disproportionately impacted by COVID-19. A 2020 North American review found that likely due to a high prevalence of medical comorbidities and a high proportion of individuals aged 65 years and up, homeless populations have significantly increased risks of developing severe COVID-19 (Perri et al., 2020). A study within the GTA found that individuals using shelters had a 19-fold higher chance of contracting COVID-19 than the general population (Wang et al., 2020).

The previously mentioned TPH review also highlights the social and economic impacts of the pandemic on minority groups. Indigenous peoples, immigrants, and racialized groups reported lower life satisfaction, poor mental health, unemployment, financial difficulties, and experiences of racism (City of Toronto, 2021). Specifically, a notable increase in hate crimes towards East and Southeast Asian communities in Toronto was observed during the pandemic due to the geographical origin of the disease (Toronto Police Service, 2022). Women were more likely to face unemployment and wage losses than men due to childcare and school closures (City of Toronto, 2021). LGBTQ2S individuals reported increased social isolation, financial difficulties, and housing insecurity, with some having to change housing and live with members unsupportive of their gender identity (City of Toronto, 2021).

GOVERNMENT ACTION

COVID-19 posed a great challenge for the government to integrate scientific research and respond with effective measures to prevent disease transmission. As a result, strict public health measures by means of social distancing and lockdowns were implemented. These included travel bans, school closures, remote work, cancellation of mass gatherings, and closures of non-essential businesses (Brankston et al., 2021). For example, the Government of Ontario issued and amended stay-at-home orders in January and April of 2021 that made it illegal to leave one's residence except for reasons deemed 'essential' (Tsekouras, 2021).

A study conducted in May 2020 surveyed Canadians on their perceptions of the implemented public health measures (Brankston et al., 2021). They found that younger age groups, individuals in the paid workforce, and those with lower incomes were less confident in their ability to comply with public health measures in

comparison to the general population (Brankston et al., 2021). Also, individuals with lower education or income were less likely to receive paid sick leave, increasing their risk of presenteeism, or attending work while sick (Brankston et al., 2021). With school closures, the survey found that individuals with dependent children performed childcare while maintaining their employment, making self-isolation when ill difficult (Brankston et al., 2021). The overall perceived ability to comply with public health measures was high; however, these measures were not feasible for all groups (Brankston et al., 2021).

To determine if public health measures in the GTA were effective in containing the spread, a study conducted from March 2020 to March 2021 used epidemiologic and Google mobility data (Dainton & Hay, 2021). The study established that increased mobility was correlated with increased disease spread; however, the increased public health restrictions within the GTA were found to have inconsistent impacts on this mobility (Dainton & Hay, 2021). Therefore, the public health restrictions yielded a small decrease in COVID-19 transmission, though the researchers warn to interpret these findings with caution considering the role of confounding variables (Dainton & Hay, 2021).

Similarly, another Canadian review published in December 2020 notes that in comparison to other countries, Canada's COVID-19 response was delayed and lacking (Yu et al., 2020). For instance, Ontario went into lockdown and incorporated masking policies days after international health organizations announced COVID-19 as a worldwide pandemic and recommended wearing face masks as a preventative measure (Yu et al., 2020). Also, public health experts agree that vigorous testing and close transmission monitoring can greatly reduce viral spread; however, Canada's COVID-19 testing was initially limited due to a shortage of supplies and poor logistics (Yu et al., 2020). For example, even weeks after the start of the pandemic when mobile testing appeared, it was observed that in the GTA, non-racialized neighbourhoods received these testing accommodations far in advance of racialized neighbourhoods (Ahmed et al., 2021). Considering the higher risk of transmission within racialized neighbourhoods, community leaders believe this incident is evidence of systemic discrimination and neglect (Ahmed et al., 2021). Other reported evidence of Canada's lack of preparation for the pandemic included negligence of long-term care homes, insufficient medical resources, ineffective

public communication, and underfunding of biomedical research (Yu et al., 2020). Researchers speculate that earlier interventions of mass school closures, international border closures, and testing and tracing protocols could have made larger strides in reducing viral transmission; however, data on this is still being collected (Yu et al., 2020).

