

# Impact of Pandemic on Public Transportation Service in Kota Kinabalu

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**ABSTRACT** Implementation of the Movement Control Order during pandemic with new regulations is expected to have consequential destruction to all service sectors and increase the disruption risk factor for future public transportation planning. Hence, it is necessary to investigate the people's travel behaviors and perceptions related to pandemic and public transportation service as part of the impact assessment for sustainability of public transportation operation. This study was conducted in the city of Kota Kinabalu, Sabah where questionnaire surveys were distributed to respondents and results were analyzed using statistical analysis methods. The McNemar Bowker and Wilcoxon Signed-Rank tests proved that there are significant impacts of COVID-19 pandemic to the mobility characteristics and travel mode preference on using public transport for primary outdoor trips. The number of trips completed were significantly reduced, while the choices of transport mode were also influenced by the spread of COVID-19 whereby respondents choosing to avoid public transportation. The findings also showed differences in travel behaviors concerning demographic factors. Based on the respondent perception on pandemic COVID-19, 71% agree that probability of being infected is higher when using public transport. Hence, public transport sector needs to strictly follow the standard operating procedure during pandemic to attract more public transport usage for economic sustainability.

**KEYWORDS:** Pandemic; Public Transportation; Mobility; Travel Mode; Perception

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## INTRODUCTION

An outbreak of respiratory disease later proved to be caused by a new coronavirus, officially called Coronavirus Disease 2019 (COVID-19), was first identified in Wuhan on December 31, 2019 (Cheng *et al.*, 2020). On March 11, 2020, World Health Organisation (WHO) acknowledged COVID-19 as a pandemic, and the estimated number of contaminated cases have crossed more than 8,400,000 individuals by the middle of June 2020, destroying more than 450,000 lives.

To hinder the extend of the extremely transmissible COVID-19 virus, many countries have decided to enact specific mandatory steps. Malaysia has taken a deep measure to flatten the curve by starting a new policy called the Movement Control Order (MCO) on March 18, 2020. All Malaysians are ordered to stay indoors during the implementation of MCO. Suspension of mass meetings, health inspection and quarantine for Malaysians arriving from abroad, the regulations of foreigners arriving in the country and the closing of all facilities other than primary and necessary ones, such as health services, water, electricity, telecommunications and food supply firms, were further restrictions enforced (Aziz *et al.*, 2020). It became a mandatory norm in majority of the countries to avoid any physical contacts and minimize interaction between individuals (i.e., physical distancing). The new norm has caused declined in urban travel to the entire world and all public transportation modes have experienced severe lost in terms of cost. Restrictions on Malaysia's public transport, where not more than 50% of all seats were allowed to be occupied, has led to an unprecedented declined in demand for public transportation in Peninsular Malaysia.

Mobility is an integral aspect of living as a human being. Despite that, mobility restrictions are

the only efficient policy that can be applied to curb the spread of the disease. Globally, government orders to mitigate the spread have caused a major decline in mobility. Specifically, in Malaysia, the mobility of public transport is diminished within a few days after the commencement of restrictions order on March 29, 2020. The usage of public transportation has been restricted following the restrictions of human mobility. COVID-19 a respiratory infection brought by infected individuals when breathing, speaking, coughing and sneezing are known to be transmitted through droplets (5 to 10  $\mu\text{m}$ ) and aerosols (smaller than 5  $\mu\text{m}$ ). As stated by WHO, non-pharmaceutical measures are widely adopted across the world where people have to keep a distance of at least one meter from other persons. Due to social distancing rules, the key factor is to decrease the availability on public transport networks, which means that the people would have to reconsider their travel options (Lavery *et al.*, 2020).

The COVID-19 pandemic poses a significant challenge for contemporary public transportation worldwide, resulting from an unprecedented decline in demand and revenue (Tirachini & Cats, 2020). In particular, a post-COVID-19 may see a prolonged decline in demand for commuter transport due to a mixture of persistent economic crisis and evolving of working habits. The extreme decrease in demand for public transportation due to COVID-19 was coupled with rising costs as a consequence of new standards of hygiene and cleaning. Hence, this study investigates the impact of COVID-19 on public transportation service in Kota Kinabalu, Sabah.

