Uptake in on-demand ride-hailing for intracity long distance trip making during COVID-19

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ABSTRACT
Changes in mobility patterns are expected during global pandemics. Despite the role of cost and travel time on mode choice, these factors may be considered secondary to perceived safety during global health crises. This study seeks to shed light on changes in public transport mode preferences during the outbreak of COVID-19. A survey involving 1100 commuters showed that there were statistically significant differences in mode preferences prior to, and during the outbreak of COVID-19 in urban Ghana. The results suggest that more people (59.0%) were willing to opt for on-demand ride-hailing during the pandemic, in comparison to the 30.0% that would have opted for it prior to the pandemic. This however came at the detriment of the most common public transport form (trotro) which experienced a decline from 64.0% to 28.6%. The gains for ride-hailing and losses for trotros were also consistent across all age groups despite cost and time being constant. The results suggest the outbreak of COVID-19 and concerns surrounding its infectious nature had implications for travel choice considerations in Ghana. The outbreak as well exposed the vulnerabilities of the transport service in light of public health shocks, although mode preference changes are not expected to last.

Introduction
According to Dzisi and Dei (2020), public transportation in Ghana saw significant changes in operations during the outbreak of COVID-19. The coronavirus disease, which is a highly transmissible pathogenic viral infection that affects the respiratory system of the host organism, saw rapid human to human transfer (Shereen et al., 2020) in Ghana since the first recorded cases in the country. To help curb the rate of spread of the virus, guidelines were issued to transport operators to reduce the number of passengers on board public transport vehicles. Commuters were also encouraged to observe physical distancing within vehicles, wear face masks, and wash their hands regularly. Based on a roadside observation on the compliance of operators and commuters with these guidelines, it was determined that majority (98.0%) of operators complied with the policy.
on in-vehicle physical distancing, although only 12.6% of buses were compliant with the policy on mass masking in Ghana (Dzisi & Dei, 2020).

Poku-Boansi and Adarkwa (2013) note that the time taken by commuters to make trips, irrespective of the purpose in Ghana, ranges from 15 to about 80 minutes, along average route lengths of between 7.2 km to 14.5 km. This made public transport fall under the category of high-risk environments, since most public transport forms in Ghana had lesser than the 2 m minimum required spacing that could ensure a lower chance of transmission of the virus, and as well, exceeded in most cases, the maximum contact time of 15 min (Dzisi & Dei, 2020; Keeling et al., 2020).

Universally, there are no physical distance thresholds for categorizing trips as either 'long', 'medium' or 'short'. Despite this, different countries have designated certain distance thresholds for particular purposes in national travel (Limtanakool et al., 2006). This study borrows from the categorization given to trips of 10 km and above as 'long distance trips' as done by Agyemang (2017) and Amoh-Gyimah and Aidoo (2013) to categorize trips greater than 10 km in Ghana as 'long distance' trips.

Long distance trips in particular were also examined because they exceeded the average reasonable distance (<5 km), for which commuters would have been willing to walk or cycle (Jain & Tiwari, 2013). Consequently, changes in commuter mode preferences were expected to highlight commuters’ state of mind, and to help anticipate potential long-term change in mode choice and travel patterns post pandemic. Public transport modes (trotro, chartered taxi and ride-hailing) that were considered feasible for such trips were specifically selected, and commuters’ preference or otherwise of these modes evaluated during the pandemic.

Trotros which are a form of informal public transport were the first mode considered feasible for this study on intracity long distance trips. Trotros are according to Abane (2011) the most preferred mode of transport for majority of commuters in urban Ghana. These minibuses are the cheapest mode of transport, and the most reliable form of commute. Trotros however have a generally lower service quality, and are notorious for being overcrowded. Chartered taxis which are another form of commute, were the second most viable mode of transport for such trips. Chartered taxis are however, significantly more expensive since the price agreed upon between the commuter and the driver is based on a rough estimate of the travel distance. Unlike the minibus trotro, taxis however have smaller occupancies, with a total capacity of five passengers, making them a much more preferable, if not safer mode of travel in the face of an infectious disease outbreak. When chartered, a person gets to travel only with the driver or in the company of known associates. Ride-hailing, which is a recent feature on the public transport scene in Ghana was the third and final transport option evaluated in the study. While ride-hailing shares some similarities to chartered taxis, it provides an added advantage of being easily accessed via mobile phone app, and offers cheaper fares to chartered taxis (Dzisi et al., 2020). These cheaper fares are the result of a metered pricing system, and the use of GPS and other smart technologies that help the drivers to be much more efficient in their operations. Easier access via mobile phone app also implies one can access transportation from the comfort of their present location without having to go to the roadside to hail a cab. These reasons make ride-hailing popular among young people, with factors such as safety, convenience and security also factoring in its use.
Literature review

