Public Health Ontario | Santé publique Ontario

SYNTHESIS

12/2/2020

Public Transport and COVID-19 – What We Know So Far

Introduction

Public Health Ontario (PHO) is actively monitoring, reviewing and assessing relevant information related to Coronavirus Disease 2019 (COVID-19). "What We Know So Far" documents are intended to provide a rapid review of the evidence related to a specific aspect or emerging issue related to COVID-19.

Key Findings

- In the early days of the COVID-19 pandemic, reductions in the use of public transportation as a strategy to reduce the spread of the infection were implemented across Canada, particularly in major cities such as Toronto.
- Overall, the evidence on the risk of COVID-19 infection during use of public transportation is mixed. Given the small number of included studies, the heterogeneity of study designs, how data were analysed, as well as the variability in results, it is difficult to draw conclusions on the risk of COVID-19 infection with use of public transport.
- The majority of studies included here reported on COVID-19 infection and public transport use in the early weeks and months of the pandemic; therefore, consideration on the risk of infection when using public transport with public health measures in place such as mask-wearing, were not considered.
- Several sources such as the World Health Organization (WHO) and the United States (US) Centers for Disease Control and Prevention (CDC) provide guidance for safe use of public transportation in the context of COVID-19.
- Future studies should evaluate the risk of COVID-19 infection with consideration of the social determinants of health. One study in this review found that areas of lower median income, those with a greater percentage of non-white and/or Hispanic/Latino, essential workers and healthcare workers reported more subway use during the pandemic. This warrants future study of the increased risk to these populations.

Background

The scientific evidence to date reports that the primary mode of transmission of COVID-19 is through direct, unprotected contact with respiratory droplets from an infected individual.[1] The evidence surrounding transmission via infectious aerosols suggests that infection may occur under certain circumstances, such as where there is suboptimal ventilation; however, this mechanism of spread is less common. Evidence on confirmed cases of transmission through contact with fomites (i.e., COVID-19 infection due to contact with a contaminated object) is sparse;[1] however, this mechanism of transmission is assumed to occur. The evidence suggests that a droplet can travel anywhere from 2 metres and up to 8 metres.[1] During the first wave period of lockdown in Ontario, several public health measures were introduced to slow the spread of COVID-19.This included physical distancing; the closure of schools, recreational facilities, entertainment/arts venues, and indoor and outdoor amenities; and strong advice to work-from-home.[2] This also included limiting the number of available public transport vehicles. As a result of these measures, the Toronto Transit Commission (TTC) reported that ridership declined by 71% between March 8th and 31st, 2020.[3] Jurisdictions including Ontario are balancing the need to maintain essential services such as public transportation, while reducing the risk of COVID-19 infection.

The quantitative risk of infection of COVID-19 when using public transportation is still largely unknown. However, understanding the risk to users is important to inform policies to reduce the spread of the disease. Given the ongoing need for use of public transportation as an essential service, particularly in populations at greater risk of COVID-19 infection (e.g., essential workers, communities without access to personal vehicles or parking),[4] summaries of the evidence on the risk for COVID-19 when using public transportation and preventive measures is needed.

This document examines the state of evidence on the risk of COVID-19 infection related to the use of public transport. This scope is limited to risk associated with public buses, subways, light rails, speed rails, and rail cars – and does not include literature on transmission associated with cruise ships, school-related transportation or air travel.

Methods

The development of "What We Know So Far" (WWKSF) documents includes a systematic search of the published literature as well as scientific grey literature (e.g., ProMED, CIDRAP, Johns Hopkins Situation Reports) and media reports, where appropriate. Relevant results are reviewed and data extracted for synthesis. All WWKSF documents are reviewed by PHO subject matter experts before posting.

To identify relevant evidence on this topic, systematic searches in MEDLINE, Embase, CINAHL and Scopus databases were conducted on September 9th, 2020 by PHO Library Services. A grey literature search was conducted for the websites of key organizations (e.g., WHO, CDC) on September 15th, 2020. As the literature in this area is evolving rapidly, as well as to provide background information, we included all study designs and reports on this topic. We completed a hand search of all reference lists of included articles. Two reviewers screened all titles and abstracts. Any need for clarification was discussed among the two reviewers.

As the COVID-19 outbreak continues to evolve and the scientific evidence expands, the information provided in these documents is only current as of the date of posting.

