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**Article**

## COVID-19 impact on urban mobility

Journal of Urban Management

**Provided in Cooperation with:**

Chinese Association of Urban Management (CAUM), Taipei

*Suggested Citation:* Fatmi, Mahmudur Rahman (2020) : COVID-19 impact on urban mobility, Journal of Urban Management, ISSN 2226-5856, Elsevier, Amsterdam, Vol. 9, Iss. 3, pp. 270-275, <https://doi.org/10.1016/j.jum.2020.08.002>

This Version is available at:

<https://hdl.handle.net/10419/271394>

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## Forum Essay

## COVID-19 impact on urban mobility

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## ARTICLE INFO

## Keywords:

COVID – 19

Out-of-home travel activity

In-home activity

Long-distance travel

## ABSTRACT

This paper presents individuals' adjustment in daily out-of-home travel activities, in-home activities, and long-distance travel during the COVID – 19 travel restrictions. This study utilizes data from the COVID – 19 Survey for assessing Travel impact (COST) for the Kelowna region of British Columbia, Canada. The analysis suggests that individuals' participation in out-of-home activities were reduced by more than 50% during COVID – 19. The highest daily frequency of travel is found for routine shopping, followed by work-related travel. A comparative analysis of adjustment in out-of-home activities during COVID – 19 and the pre-pandemic period suggests that work-related travel increased for some occupations such as health, community, government, and sales and services. For recreational/social activities, travel increased for a higher share of older adults, and decreased for a higher share of younger adults. In the case of in-home activities, higher income households were found to be predominant in tele-working for a longer duration; whereas, lower and middle income groups were more involved in leisure and discretionary activities, and sleep. In the case of long-distance travel, the majority of the completed long-distance travel was made regionally using private car. Among the altered (i.e. cancelled, rescheduled, and unchanged) long-distance trips, international air-travel was predominant. The findings of this study provide insights towards people's immediate response to COVID – 19 travel restrictions, which will help in developing transportation plans and policies during COVID – 19, as well as for future pandemic and any other unprecedented scenarios.

## 1. Introduction

COVID – 19 has significantly impacted our lives and has created an unprecedented scenario as people around the world are locked down, and businesses and government – private institutions are closed. One of the sectors that has experienced the major impact is transportation. The majority of the countries have imposed restrictions on traveling – i.e. both local and long-distance traveling, immediately following the outbreak of the virus in that country. This travel restriction has significantly affected people's mobility behavior. For example, around 52% reduction in activities has been observed in the transit stations of Canada during COVID – 19 (i.e. mid-March to the end of April) compared to the pre-pandemic period (Google, 2020). Much of the changes in travel demand has been attributed by individuals' adjustments in their daily travel activities such as replacing out-of-home activities with in-home activities. For instance, around 50% of Canadians are working from home due to COVID – 19 (Leger, 2020). There has been a surge in online shopping, avoiding travel for in-store purchases. In the case of long-distance travel such as international travel, people were required to adjust their travel plan primarily due to the closure of borders. However, little is known regarding individuals' immediate response in-terms of adjusting their travel activities; specifically, due to the unavailability of disaggregate-level data capturing individuals' travel activities immediately following the outbreak of such a pandemic.

This paper discusses how individuals immediately responded to COVID – 19 in Canada, upon the outbreak of the pandemic

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<https://doi.org/10.1016/j.jum.2020.08.002>

Received 22 July 2020; Accepted 3 August 2020

Available online 14 August 2020

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followed by the nation-wide travel restrictions and provincial state of emergencies imposed during the mid-March. Particularly, this paper focuses on individuals' engagement in daily and long-distance travel. Data for this study comes from a web-based survey known as the COVID – 19 Survey for assessing Travel impact (COST) conducted from the last week of March to the first week of April. Data from the COST survey is utilized to analyze engagement in in-home activities, out-of-home travel activities, and long-distance travel of individuals residing in the Kelowna region of Canada.