According to IEA (2020), mass transport, which brings together people in close proximity of each other, faces the most tangible behavioral changes during health crises such as the COVID-19 pandemic. The outbreak of the Severe Acute Respiratory Syndrome (SARS) epidemic in 2003 changed the transport mode choice of several people in affected countries. In Taipei, Taiwan, this was evident in the changes recorded in underground train ridership levels at the time. Using data from ridership levels and the daily reported new cases, dynamics of public fear concerning the spread of infection in the city were modelled. Consequently, it was estimated that the outbreak in the city resulted in a reduction of about one thousand two hundred underground rail service users every time a new case of SARS was reported. These losses were immediate and took on average, 28 days to dissipate. In total, about 50% of underground ridership was lost during the peak of infection in 2003 (Wang, 2014), taking about four months for ridership levels to return to pre-crisis levels (IEA, 2020).

In a survey of about 28,000 adults in 14 countries, Skinner (2020) found that majority of people in India (78%), Japan (77%), United Kingdom (71%) and Mexico (71%) were apprehensive about the reopening of businesses and transport during the peak of the COVID-19 pandemic. People in these countries also thought that the economy and businesses should not be open until the virus was fully contained. In Ghana, earlier studies suggest there were heightened levels of concern about COVID-19 even prior to the lockdowns. Majority (68.3%) of people had a high-risk perception towards COVID-19, about 78.3% stated they were worried about the outbreak of the disease, and 67.4% perceived themselves as being at high risk of contracting the disease (Serwaa et al., 2020).

Some of these concerns also have had impact on other aspects of daily life. A survey by the Ghana e-commerce association before, during, and after the partial lockdowns in Accra and Kumasi showed about 85% of people avoided public places such as malls, markets, and supermarkets during the outbreak, with 98% stating they would as well continue to avoid such places in the event of an intensified outbreak. The survey also revealed a shift towards e-commerce, with over 94% of respondents willing to use online shopping services during the period. About 89% also stated they would continue using such services well after COVID-19 and 60% were willing to even accept delays in delivery of their wares. The use of mobile money payments was preferred over cash or debit card payments, with concerns about possible infection being the primary reason for this choice (Asinor, 2020; KPMG Ghana, 2020).

Naveen and Anders (2020) and Ratten (2020), acknowledge that the COVID-19 pandemic helped to open new markets for many new businesses. The pandemic especially created new user demographics for e-commerce businesses and resulted in the launch of many startups (Wharton Business School, 2020). In countries such as Denmark, factors such as the convenience, risk of pandemic, intensified online competition and new distribution and logistics capacities made e-commerce particularly attractive for even elderly folk (Nyrop et al., 2020).

De Vos (2020) also asserts that the COVID-19 virus which primarily spreads by air droplets (Howard et al., 2020), has influenced the frequency of travel across many parts of the world. Some of these changes have been observed in aviation (Mhalla, 2020), marine and public transit (Bird et al., 2020). Public transit in many developing cities including
Addis Ababa, Nairobi and Johannesburg noticeably have operated at only about 60% of normal capacity. In Brazil, public transit experienced losses of about 188 USD million as a result of COVID-19 (Grillo, 2020). This has been the case across many parts of the world, with losses to public transit, severely affecting operations and possible recovery post pandemic. In Ghana, visits to public transit stations experienced an average decline of 22.1% between February 2020 and July 2020. This figure was 46.9% in South Africa, 34.8% in Rwanda, 45.3% in Uganda, 37.4% in Brazil and 47.8% in Spain over the same time period. Figure 1 shows how the pandemic affected visits to transit stations in six countries, and the gradual return to normalcy following the first lockdown in these countries.