In addition to the response of the federal government, GTA municipal governments have attempted to respond to COVID-19 inequities. For example, the City of Toronto has been collaborating with other institutions to improve access to COVID-19 testing, provide extra support for those who need to self-isolate, and share public health information and supplies (City of Toronto, 2021). They have set up programs to address socio-economic challenges during COVID-19, including food programs, mental health services, and anti-racism campaigns (City of Toronto, 2021). They have also advocated for paid sick leave, housing, and income supports (City of Toronto, 2021). In the Peel region, a website was developed for homeless individuals with COVID-19 to help them isolate while receiving health and social support (Perri et al., 2020). Peel Public Health has further advocated for better worker protections, better workplace inspections, paid sick leave, and rental and eviction protection (Berry & Weikle, 2020).

VACCINE DISTRIBUTION

Many public health experts have noted that the equitable distribution of COVID-19 vaccines is key to ending the pandemic (Choi et al., 2021). A study conducted from April 2021 to June 2021 explored COVID-19 vaccination rates in the city of Toronto (Choi et al., 2021). In mid-April 2021, it was found that vaccination rates were initially lower in neighbourhoods with higher COVID-19 rates (Choi et al., 2021). Certain sociodemographic factors were also associated with these differences in vaccination rates (Choi et al., 2021). For instance, neighbourhoods with greater proportions of college graduates, essential workers, and the elderly were found to have higher initial vaccination rates, while those with greater proportions of immigrants and Indigenous individuals had lower initial vaccination rates, with immigrants specifically showing slow growth in vaccine uptake (Choi et al., 2021). Overall, vaccination rates were initially lower in neighbourhoods with high shares of lower-income individuals, racialized groups, immigrants,

essential workers, and people living in crowded housing (City of Toronto, 2021).

Lower initial vaccination rates can be partially explained by the initial limited vaccine supply (Choi et al., 2021). As vaccine supply increased after mid-April, municipal governments prioritized vaccinations in racialized communities with higher COVID-19 case counts (Choi et al., 2021). Over time, although most neighbourhoods had equally high vaccination rates, neighbourhoods with high COVID-19 case counts initially continued to have high COVID-19 case counts (Choi et al., 2021). Likewise, an Ontario-wide study completed in April 2021 found that although vaccination rates were similar across all Ontario neighbourhoods, this did not meet the needs of specific neighbourhoods to bring COVID-19 case counts down to a safe level (Iveniuk & Leon, 2021). The GTA especially was noted to have persisting inequities as neighbourhood poverty, racialization, and COVID-19 rates were negatively associated with vaccination rates (Iveniuk & Leon, 2021). This study suggests that the GTA has been unsuccessful in providing an equitable distribution of vaccines despite its attempt to reallocate vaccines to COVID-19 hotspots (Iveniuk & Leon, 2021). This is likely a result of multiple social and institutional factors such as a lack of facilities to administer vaccines in high-burden areas, insufficient public health messaging, delays in vaccine supply rollout, and lack of communication with healthcare professionals (Iveniuk & Leon, 2021). Therefore, achieving true vaccine equity may require action on part of a finer understanding of social and institutional systems (Iveniuk & Leon, 2021).

The City of Toronto has since tried to address vaccine inequities by spreading awareness on vaccinations personalized for certain minority groups (City of Toronto, 2021). The city has also organized pop-up vaccine clinics in hotspots, assisted with transportation services to clinics, and provided dedicated clinics for people with disabilities and on-site clinics for homeless shelters (City of Toronto, 2021).

DISCUSSION

The current landscape of literature related to GTA COVID-19 hotspots has highlighted several main takeaways. Firstly, the geographical analysis of

COVID-19 hotspots in the GTA demonstrates an unequal disease burden. To further explore this, researchers assessed the contribution of sociodemographic and socioeconomic factors to COVID-19 rates.

Studies on such factors highlighted that COVID-19 hotspots include individuals of vulnerable sociodemographic groups (i.e., elderly, children, minority groups) and lower SES (Choi & Denice, 2020). A number of potential hotspots were identified as lower-income neighbourhoods, which are home to essential workers, multiple long-term care homes, and poor public transit systems (Choi & Denice, 2020). This suggests how the poor infrastructure of municipalities might contribute to increased disease transmission.

Pre-pandemic inequities have contributed to the further disadvantage of minority groups during the pandemic. Lower SES associated with minority groups has contributed to their increased COVID-19 susceptibility (City of Toronto, 2021). Social and economic impacts of COVID-19 on minority groups have included unemployment, increased poverty, housing instability, food insecurity, poor mental health, isolation, lack of childcare, experiences of racism, and other forms of discrimination (City of Toronto, 2021).