## 2. COVID – 19 survey for assessing travel impact (COST)

The COVID – 19 Survey for assessing Travel impact (COST) is a web-based survey, which was deployed from March 24th to May 9th, 2020 to collect information regarding individuals' immediate response to the travel restriction during the pandemic. The survey collected data related to the daily activities, long distance travel, and sociodemographic information from respondents around the world. The daily activity component asked respondents about their out-of-home and in-home activities on the previous weekday. Information regarding the out-of-home activities include activity participation, travel mode, travel companion, and travel satisfaction, among others. In the case of the in-home activities, respondents provided information related to the frequency and duration of the activities. Then, respondents provided how their out-of-home and in-home activities were changed in-comparison to the pre-pandemic period. Similar out-of-home and in-home activity information were collected for a weekend day. For the long-distance travel component, respondents were asked to provide their planned and completed travel since January 2020. They provided information regarding the origin, destination, mode and purpose of their travel. They provided information on whether the travel was completed, cancelled, rescheduled, or unchanged. The socio-demographic component asked respondents about their gender, age, marital status, education, employment status, occupation, driving license ownership, household size, number of children, household income, and number of vehicles in the household.

Following data collection, the cleaning and validation were performed for the segment of the data collected from the Kelowna region of British Columbia, Canada. The Kelowna region includes the City of Kelowna, West Kelowna, Vernon, Lake Country, and Peachland. The validation exercise is performed by comparing the data with the Canadian census. An iterative proportional fitting technique was adopted to validate the sample (Lomax & Norman, 2015). The validated sample size is 202. The validation results suggest that the majority sample characteristics lies within a few percentage points from the census data. For example, female shows a share of 51.98% and 51.45% in the COST and census data respectively, which is a difference of around 0.50% only. In the case of marital status, the share of married individuals in the COST and census is 52.33% and 51.28% respectively, which is around 1% difference only. Among the household-level characteristics, the share of two-person household in COST and census is around 45.05% and 43.19%, which is a difference of less than 2%. Similarly, the COST sample over-represents renters by around 3% only. Therefore, it can be concluded that the COST sample reasonably represents the Kelowna population, which is considered for further analysis and discussion.

## 3. Daily and long-distance travel during COVID – 19

This section presents analysis regarding individuals' daily activities including out-of-home activities and in-home activities, and long-distance travel immediately following the travel restrictions imposed in British Columbia, Canada. Daily activity analysis presented in this paper focuses on weekday activity only.

### 3.1. Out-of-home travel activities

Overall, individuals made around 1.62 trips/day/person during COVID – 19 compared to around 3.33 trips/day/person in the pre-pandemic period, which is a drop by more than 50%. To better understand participation in different out-of-home activities, they were thematically aggregated into the following categories: *work* which includes work/school/work related errands, *pick-up online order*, *recreation/social* which includes recreation/visit family and friends/civic/religious activities, *routine shopping*, and *household errands* which includes personal business/household errands/pick up or drop off household members/health care/other activities. The frequency of daily activity participation during the COVID – 19 pandemic is presented in Fig. 1. The graph reports the average number of trips per person. On an average, the highest daily frequency of travel is found for routine shopping – i.e. around 0.5 trips/



Fig. 1. Frequency of activity participation during COVID – 19.