Public Transport and COVID-19 Infection

A search of the peer-reviewed literature on the risk of COVID-19 infection with the use of public transport identified a total of 479 articles. After all peer-reviewed titles and abstracts were screened by two independent reviewers, a total of seven articles that reported on the risk of COVID-19 infection to individuals using public transport were included.[4-10] Two of the nine peer-reviewed articles were found from the grey literature search.[6,10] A total of eight reports from the grey literature search that summarized recommendations for safe use of public transport were also included.[11-18]

Overall, the majority of studies took place in Wuhan, China or neighbouring provinces (4 studies).[5,8-10] One study reviewed data from India,[7] one study from the US,[4] and one study examined COVID-19 incidence rates in 149 different countries.[6] All studies reviewed cases early in the pandemic, during times of quarantine or lockdown. Given the small number of included studies, the heterogeneity of study designs, how data were analysed, as well as the variability in results, this synthesis reports results for each study included, by study location.

Studies from China (Four studies)

Hu et al. quantified the risk of COVID-19 infection on high-speed train passengers in China using data from 2,334 index patients (i.e., the first identified case in a group of related cases of COVID-19) and 72,093 close contacts who shared travel times.[5] The authors estimated that from December 19, 2019 to March 6, 2020, the COVID-19 attack rate in train passengers on seats within a distance of three rows and five columns from the index patient varied from 0 to 10.3% (95% confidence interval [CI]: 5.3-19%) with a mean of 0.3% (95% CI: 0.29-0.37%).[5] Passengers with seats in the same row (including adjacent to the index case) had an average attack rate of 1.5% (95%CI: 1.3-1.8%), higher than in other rows (0.14%, 95%CI: 0.11-0.17%).[5] The relative risk (RR) of infection in these cases was 11.2 times higher compared to other rows (95% CI: 8.6-14.6).[5] Travellers adjacent to the index patient had the highest attack rate of all seats in the train (3.5%, 95% CI: 2.9-4.3%; RR=18.0, 95%CI: 13.9-23.4).[5] The attack rate decreased with increasing distance, but also increased with increased travel time in the train car. The attack rate increased on average by 0.15% (p=0.005) per hour of co-travel; for adjacent passengers, the increase was 1.3% (p=0.08), the highest of all seats.[5] The authors of this paper suggest that public transport passengers in confined spaces might need to improve personal hand hygiene and use face masks to reduce the risk of COVID-19 infection.[5]

Shen et al., compared the number of cases of COVID-19 reported from 128 individuals that travelled on two buses out of Zhejiang province in China to an organized event, a total of 100 minutes of bus travel.[9] One traveller on one of the buses was an index case of COVID-19. On the bus with the index case, 24 of the 68 individuals (35.3% [including the index patient]) travelling on the bus tested positive for COVID-19 after attending the event.[9] Travellers on this bus were reported to have a 34.3% (95% CI: 24.1%-46.3%) higher absolute risk of COVID-19 infection compared with travellers on the other bus.[9] Within the index case's bus, individuals in high-risk zones (i.e., seating in areas close to the index case) had moderately, but non-significantly, higher risk for COVID-19 compared with those in the low-risk zones.[9] Authors of this study speculate that due to the closed environment within the index case bus, and the use of air recirculation, transmission via infectious aerosols was possible.[9]

Luo et al. used a prospective cohort study design to examine the secondary attack rate of COVID-19 infection among 3,410 close contacts on public transport in Guangzhou, China. Of the 3,410 close contacts of an index case, 3.7% (95% CI: 3.1%-4.4%) were infected.[8] Compared with a household setting (10.3%, derived from the study), the secondary attack rate was lower for exposure on public transportation (0.1%; OR=0.01, 95%CI: 0.00-0.08).[8]

The study by Zhao et al., reported a significant association between travel by train from Wuhan, China and the number of COVID-19 cases in six destination cities; however, no associations with other means of transportation were found (bus and car).[10] This study estimated that a 10-fold increase in the average number of train passengers from Wuhan would be associated with a statistically significant, 8-fold increase in the number of cases of COVID-19 in destination cities (8.27, 95%CI: 0.35, 16.18).[10]

Studies from Other Countries (Three studies)

The study by Krishnamurthy et al. used a probabilistic model to examine the transmission of COVID-19 during train travel from a single index case, across four districts in India. They found a higher probability of acquiring infection in a closed compartment train car (i.e., "ladies compartment") compared to an open compartment train (0.11 vs. 0.07).[7] Further, when examining infection rates in train travel to bus travel (both with 50% occupancy), there was a higher probability of infection in buses, compared to trains (0.19 vs. 0.07).[7]

A study by Sy et al. estimated the association of COVID-19 infection with subway use in the early days of the pandemic in New York City in the US. At baseline, areas of lower median income, greater percentage of non-white and/or Hispanic/Latino, essential workers and healthcare workers used the subway more during the pandemic.[4] When adjusted for COVID-19 testing effort, there was a higher rate of COVID-19 per 100,000 population with increased subway use.[4] This association; however, was reduced with adjustment for median income (from RR=1.11, 95% CI: 1.03-1.19 to 1.06, 95% CI: 1.00-1.12).[4] All socioeconomic status variables were related to the rate of positive cases when adjusted for testing effort and income, with the strongest association in essential workers (RR=1.59, 95%CI: 1.36-1.86).[4]