Furthermore, studies have shown that the Canadian government and its municipalities were unprepared to handle COVID-19. For instance, certain public health guidelines were delayed, ineffective, and/or not feasible for particular vulnerable groups (Yu et al., 2020; Dainton & Hay, 2021; Brankston et al., 2021). Government negligence is speculated to have exacerbated the expected impacts of the pandemic (Yu et al., 2020). Even still, municipalities still attempted to address COVID-19 inequities with specialized community programs (City of Toronto, 2021).

Lastly, vaccine inequities were observed throughout the GTA despite attempts to reallocate vaccine supplies to hotspots. Although vaccination rates were similar throughout all neighbourhoods, COVID-19 case counts in hotspots were not reduced to safe levels (Iveniuk & Leon, 2021). This suggests that the influence of systemic social issues maintain the prevalence of hotspots (Iveniuk & Leon, 2021). However, since the initial roll-out of vaccines, municipalities have undertaken initiatives to particularly increase vaccine access to minority and vulnerable groups (City of Toronto, 2021).

LIMITATIONS

This review has limitations due to gaps in the available literature. It is difficult to make comparisons between GTA regions as case count data is not represented in a standardized method. The City of Toronto maps case counts within neighbourhoods, whereas other GTA regions map case counts within variably broader regions. This prevents a thorough understanding of how the interaction between GTA communities contributes to COVID-19 spread. Furthermore, most studies on the impact of COVID-19 in the GTA are cross-sectional or involve relatively short time periods. This provides only a narrow perception of what is a rapidly evolving situation. Also, many studies exploring the social determinants of health lack specific information on factors such as race, immigration, undocumented status, disability, and sexual orientation (City of Toronto, 2021). Having this information would enable a better sociodemographic analysis of COVID-19's impact. Moreover, much of the available peer-reviewed literature focuses on the City of Toronto

without much consideration of other GTA regions. For instance, while grey literature on the Region of Peel is available, there is limited peer-reviewed information. Future research should aim to make standardized comparisons of COVID-19 cases over a longer time period while considering various social factors.

CONCLUSION

This literature review highlights the differential impact of COVID-19 on GTA communities. The observed unequal burden of COVID-19 demonstrates such inequities within the GTA. To bring this pandemic to an end, policymakers should consider various social factors to implement equitable changes.