## METHODOLOGY

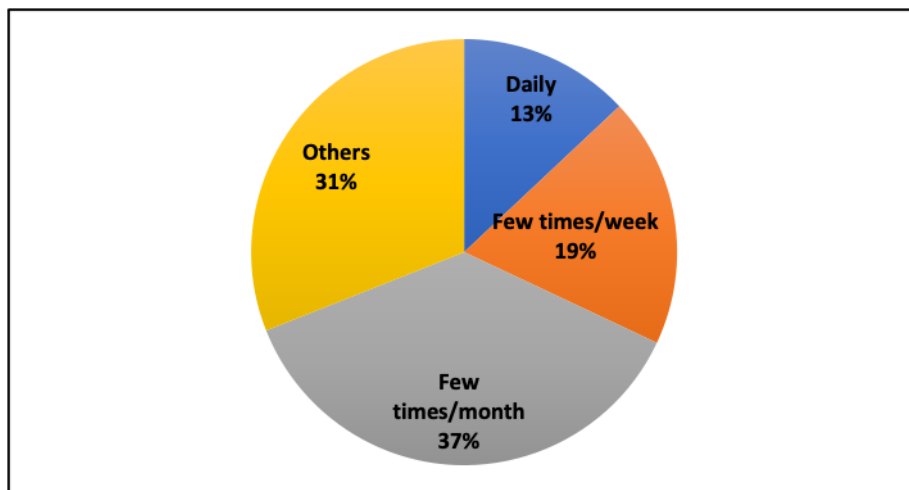
An online questionnaire survey was designed to capture the travel behaviours, satisfaction and perception of respondents hailing from diverse demographic backgrounds on number of trips and mode preferences for a primary outdoor trip purposes before and during the pandemic. The questionnaire survey was circulated mainly through social media sites and Whatsapp's contacts to reach a broader audience in and near Kota Kinabalu, Sabah. After data screening, the survey conducted from earlier of April 2021 to end of May 2021 produced 333 response sets. The number of responses were based on suggestion by Teare et. al (2014) and Sekaran (2006). Collected data were analysed using Microsoft Excel and SPSS software. For primary outdoor trip purposes, analysis was used to assess the mobility characteristics, travel modes preference, effect of various demographic factors on trip numbers and modes and people perceptions. Data were collected regarding six types of demographic characteristics, namely; age, gender, employment status, academic qualification, transportation and frequency on using public transportation. Mobility characteristics assessed change in trip numbers for primary outdoor trip purposes, namely, work/class, grocery shopping, and social/recreational/sports travel. The same goes to travel mode choice, where change in respondent's preferred mode in using public transportation for primary outdoor trip purposes is assessed.

## RESULT AND DISCUSSION

### *Analysis of Demographic Characteristics of Respondents*

Demographic characteristics attributes show that most respondents are female (69%) with a dominant age group of 18 - 25 years (81%). The highest number of respondents are from the age of group 18 - 25 years old indicated that age became one of the main variables in demographic characteristics that affect the willingness of people to complete the online surveys. In terms of employment status, majority of the respondents are unemployed (74%) and most of the respondents possess an academic qualification of Bachelor Degree's holder (63.1%). Most of the respondents used

used public transport either daily or more than three times a week. Figure 1 shows the respondent frequency of using public transportation before COVID-19.



**Figure 1.** Respondent Frequency of Using Public Transportation

#### *Impact of COVID-19 on Primary Outdoor Trips*

Primary outdoor trips are the main reason for people travel. This study focuses on the primary outdoor trips because they are made out of necessity, and individuals may not have complete control over them. The impact of COVID-19 was analysed based on mobility characteristics and travel mode preference.