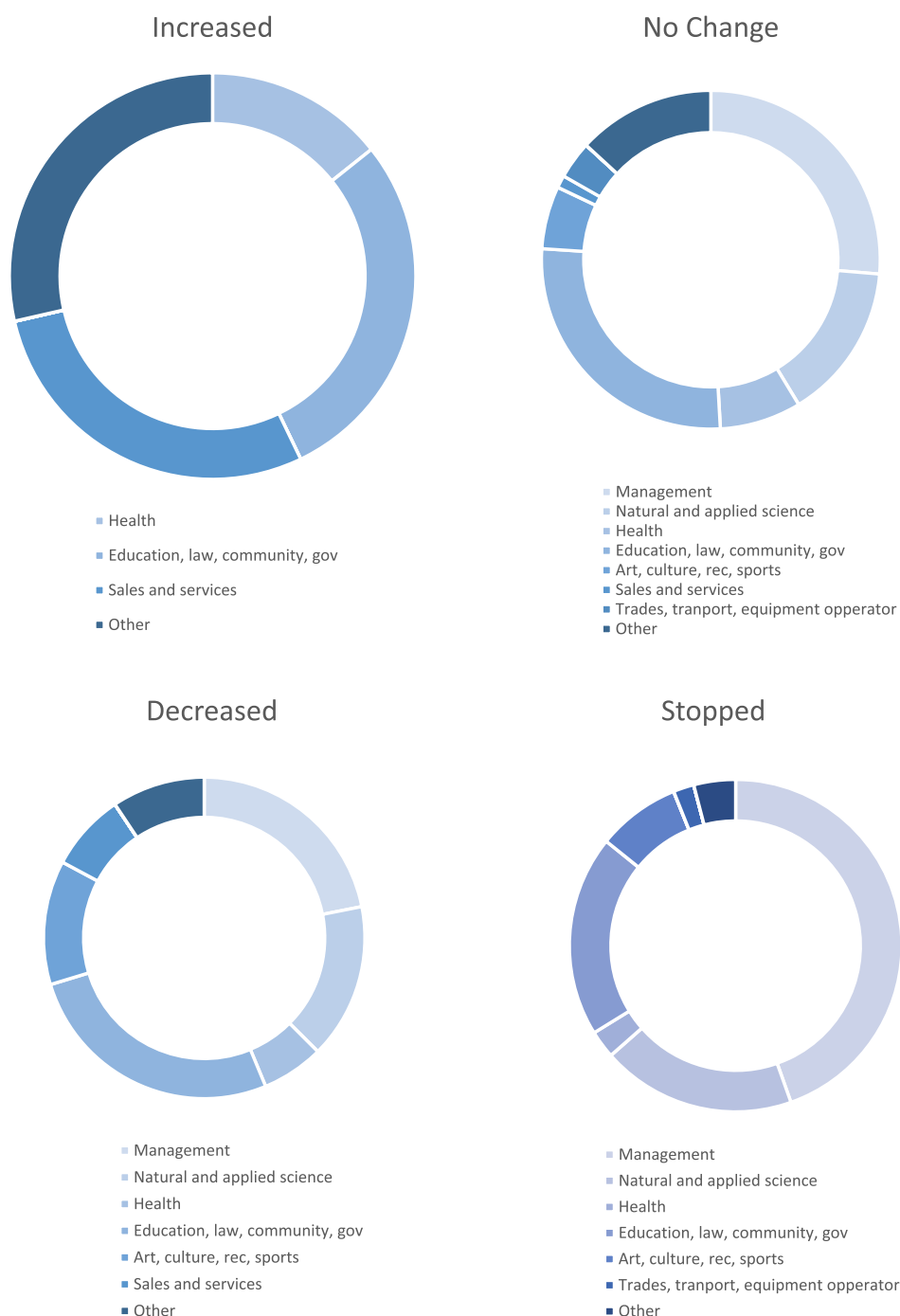


Fig. 2. Change in travel for work activities during COVID – 19 compared to the pre-pandemic.

person/day. Individuals made around 0.4 trips/person/day for out-of-home work activities. In the case of recreational/social and pick-up online order activities, the frequency is around 0.28 and 0.23 trips/person/day respectively.

The change in out-of-home activity analysis focuses on travel related to work, and recreation/social activities. Change refers to the adjustment made during COVID – 19 compared the pre-COVID – 19 period. In the case of work activities, distribution for the change is reported by occupation (Fig. 2). The analysis reveals that work-related travel increased for some specific occupations such as health, education, law, community, government, and sales and services. Among the individuals reported an increase in their work travel, around 29% were associated with sales and services. Around 14% were health professionals. In the case of participation in recreation/social travel activities, distribution for the change is reported by age (Fig. 3). Among the individuals who reported an



Fig. 3. Change in travel for recreation/social activities during COVID – 19 compared to the pre-pandemic.

increase in their recreation/social travel activities, a higher share of older adults increased their travel for participation in recreation/social activities. For example, around 65% of the individuals with an increase in recreation/social activities were aged 60 years and above. Among the individuals who reported to stop traveling for recreation/social activities, younger adults were found to be predominant. For instance, the share of individuals aged below 35 years was around 42%. In the case of decrease in recreation/social activities, a higher share of middle-age individuals were found.

### 3.2. In-home activities

In-home activities are thematically aggregated into: *work and school*, *online shopping*, *leisure and discretionary*, *household and personal maintenance*, and *sleep and other*. The duration of in-home activities by income group is presented in Fig. 4. The analysis results suggest that higher proportion of higher income household worked at home for a longer duration. Specifically, the 75th percentile of the work/school activity duration for household income > 100,000 CAD was around 2.92 h. The average duration of mandatory in-home activity for this income group was around 2.10 h. Lower and middle income groups were more involved in leisure and discretionary activities, and sleep. For example, the average duration of leisure and discretionary activities for the income groups < 50,000 CAD, 50,000–100,000 CAD, and > 100,000 CAD were 1.46, 2.06, and 1.15 h respectively. The 75th percentile point of the leisure and discretionary activity duration for the middle income group of 50,000–100,000 CAD was around 3 h. For sleep activities, the average duration for the income groups 50,000–100,000 CAD and > 100,000 CAD were 3.67 and 2.81 h respectively.