In the study by Islam et al., the authors examined the implementation of any physical distancing measure on the incidence of COVID-19, across 149 countries using daily COVID-19 count data. The results of this study suggest that on average, the implementation of any physical distancing intervention was associated with a 13% overall reduction in COVID-19 incidence (incidence RR=0.87, 95% CI: 0.85-0.89).[6] When examining the closure of public transport specifically, the authors report no further reduction in COVID-19 incidence when four other physical distancing interventions were in place (i.e., school closures, workplace closures, restrictions on mass gatherings and lockdown measures). They report a 15% reduction in COVID-19 incidence with the closure of public transport (Pooled IRR=0.85, 95% CI: 0.82-0.88; n=72) and a 13% reduction in COVID-19 incidence without (Pooled IRR=0.87, 95% CI: 0.84-0.91; n=32).[6] In terms of sequence of interventions, earlier implementation of lockdown was associated with a larger reduction in COVID-19 incidence (Pooled IRR=0.86, 95% CI: 0.84-0.89; n=105) compared with a delayed implementation of lockdown after other physical distancing interventions were in place (Pooled IRR=0.90, 95%CI: 0.87-0.94; n=41).[6]

Recommendations to reduce the risk of transmission on public transport vehicles

There were several recommendations to reduce the risk of COVID-19 transmission with public transport use from reports found from the grey literature search[11-18] as well as from sections of the studies reported in this WWKSF. The majority of documents recommend the following:

- Physical distancing of both passengers and workers (i.e., maintaining a distance of at least two metres from others; preventing crowding in boarding and off-boarding areas; installing physical barriers for both passengers and workers where physical distancing cannot be established; reducing the capacity of riders on vehicles to ensure space between passengers; and restricting passenger flow on vehicles that include front vehicle on-boarding and back of vehicle off-boarding).

- Hand hygiene (i.e., using hand sanitizer when boarding and off-boarding public transport vehicles).
- Informing users and workers on the signs and symptoms of COVID-19 and advising passengers and workers to avoid public transport when symptomatic.
- Use of face masks or coverings for both passengers and workers when on public transportation or areas of boarding and off-boarding; ensuring proper ventilation in vehicles, adapted for local conditions (e.g., use of windows and skylights, maintenance and/or replacement of air filtration systems when necessary).
- Frequent cleaning and disinfecting of frequently touched areas and surfaces (e.g., vehicles, areas of boarding and off boarding, public restrooms, areas of payment where contact-less payment cannot be provided).
- Two reports were found that provided recommendations specific to the use of ride-share or other vehicle for hire services. This included the CDC and Transport Scotland.[11,13] Recommendations include avoiding riding with unmasked drivers or passengers, where possible; touching surfaces within the vehicle; limiting the number of passengers in the vehicle to only those necessary; and practicing hand hygiene.[11,13]

References

1. Ontario Agency for Health Protection and Promotion (Public Health Ontario). COVID-19 routes of transmission – what we know so far [Internet]. Toronto, ON: Queen's Printer for Ontario; 2020 [cited 2020 Dec 02]. Available from: https://www.publichealthontario.ca/-/media/documents/ncov/wwksf-routes-transmission-mar-06-2020.pdf?la=en

2. Canadian Institutes for Health Information (CIHI). COVID-19 intervention scan [Internet]. Ottawa, ON: CIHI; 2020 [cited 2020 Nov 04]. Available from: https://www.cihi.ca/en/covid-19-intervention-scan

3. Bubbers M. In Canada and cities around the world, rush-hour traffic plummets as people respond to the COVID-19 pandemic. Globe and Mail [Internet], 2020 Mar 24 [cited 2020 Nov 11]; Mobility. Available from: https://www.theglobeandmail.com/drive/mobility/article-rush-hour-traffic-plummets-as-people-respond-to-the-covid-19-pandemic/

4. Sy KTL, Martinez ME, Rader B, White LF. Socioeconomic disparities in subway use and COVID-19 outcomes in New York City. medRxiv 20115949 [Preprint]. 2020 May 30 [cited Dec 02]. Available from: https://doi.org/10.1101/2020.05.28.20115949

5. Hu M, Lin H, Wang J, Xu C, Tatem AJ, Meng B, et al. Risk of coronavirus disease 2019 transmission in train passengers: an epidemiological and modeling study. Clin Infect Dis. 2020 Jul 29 [Epub ahead of print]. Available from: https://doi.org/10.1093/cid/ciaa1057