#### *Mobility Characteristic of Primary Outdoor Trips*

Mobility characteristics based on transportation usage for work/classes, grocery shopping and social/recreational/sports are presented in Figure 2. In general, during pandemic the mobility characteristics and travel mode preference changed. Percentage of never use public transport increase for all types of mobility and public transportation usage. The reduction in public transport usage might be due to the announcement made by the government to allow at least 30% of the workers to work at the office to limit the spread of COVID-19. Other works such as machine operators and drivers, community and personal service workers and labourers where the work cannot be done from home are allowed to go to office. Whereas, trips for education purposes were highly characterised by a shift to digital solutions and virtual as opposed to corporeal mobility. The rest of the respondents are engaged with public transport but with a minimum trip possible, some only use public transport once in a month or at least a few times in a month.

Mobility characteristics using public transportation for grocery shopping shows significant increase of never use public transport during pandemic. The number of respondents that use public transport monthly and weekly during the pandemic decrease to 18% and 21%, respectively. The option of delivery services provided by a company such as Grab in Kota Kinabalu areas has increased the number of people to stop using public transport for grocery shopping as they will choose to use delivery services to avoid being stuck in crowded places like the supermarket. Hence, the demand for grocery deliverers increased during pandemic. This case study also observed how often people attend outdoor activities like social, recreational, and sport using public transportation. Mobility characteristics by monthly and weekly are decrease during pandemic due closing of recreational/ sports centre. According to Shakibaei *et al.* (2021) behavioural changes are triggered by

both people's self-regulation and governmental measures to restrict travel and social contact and to flatten the curve in the short term.