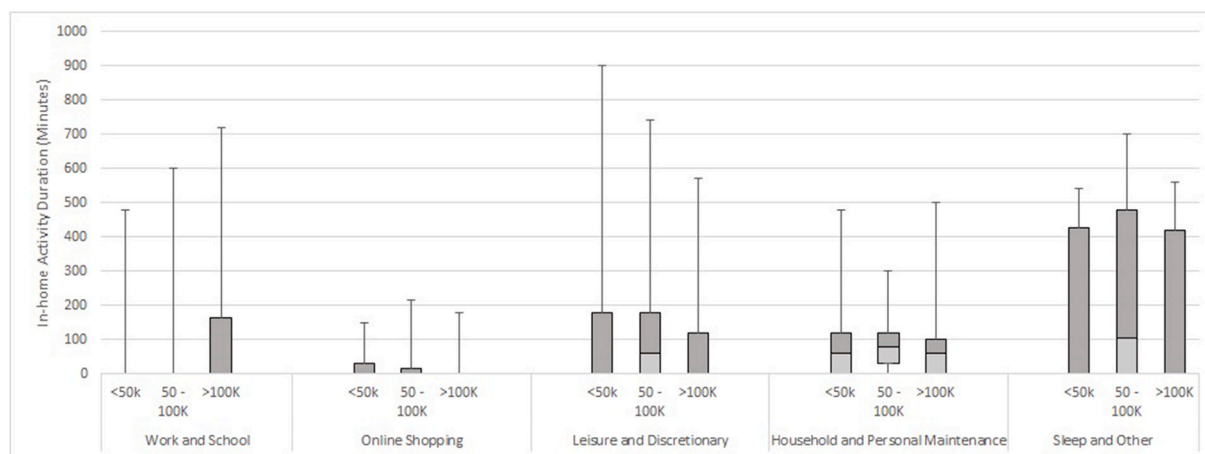


Fig. 4. In-home activity participation during COVID – 19.

### 3.3. Long-distance travel

In the case of long-distance travel, around 42% individuals completed at least one long-distance travel since the January of 2020. Among the altered trips which includes cancelled, rescheduled, and unchanged travel, the majority were cancelled. Specifically, around 89% of the altered long-distance trips were cancelled. Further analysis is performed by thematically aggregating long-distance travel into: *regional travel* which is travel within the same province or state, *domestic travel* which is travel within the same country, and *international travel* which is travel across borders. Long distance travel is analyzed by travel mode and individuals' occupation (Fig. 5). The right side (i.e. solid bars) of the graph represents percentage share distribution of occupation and travel mode for the completed trips. The left side (i.e. hatched bars) of the graph represents percentage share distribution of occupation and travel mode