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REFERENCES

- Ahmed, R., Jamal, O., Ishak, W., Nabi, K., & Mustafa, N. (2021). Racial equity in the fight against COVID-19: A qualitative study examining the importance of collecting race-based data in the Canadian context. *Tropical Diseases, Travel Medicine and Vaccines*, 7(1), 15. doi: 10.1186/s40794-021-00138-2
- Berry, S., & Weikle, B. (2020). *Covid-19 hotspot Brampton, ont., chronically underfunded in community health services, local advocate says* | CBC Radio. Retrieved November 6, 2021, from <https://www.cbc.ca/radio/whitecoat/covid-19-hotspot-brampton-ont-chronically-underfunded-in-community-health-services-local-advocate-says-1.5823815>.
- Biglieri, S., De Vidovich, L., & Keil, R. (2020). City as the core of contagion? Repositioning COVID-19 at the social and spatial periphery of urban society. *Cities & Health*, 0(0), 1–3. doi: 10.1080/23748834.2020.1788320
- Brankston, G., Merkle, E., Fisman, D. N., Tuite, A. R., Poljak, Z., Loewen, P. J., & Greer, A. L. (2021). Socio-demographic disparities in knowledge, practices, and ability to comply with COVID-19 public health measures in Canada. *Canadian Journal of Public Health*, 112(3), 363–375. doi: 10.17269/s41997-021-00501-y
- Choi, K. H., & Denice, P. A. (2020). Neighborhood SES and the COVID-19 Pandemic. *SocArXiv*. doi: 10.31235/osf.io/3xg5q
- Choi, K. H., Denice, P. A., & Ramaj, S. (2021). *Vaccine and COVID-19 Trajectories*. *Socius*, 7, 23780231211052944. doi: 10.1177/23780231211052946
- Ciotti, M., Ciccozzi, M., Terrinoni, A., Jiang, W. C., Wang, C. B., & Bernardini, S. (2020). The COVID-19 pandemic. *Critical reviews in clinical laboratory sciences*, 57(6), 365–388. doi: 10.1080/10408363.2020.1783198
- City of Toronto. (2021). *Covid-19: Pandemic data*. Retrieved October 6, 2021, from <https://www.toronto.ca/home/covid-19/covid-19-pandemic-data/>.
- Dainton, C., & Hay, A. (2021). Quantifying the relationship between lockdowns, mobility, and effective reproduction number (Rt) during the COVID-19 pandemic in the Greater Toronto Area. *BMC public health*, 21(1), 1658. doi: 10.1186/s12889-021-11684-x
- Edmonds, J., & Flahault, A. (2021). Refugees in Canada during the first wave of the COVID-19 pandemic. *International Journal of Environmental Research and Public Health*, 18(3), 947. doi: 10.3390/ijerph18030947
- Government of Canada. (2019). *Canada's Health Care System*. Retrieved June 5, 2022, from <https://www.canada.ca/en/health-canada/services/health-care-system/reports-publications/health-care-system/canada.html>
- Government of Canada. (2021). Guidance on essential services and functions in Canada during the COVID-19 pandemic. *Public Safety Canada*. Retrieved August 9, 2022, from <https://www.publicsafety.gc.ca/cnt/ntnl-scrtr/crtcl-nfrstrct/esf-sfe-en.aspx>
- Government of Canada (2022). *Coronavirus disease (COVID-19): Employee illness and leave requests*. Retrieved August 9, 2022, from <https://www.canada.ca/en/government/publicservice/covid-19/employee-illness-leave.html>
- Halton Region. (2021). *Status of covid-19 cases in Halton*. Retrieved October 6, 2021, from <https://www.halton.ca/For-Residents/New-Coronavirus/Status-of-COVID-19-Cases-in-Halton>
- Hamidi, S., Sabouri, S., & Ewing, R. (2020). Does density aggravate the COVID-19 pandemic? *Journal of the American Planning Association*, 86(4), 495–509. doi: 10.1080/01944363.2020.1777891
- Iveniuk, J., & Leon, S. (2021). *An uneven recovery: Measuring COVID-19 vaccine equity in Ontario*. <https://www.wellesleyinstitute.com/publications/covid-19-vaccine-equity/>
- Lessler, J., Azman, A. S., McKay, H. S., & Moore, S. M. (2017). What is a Hotspot Anyway?. *The American journal of tropical medicine and hygiene*, 96(6), 1270–1273. doi: 10.4269/ajtmh.16-0427
- Lo, L., Preston, V., Anisef, P., Basu, R., & Wang, S. (2018). Social Infrastructure and Vulnerability in the Suburbs. Toronto: *University of Toronto Press*. doi: 10.3138/9781442622630
- McKenzie, K. (2021). Socio-demographic data collection and equity in covid-19 in Toronto. *EClinicalMedicine*, 34. doi: 10.1016/j.eclinm.2021.100812