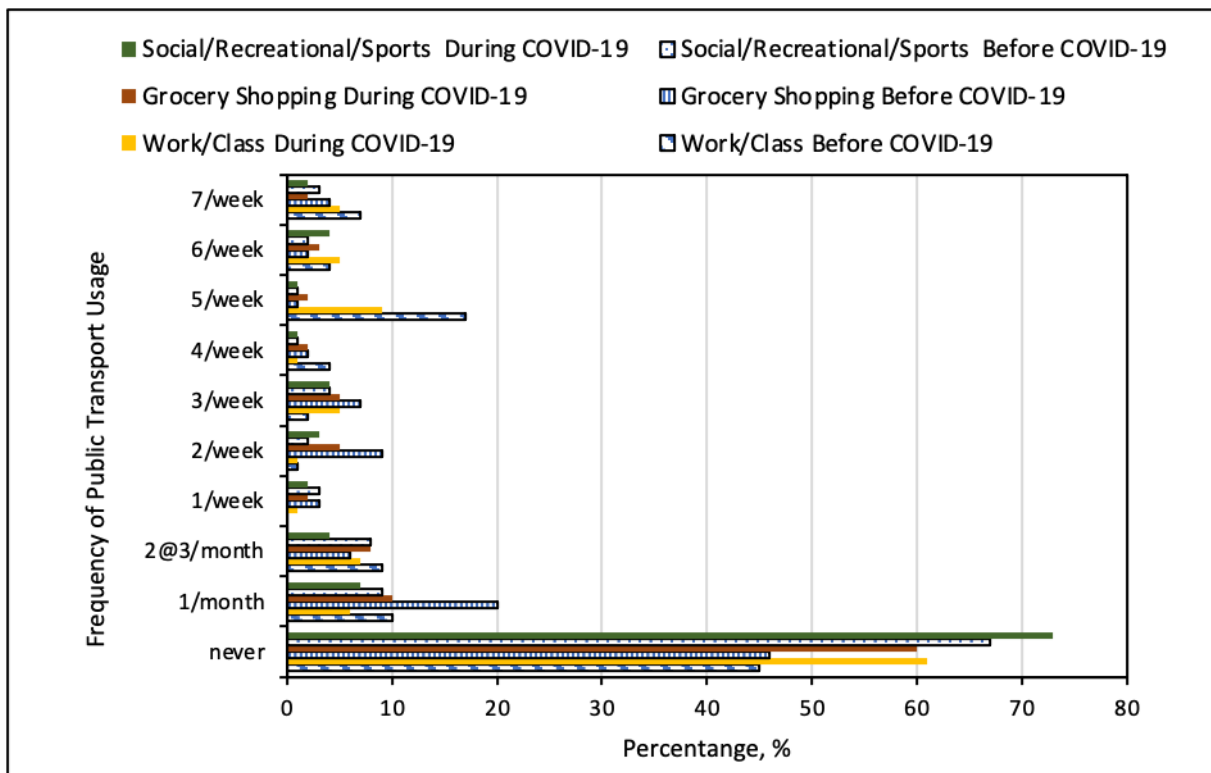


Figure 2. Mobility Characteristics on Public Transportation Usage

In this study, the Wilcoxon Signed-Rank test is carried out to distinguish the significant difference in the frequency travelled for the primary trips before and during the pandemic. The Wilcoxon Signed-Rank test indicated statistically significant differences in the frequency travelled for trips to work/class, grocery shopping, and social/recreational/sport. The statistical data displayed are ( $Z = -12.206$ ,  $p < 0.001$ ), ( $Z = -5.491$ ,  $p < 0.001$ ) and ( $Z = -3.498$ ,  $p < 0.001$ ) accordingly. This means that the of COVID-19 significantly affect the mobility characteristics of public transport user.

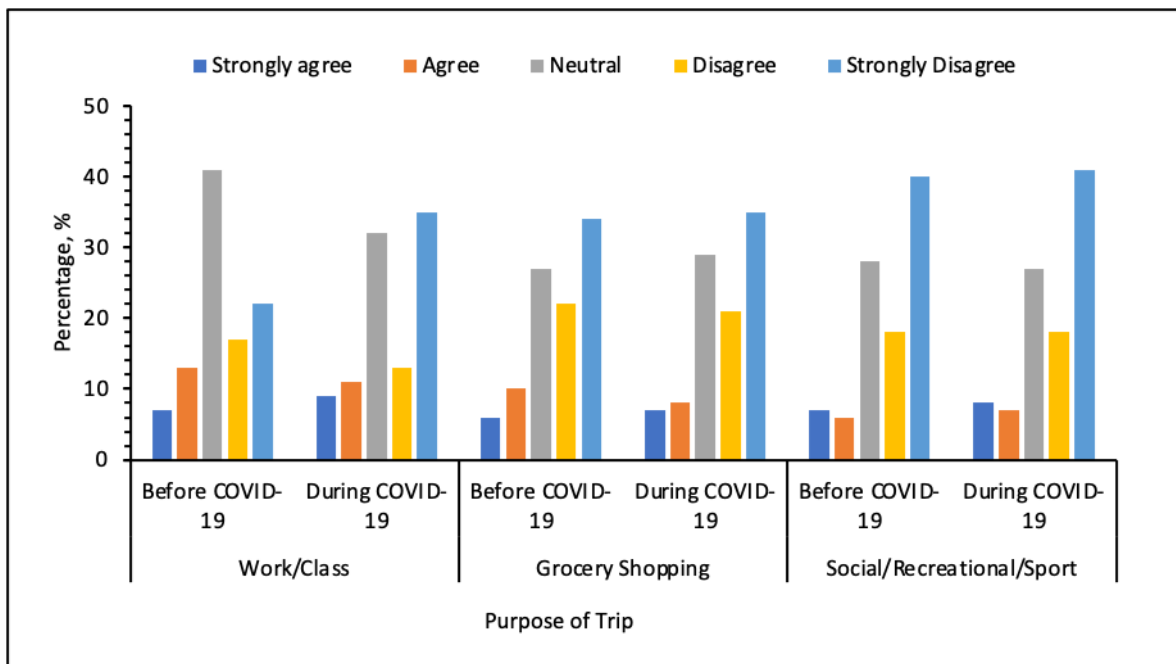
#### Travel Mode Preference for Primary Outdoor Trips

To explore the diversification of individual's mode choice about travel behaviours due to COVID-19 pandemic, questionnaire surveys on travel mode preference were constructed in Likert-scale format. Figure 3 shows the travel mode preference by using public transportation for various trip's purpose such as work/class, grocery shopping and social/recreational/sport. About 22% and 17% respondents indicate strongly disagreed and disagreed respectively, in using public transport to work/class. However, during the pandemic of COVID-19, number of respondents voted for strongly disagree and disagree increases with 35% and 13% respectively. In terms of mode preference for grocery shopping, analysis shows that about 34% respondents strongly disagreed with using public transport to do errands, followed by 22% disagreed. As predicted, the changes are observed where respondents who strongly disagreed and disagreed with using public transportation for the same purpose increased to 35%, followed by 21% disagreed. The respondents were also asked about their preferences to use public transport to participate in social/recreational/sports activities, including family visits, cinema, park, gym, joining sports, cultural and social events. The number of respondents who are strongly disagreed with the statement is 40%, followed by 18% of the respondents have disagreed. The changes observed showed that the number of respondents who

strongly disagreed with the statement rose to 41%, where the number of respondents disagreed decreased slightly to 18%.