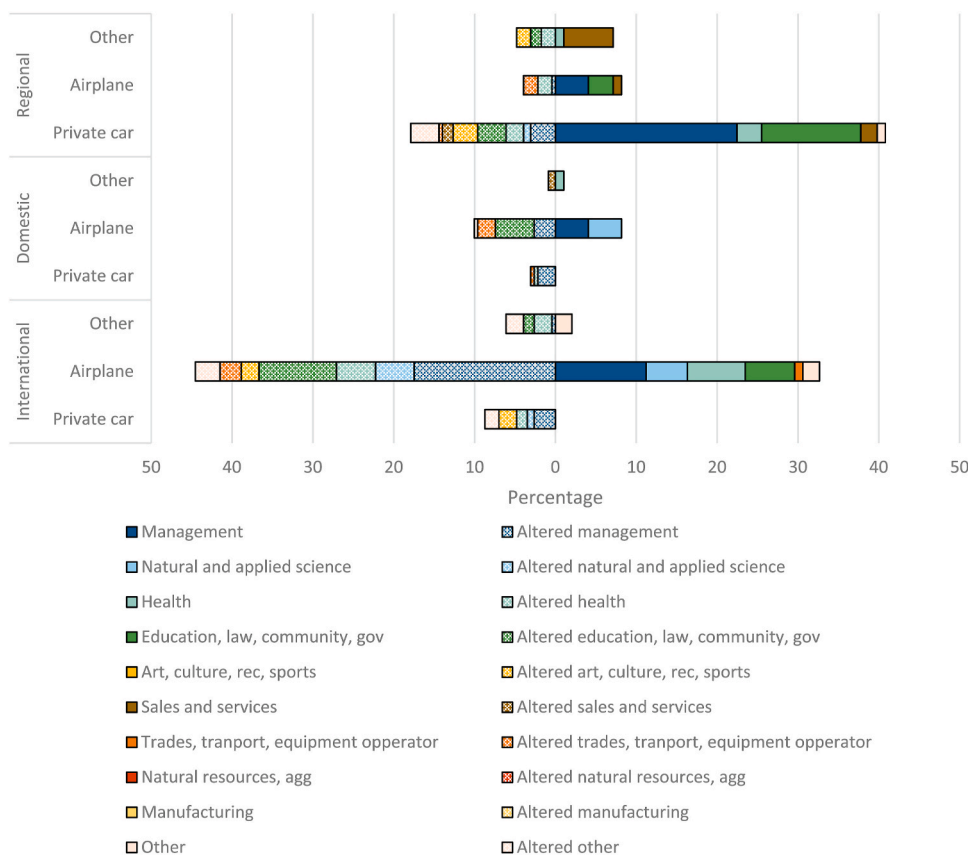


Fig. 5. Adjustment in long-distance travel.

for altered trips. Overall, a higher share of the completed long-distance travel were regional. Specifically, around 55% of the completed trips were regional. For modal distribution, around 40% of the regional completed trips were performed using private car. Further analysis related to the occupation of the individuals reveals that around 27% of the regional completed car trips were performed by management professionals. The author would like to caution the interpretation related to the management occupation distribution, since the survey data over-represents this occupation group. In the case of altered long-distance travel, around 58% of the trips were international. Among the altered trips, international air travel were predominant, to be specific around 45%. Furthermore, around 17% of the altered international air travel were by management professionals.

#### 4. Conclusions

This study presents findings towards individuals' immediate response to COVID – 19, in-terms of adjusting their travel activities. Specifically, this research presents individuals' adjustment in daily activities which includes out-of-home travel activities, in-home activities, and long-distance travel. Data for this study comes from the COVID – 19 Survey for assessing Travel impact (COST). Data collected for the Kelowna region of British Columbia, Canada, are utilized in this study. The analysis suggests that individuals' out-of-home activity participation is reduced by more than 50% during COVID – 19. The highest daily frequency of travel is found for routine shopping, followed by work-related travel. A comparative analysis of adjustment in the out-of-home activities during COVID – 19 and the pre-pandemic period suggests that work-related travel increased for some occupations such as health, education, law, community, government, and sales and services. For recreational/social travel activities, travel increased for a higher share of older adults. On the other hand, a higher share of younger adults were found to stop performing travel for recreational/social activities. In the case of in-home activities, higher income households were found to be predominant in tele-working for a longer duration. The average and 75th percentile duration of such mandatory activity for the income group > 100,000 CAD was around 2.92 and 2.10 h. Lower and middle income groups were more involved in leisure and discretionary activities, and sleep. For example, for leisure and discretionary activities, the average duration for the income groups < 50,000 CAD, 50,000–100,000 CAD, and > 100,000 CAD were 1.46, 2.06, and 1.15 h respectively. In the case of long-distance travel, the majority of the completed long-distance travel were made regionally using private car, which is around 40% of the completed trips. Among the altered (i.e. cancelled, rescheduled, and unchanged) long-distance trips, international air-travel were predominant, which was around 45% of the altered trips. In summary, the findings of this study provide important insights towards how people adjusted their daily out-of-home travel activity, in-home activity, and long-distance travel, which will assist in developing transportation plans and policies during and post COVID – 19, as well as for future pandemic and any other unprecedented scenarios.

#### Declaration of competing interest

This is to certify that the author, Dr. Mahmudur Rahman Fatmi, has no conflict of interest to declare regarding the publication of the essay, titled “COVID – 19 Impact on Urban Mobility”.

#### Acknowledgements

The author would like to thank the University of British Columbia for their financial support. The author would also like to thank Corrie Thirkell for helping with the data analysis.

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