6. Islam N, Sharp SJ, Chowell G, Shabnam S, Kawachi I, Lacey B, et al. Physical distancing interventions and incidence of coronavirus disease 2019: natural experiment in 149 countries. BMJ. 2020;370:m2743. Available from: https://doi.org/10.1136/bmj.m2743

7. Krishnamurthy K, Ambikapathy B, Kumar A, Britto L. Prediction of the transition from subexponential to the exponential transmission of SARS-CoV-2 in Chennai, India: epidemic nowcasting. JMIR Public Health Surveill. 2020;6(3):e21152. Available from: https://doi.org/10.2196/21152

8. Luo L, Liu D, Liao X, Wu X, Jing Q, Zheng J, et al. Contact settings and risk for transmission in 3410 close contacts of patients with COVID-19 in Guangzhou, China: a prospective cohort study. Ann Intern Med. 2020;173(11):879-87. Available from: https://doi.org/10.7326/m20-2671

9. Shen Y, Li C, Dong H, Wang Z, Martinez L, Sun Z, et al. Community outbreak investigation of SARS-CoV-2 transmission among bus riders in Eastern China. JAMA Intern Med. 2020;180(12):1665-71. Available from: https://doi.org/10.1001/jamainternmed.2020.5225

10. Zhao S, Zhuang Z, Ran J, Lin J, Yang G, Yang L, et al. The association between domestic train transportation and novel coronavirus (2019-nCoV) outbreak in China from 2019 to 2020: a data-driven correlational report. Travel Med Infect Dis. 2020;33:101568. Available from: https://doi.org/10.1016/j.tmaid.2020.101568

11. Centers for Disease Control and Prevention. COVID-19 (coronavirus disease): protect yourself when using transportation: public transit, rideshares and taxis, micro-mobility devices, and

personal vehicles [Internet]. Atlanta, GA: Centers for Disease Control and Prevention; 2020 [modified 2020 Nov 27; cited 2020 Dec 02]. Available from: https://www.cdc.gov/coronavirus/2019-ncov/daily-life-coping/using-transportation.html#PublicTransit

12. Ontario. Ministry of Transportation. Guidance for public transit agencies and passengers in response to COVID-19 [Internet]. Ottawa, ON: Queen's Printer for Ontario; 2020 [cited 2020 Dec 02]. Available from: https://files.ontario.ca/mto-guidance-public-transit-agencies-and-passengers-covid-19-en-2020-06-11-v3.pdf

13. Transport Scotland. Advice on how to travel safely [Internet]. Glasgow: Transport Scotland; 2020 [cited 2020 Nov 04]. Available from: https://www.transport.gov.scot/coronavirus-covid-19/transport-transition-plan/advice-on-how-to-travel-safely/#overview

14. United Kingdom. Department for Transport. Coronavirus (COVID-19): safer transport guidance for operators [Internet]. London: Crown Copyright; 2020 [cited 2020 Nov 04]. Available from: https://www.gov.uk/government/publications/coronavirus-covid-19-safer-transport-guidance-for-operators/coronavirus-covid-19-safer-transport-guidance-for-operators

15. European Centre for Disease Prevention and Control (ECDC). Considerations for infection prevention and control measures on public transport in the context of COVID-19 [Internet]. Stockholm: ECDC; 2020 [cited 2020 Dec 02]. Available from: https://www.ecdc.europa.eu/sites/default/files/documents/COVID-19-public-transport-29-April-2020.pdf

16. Canadian Urban Transit Association. COVID-19: guidance for the public transit industry [Internet]. Toronto, ON: Canadian Urban Transit Association; 2020 [cited 2020 Nov 04]. Available from: https://cutaactu.ca/en/content/covid-19-resources

17. Government of Pakistan. Ministry of National Health Services, Regulations & Coordination. Guidelines: public transport during covid-19 outbreak [Internet]. Islamabad: Government of Pakistan; 2020 [cited 2020 Dec 02]. Available from: https://ncoc.gov.pk/sop/19.%20050520%20Public%20Tansport%20During%20COVID%20226722.pdf

18. World Health Organization. Supporting healthy urban transport and mobility in the context of COVID-19. Geneva: World Health Organization; 2020. Available from: https://www.who.int/publications/i/item/9789240012554

Citation

Ontario Agency for Health Protection and Promotion (Public Health Ontario). Public transport and COVID-19 – what we know so far. Toronto, ON: Queen's Printer for Ontario; 2020.

Disclaimer

Public Health Ontario

Public Health Ontario is an agency of the Government of Ontario dedicated to protecting and promoting the health of all Ontarians and reducing inequities in health. Public Health Ontario links public health practitioners, front-line health workers and researchers to the best scientific intelligence and knowledge from around the world.

For more information about PHO, visit publichealthontario.ca.

Ontario