It can be deduced that more than one-half of the respondents are strongly disagreed and disagreed with using public transportation for any of their essential trips during the pandemic. The increasing number of respondents that decided to stop using public transportation immediately is because public transport users do not feel safe these days due to the infection risk and hence choose private cars (Przybylowski *et al.*, 2021). In addition, an online report by Arredondo *et al.*, (2020), on 23 March, stated that when the city of Bogotá, Colombia performed a simulation of journey limitation measures, the Trans Milenio, a bus rapid transit system, registered a fall in the number of users of 87%. The reduction in travel mode preference for primary trips in this survey is parallel with the fact-finding executed in the city of Santander, Spain. The reduction on public transport use to workplaces is 68%, 94% in journeys made for leisure or shopping, 77% in journeys for food or trips to pharmacies, and 89% in mobility around stations and transport modes.

Apart from that, The McNemar Bowker test is performed for the travel mode preference for primary trips purposes to observe if changes occurred before and during the pandemic. The McNemar Bowker test shows that there are significantly differences between the travel mode preferences to work/class as well as for grocery shopping trips, with statistical result of ( $X^2 = 42.975$ ,  $p < 0.001$ ) and ( $X^2 = 18.482$ ,  $p < 0.047$ ) respectively. However, there is no notably changes on travel mode preference for social/recreational/sport trips, with statistical result of ( $X^2 = 16.321$ ,  $p > 0.091$ ).



**Figure 3.** Travel Mode Preference by Using Public Transportation For Various Trip's purpose

#### *Relationship Between Demographics Factors with Mobility Characteristics for the Primary Outdoor Trips*

The relationship between demographics factors and mobility characteristics for the primary outdoor trips is summarized in Table 1. In addition, the Chi-Square test of independence is performed to examine the relationship for the primary outdoor trips. Further, Spearman's Rho correlation test is also included. In this study, a trip is defined as a one-way journey from an origin to a destination. For instance, a one-way journey from home to the workplace is counted as one trip, and the one-way journey from the workplace to home is counted as another trip. The p-value indicates how probable the results are due to chance. The outcomes in this research are assessed at

two significance levels, which are  $p < 0.05$  and  $p < 0.001$ . Conventionally,  $p < 0.05$  is referred to as statistically significant and  $p < 0.001$  as statistically highly significant.

From the statistical analysis data, there is no statistically significant relationship between educational level and frequency of using public transportation for all of the primary outdoor trips before and during the pandemic of COVID-19. Apart from that, both show no significant correlation for Spearman's Rho test. These findings are supported by Abdullah *et al.*, (2020), where there are weak correlations observed for educational level and the number of trips for primary trip purposes before COVID-19. Nevertheless, the correlation was not significant during COVID-19. Further, the relationship between age, gender, and employment status is distinguished before and during the outbreak of the COVID-19 pandemic for activity frequency to work/class, grocery shopping, and social/recreational/sports activities. Specifically, for the number of trips to work/class, the relationship with age ( $X^2 = 22.019$ ,  $p < 0.005$ ), ( $X^2 = 17.327$ ,  $p < 0.044$ ) and employment status ( $X^2 = 64.698$ ,  $p < 0.001$ ), ( $X^2 = 72.035$ ,  $p < 0.001$ ) is statistically significant before and during COVID-19. With regards to the breakdown of the work/class based on age, it can be said that younger respondents are remarkably less active in using public transportation for daily trips to work/class before the pandemic. de Haas *et al.*, (2020) also mentioned that younger people are more likely to be affected by work (more flexible and temporary contracts) and education.