- Mishra, S., Ma, H., Moloney, G., Yiu, K. C. Y., Darvin, D., Landsman, D., Kwong, J. C., Calzavara, A., Straus, S., Chan, A. K., Gourmiz, E., Rilkoff, H., Xia, Y., Katz, A., Williamson, T., Malikov, K., Kustra, R., Maheu-Giroux, M., Sander, B., & Baral, S. D. (2021). Increasing concentration of COVID-19 by socioeconomic determinants and geography in Toronto, Canada: An observational study. *Annals of Epidemiology*. doi: 10.1016/j.annepidem.2021.07.007
- Mueller, A. L., McNamara, M. S., & Sinclair, D. A. (2020). Why does COVID-19 disproportionately affect older people?. *Aging (albany ny)*, 12(10), 9959. doi: 10.18632/aging.103344
- Nafilyan, V., Islam, N., Ayoubkhani, D., Gilles, C., Katikireddi, S. V., Mathur, R., ... & Khunti, K. (2021). Ethnicity, household composition and COVID-19 mortality: a national linked data study. *Journal of the Royal Society of Medicine*, 114(4), 182–211. doi: 10.1177/20210141076821999973
- Perri, M., Dosani, N., & Hwang, S. W. (2020). COVID-19 and people experiencing homelessness: Challenges and mitigation strategies. *CMAJ*, 192(26), E716–E719. doi: 10.1503/cmaj.200834
- Pirrie, M., Agarwal, G. (2021) Older adults living in social housing in Canada: the next COVID-19 hotspot?. *Can J Public Health*, 112, 4–7. doi: 10.17269/s41997-020-00462-8
- Rao, A., Ma, H., Moloney, G., Kwong, J. C., Jüni, P., Sander, B., Kustra, R., Baral, S. D., & Mishra, S. (2021). A disproportionate epidemic: COVID-19 cases and deaths among essential workers in Toronto, Canada. *Annals of epidemiology*, 63, 63–67. doi: 10.1016/j.annepidem.2021.07.010
- Region of Durham. (2021). *Case status in Durham Region*. Retrieved October 6, 2021, from <https://www.durham.ca/en/shared-content/covid-19-durham-region-case-status.aspx>
- Region of Peel. (2021). *Profile of covid-19 cases*. Retrieved October 6, 2021, from <https://data.peelregion.ca/documents/RegionofPeel::profile-of-covid-19-cases/explore>
- Shariati, M., Mesgari, T., Kasraee, M., & Jahangiri-rad, M. (2020). Spatiotemporal analysis and hotspots detection of COVID-19 using geographic information system (March and April, 2020). *Journal of Environmental Health Science and Engineering*, 18(2), 1499–1507. doi: 10.1007/s40201-020-00565-x
- St-Denis, X. (2020). Sociodemographic determinants of occupational risks of exposure to COVID-19 in Canada. *Canadian Review of Sociology/Revue Canadienne de Sociologie*, 57(3), 399–452. doi: 10.1111/CARS.12288
- Toronto Global. (2021). *Toronto Region*. [Image]. Retrieved December 11, 2021, from <https://torontoglobal.ca/where-to-find-us>.
- Toronto Police Service. (2022). *2021 Hate/Bias Crime Statistical Report*. Retrieved June 7, 2022, from <https://www.tps.ca/services/resource-centre/2021-hatebias-crime-statistical-report/>
- Tsekouras, P. (2021). *What happens after Ontario's stay-at-home order ends today?* Toronto. Retrieved November 6, 2021, from <https://toronto.ctvnews.ca/what-happens-after-ontario-s-stay-at-home-order-ends-today-1.5449779>.
- Vaz, E. (2021). COVID-19 in Toronto: A Spatial Exploratory Analysis. *Sustainability*, 13(2), 498. doi: 10.3390/su13020498
- Wang, L., Ma, H., Yiu, K. C. Y., Calzavara, A., Landsman, D., Luong, L., Chan, A. K., Kustra, R., Kwong, J. C., Boily, M.-C., Hwang, S., Straus, S., Baral, S. D., & Mishra, S. (2020). Heterogeneity in testing, diagnosis and outcome in SARS-CoV-2 infection across outbreak settings in the Greater Toronto Area, Canada: An observational study. *Canadian Medical Association Open Access Journal*, 8(4), E627–E636. doi: 10.9778/cmaj.20200213
- World Health Organization. (2020). *Impact of covid-19 on people's livelihoods, their health and our Food Systems*. Retrieved May 5, 2022, from <https://www.who.int/news/item/13-10-2020-impact-of-covid-19-on-people-s-livelihoods-their-health-and-our-food-systems>
- York Region. (2021). *Covid-19 in York Region*. Retrieved October 6, 2021, from https://www.york.ca/wps/portal/yorkhome/health/yr/ut/p/z1/jY2xCSlwGISfXSF4LzE2cQxVvmz8dIhtzVlySUCrg_j8inRxxMhJbwXf3UaSB4pSe-Zwe-Taly7ufYjWYbdi5Fj4oU8MiWC-1wXYtqP8A-BELiv_sCOAs3_cUvxXNwShw57XtRIDi5QxIqSonani4YMA7vV9tjBN05QwUJpfrUDmxQvv--mB/dz/d5/L2dBISEvZ0FBIS9nQSEh/#.YbWJUvHMI11
- Yu, A., Prasad, S., Akande, A., Murariu, A., Yuan, S., Kathirkamanathan, S., Ma, M., & Ladha, S. (2020). COVID-19 in Canada: A self-assessment and review of preparedness and response. *Journal of global health*, 10(2), 0203104. doi: 10.7189/jogh.10.0203104