**Table 1.** Relationship Between Demographic Factors with Mobility Characteristics on Public Transportation for The Primary Outdoor Trips

Item	Before COVID-19		During COVID-19	
	X <sup>2</sup>	P	X <sup>2</sup>	P
Relationship with the activity frequency to work/class				
Age	22.019	0.005*	17.327	0.044*
Gender	12.845	0.117	23.191	0.006*
Education Level	44.889	0.065	43.575	0.180
Employment Status	64.698	0.001**	72.035	0.001**
Frequency on using Public Transport	16.795	0.857	31.442	0.253
Relationship with the activity frequency to grocery shopping				
Age	18.936	0.026*	12.855	0.169
Gender	27.393	0.001**	34.840	0.001**
Education Level	23.150	0.952	34.460	0.542
Employment Status	20.349	0.016*	42.029	0.001**
Frequency on using Public Transport	31.378	0.256	38.230	0.074
Relationship with the activity frequency to social/recreational/sport				
Age	19.531	0.021*	12.523	0.185
Gender	22.867	0.007*	35.148	0.001**
Education Level	23.912	0.939	37.501	0.400
Employment Status	42.887	0.001**	43.983	0.001**
Frequency on using Public Transport	38.666	0.68	28.8210	0.370

\*Significant at the 0.05 level.

\*\*Significant at the 0.001 level.

Grocery trips are an integral component of people's lives as to meet their basic daily needs. In this study, age ( $X^2 = 18.936$ ,  $p < 0.026$ ) is noticed to have a significant relationship with the frequency of trips made on grocery shopping in using public transportation before the outbreak. It can be interpreted that younger respondents are more likely to go grocery shopping using public transportation compared to older respondents. According to de Haas *et al.* (2020), older people are

much less active in grocery shopping. However, no significant relationship for age ( $X^2 = 12.855$ ,  $p > 0.169$ ) observed during the pandemic. The frequency of using public transportation for grocery shopping decreased during the pandemic, and this is supported by Shakibaei *et al.* (2021). In terms of gender ( $X^2 = 27.393$ ,  $p < 0.001$ ) before and ( $X^2 = 38.840$ ,  $p < 0.001$ ) during pandemic, females are more frequently using public transportation in weekly trips for grocery shopping than males. Even before the pandemic, males are less active in using public transportation to buy grocery stocks, where they are most likely use public transport for grocery trips purpose once a month. During the COVID-19, there is a significant relationship analyzed through the Spearman's Rho test that showed the correlation is negative. This means, females are more likely to use public transport during a pandemic for grocery shopping trips than males. Aside from that, the findings also show significant relationship between the frequency of grocery trips with employment status ( $X^2 = 20.349$ ,  $p < 0.016$ ) before and ( $X^2 = 42.029$ ,  $p < 0.001$ ) during pandemic. The unemployed are most likely use public transport to perform grocery shopping than employed respondents.

In the scope of frequency trips to social/recreational/sport activities, the data exhibit that age is significantly related only before the pandemic ( $X^2 = 19.531$ ,  $p < 0.021$ ) and not during the pandemic ( $X^2 = 12.523$ ,  $p < 0.185$ ). Younger respondents used public transport more to attend such trips. This finding is aligned with research by Shakibaei *et al.*, (2021), where younger respondents are remarkably more active. Somehow, in entering the next phase where the effect of COVID-19 is slowly and finally caught the people's attention, the active role of younger respondents remarkably decreased. No significant relationship is found during the pandemic, and younger respondents decreased their trips for such activities when using public transportation. The outbreak of infectious diseases affects people's lifestyles significantly, as they undertake fewer outdoor activities as a protective measure and follow government orders of restricted movements.

#### *Relationship Between Demographics Factors with Travel Mode Preference on Public Transport for the Primary Outdoor Trips*

Table 2 compares the relationship of travel mode preference for the primary outdoor trips with demographics factors before and during COVID-19. It shows that gender, education level and frequency of using public transport display no significant relationship with travel mode preference for work/class and grocery shopping. In terms of travel mode preference to social/recreational/sports trips, only education level and frequency on using public transport are not significantly related. Whereas, it is observed that age had a significant relationship for all of the trips before ( $X^2 = 22.475$ ,  $p < 0.001$ ) and ( $X^2 = 10.400$ ,  $p < 0.034$ ) during the pandemic. In terms of travel mode to work/class during the pandemic, younger respondents are less likely to use public transportation than older respondents. Younger people stayed more at home, compared to other age groups, also due to the fact that they are likely to be employed or because they are mainly employed in the food and beverages sector. Food and beverages sector are the sector that was strongly influenced by the lockdown whereby it closed or operated for fewer hours with limited staff. Apart from that, employment status is not related at all with travel mode preference to work/class before the pandemic ( $X^2 = 7.537$ ,  $p > 0.110$ ), and it is somehow become highly related during the pandemic ( $X^2 = 43.480$ ,  $p < 0.001$ ). Respondents who are working seem to be less likely to use public transport as a transport option to work as well as respondents who are not working. The rate of teleworking is increasing, and students are attending online learning, this explained why people that are working and not working are not using public transport during the pandemic.

The same analogous travel mode preference to work/class goes with travel mode preference for grocery shopping, where age ( $X^2 = 10.227$ ,  $p < 0.037$ ), ( $X^2 = 15.799$ ,  $p < 0.003$ ) and employment status ( $X^2 = 9.573$ ,  $p < 0.048$ ), ( $X^2 = 10.396$ ,  $p < 0.034$ ) become significantly related before and during the

pandemic. Younger respondents are most likely preferred not to use public transportation for grocery shopping before the pandemic. While entering the pandemic phase, the number of younger respondents who do not using public transportation are increasing. The same pattern goes for employment status. For the relationship of travel mode preference for social/recreational/sports activities, it is analysed that age ( $X^2 = 9.985$ ,  $p < 0.041$ ), ( $X^2 = 13.754$ ,  $p < 0.008$ ) and gender ( $X^2 = 18.530$ ,  $p < 0.001$ ), ( $X^2 = 18.018$ ,  $p < 0.001$ ) are statistically significant both before and during the pandemic. In terms of age, younger respondents prefer not to use public transportation to attend such activities, it goes the same with older respondents, whilst only a small portion of the respondents prefer to use public transportation.

**Table 2.** Relationship Between Demographics Factors with Travel Mode Preference on Public Transportation for the Primary Outdoor Trips

Item	Before COVID-19		During COVID-19	
	X <sup>2</sup>	P	X <sup>2</sup>	P
Relationship with travel mode preference for work/class				
Age	22.475	0.001**	10.400	0.034*
Gender	3.840	0.428	6.599	0.159
Education Level	13.781	0.615	18.468	0.297
Employment Status	7.537	0.110	43.480	0.001**
Frequency on using Public Transport	13.278	0.349	12.782	0.385
Relationship with travel mode preference for grocery shopping				
Age	10.227	0.037*	15.799	0.003*
Gender	5.828	0.212	7.539	0.110
Education Level	19.533	0.242	11.338	0.788
Employment Status	9.573	0.048*	10.396	0.034*
Frequency on using Public Transport	10.236	0.595	14.971	0.243
Relationship with travel mode preference for social/recreational/sport				
Age	9.985	0.041*	13.754	0.008*
Gender	18.530	0.001**	18.018	0.001**
Education Level	21.510	0.160	13.716	0.620
Employment Status	6.734	0.151	19.780	0.001**
Frequency on using Public Transport	15.820	0.200	10.091	0.608

\*Significant at the 0.05 level.

\*\*Significant at the 0.001 level.

#### *Impact of the COVID-19 Pandemic on People Perceptions Towards Public Transportation Service.*

Figure 4 presents the people perception on people perceptions towards public transportation and COVID-19. The respondents are strongly agreed and agreed that the probability of being infected by COVID-19 is higher when using public transportation with an amount percentage of 71% in total. In contrast, 5% is strongly disagreed and disagreed with the statement. According to Chen *et al.* (2021) an enclosed environment and dense population create very favourable conditions for the spread of epidemic infections, where the floating virus in the air can spread over a long distance and may have a chance to be inhaled by healthy people under particular indoor, crowded, and inadequately ventilated spaces. Previous researches reported that if an asymptomatic patient coughs on a bus without wearing a mask during the peak hours, the virus droplets can be expelled at a speed of 10 m/s, with a concentration as high as 108 copies/mL thus, that adjacent passengers can instantly inhale the virus droplets (Buonanno *et al.*, 2020).



The findings on personal opinion on using public transportation during pandemic indicate that only 24% of the respondents strongly agreed and agreed with the statement, whereas about 42% are voting for neutral, and the outstanding respondents strongly disagreed and disagreed with an amount of 33%. This indicate that passengers perceived public transport as unsafe for travelling during the pandemic, leading to lower patronage compared with the pre-COVID-19 period. In contrast, 41% of the respondents strongly agreed and agreed using public transportation for any trips when COVID-19 is no longer a treat. Users of public transport, particularly the frequent ones find it safer. Respondent's perspective in regards to the demand on public transportation, whether it will be back to normal or otherwise shows 41% of the respondents strongly agreed and agreed with the statement. As stated by Vickerman (2021), a sustainable transport system in a post-pandemic world is unlikely to see a return to business as usual after a short period once vaccination reach the level of herd immunity.

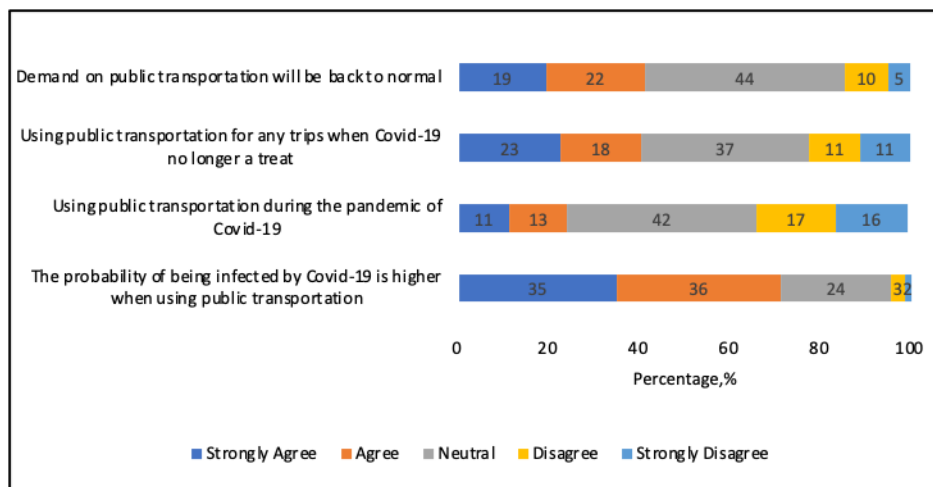


Figure 4. Respondent Perception on Pandemic of Covid-19 and Public Transportation

## CONCLUSION

This study observed the reduction on mobility characteristics before and during the pandemic of COVID-19. For mobility characteristics to work/class, the weekly trips decreased by 8%, respondents who used it once or 2/3 times in a month decreased by 20% and respondents who completely stopped using public transportation increased by 16%. As for mobility characteristics to grocery shopping, weekly trips dropped by 7%, monthly trips were also dropped by 8% and respondents who just stopped using public transportation for same purpose increased by 14%. Finally, for weekly trips to social/recreational/sports activities went down by 11%, monthly trips also reduced by 15%, whereas, respondents that completely stopped engaging with public transportation rose by 6%. Apart from that, this study managed to identify travel mode preferences among the people during the pandemic of COVID-19 for three primary trips whereby majority were reluctant to use public transportation to perform their primary trips compared to before the pandemic of COVID-19. In addition, it was observed that demographics factor that had an impact on the mobility characteristics among the respondents were age, gender and employment status. In terms of travel mode preference for work/class as well for grocery shopping, age and employment status were playing significant roles. Whereas, for social/recreational/sports activities, age, gender and employment status were significant. Apart from impact of COVID-19 on the public transportation service to the user, it also imposed unprecedented challenges to the public transport operators.

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