Bird et al. (2020) note that the international response to COVID-19 made it reasonable to assume the public’s response to the virus would exceed that of the 2003 SARS epidemic. Although public transportation under such circumstances faces significant challenges, captive riders could still be expected to adopt some form of public transport for their most essential trip making (Ardila-Gomez, 2020). With heightened concerns about public transport observed during the period (Frimpong, 2020; GNA, 2020), there was interest in evaluating the changes in behaviors of commuters towards public transport modes during the pandemic. The study as well specifically sought to compare ride-hailing (which is an e-commerce type business) to traditional public transport (chartered taxis and trotros) forms to determine if the mode experienced any changes in commuters’ preference for it, as had been the case for other e-commerce businesses during the period (Asinor, 2020; Naveen & Anders, 2020; Wharton Business School, 2020).

![Figure 1](image-url)
Methodology

Using a stated preference online survey, this study aimed at evaluating possible changes in mode preferences as a result of the pandemic. The study focused on changes in preferences because there was an assumption that changes in preferences could determine changes in behavior (Collins & Chambers, 2005). Changes in commuter preferences suggested that these were changes that commuters had given some consideration, and reflects their state of mind concerning their mode choices during the outbreak. Respondents were asked among several other questions, about their preferred public transport choice prior to, and during the outbreak of COVID-19. Respondents were as well asked about the impact of the virus on their mode choice.

The survey which was conducted over a one-month period in May 2020, followed a state-issued lockdown in the cities of Accra and Kumasi, Ghana. Respondents were presented with the public transport mode choices (trotro, taxi and ride-hailing services), with varying costs, travel times and number of stops (Table 1), in a format that sought to replicate a typical long-distance intracity trip choice (≥10 km) (Agyemang, 2017; Amoh-Gyimah & Aidoo, 2013). The use of public transport options in the survey was because of the assumption that longer distances even during the pandemic would most warrant public transport choices (Ardila-Gomez, 2020).

The online questionnaire was distributed using mainly, a bulk short message service (sms) company which was asked to send the link of the online Google forms questionnaire via text message to random participants. Respondents were as well asked to identify their locations, and gave their cellphone numbers for verification and validation purposes.

Based on Ghana’s population of 27,000,000 people, a 95% confidence interval and 4% margin of error, a minimum sample size of 601 respondents was calculated. The survey’s eventual sample of 1100 respondents was therefore considered adequate for carrying out further analysis. The data collected were analyzed using descriptive statistics, parametric and non-parametric tests.

Table 1 shows the various public transport options, their costs, travel times, and number of stops from which commuters were to make a choice. The data represents real transport fares and typical operation parameters aggregated for each of the modes for a 15.4 km long trip.

Results age and gender of respondents

The majority (62.3%) of respondents were male, and 37.7% were female. About 81.4% of them were 30 years old or younger, with the age group between 31 and 50 years being about 15.2%. In comparison, about 56.08% of the Ghanaian population is below the age of 25, and 34.27% is between the ages of 25 and 54 years (Indexmundi, 2020).

| Mode              | Trotro | Ride-hailing | Chartered Taxi |
|-------------------|--------|--------------|----------------|
| Cost              | Gh₵ 2.5| Gh₵ 30       | Gh₵ 40         |
| Travel time       | 1 h    | 40 min       | 40 min         |
| Number of Stops   | 1–3    | 0            | 0              |
Primary mode of transport

The majority (60.1%) of respondents identified the *trotro* as their main mode of transport. This was followed by taxis which had a modal share of about 11.8%, and walking which had a modal share of 9.9%. Private vehicles were the fourth most popular mode of transport with 9.7% of the modal share. Following this was ride-hailing which made up 4.8% and bicycling which constituted 3.8% of the total modal share.

Impact of COVID-19 on mode choice

Asked on the possible impacts of the virus on their mode choices during the outbreak, 73.2% stated that COVID-19 had temporarily affected their mode choice, and 26.8% stated it had no impact on their choice of mode.

Changes in mode preferences during COVID-19 pandemic

Respondents were further asked to state their mode preferences prior to and during COVID-19 based on the choice sets presented them. Figure 2 shows these modal preferences prior to, and during the pandemic. Close to 64.0% of commuters stated they were willing to choose the para-transit service (*trotro*) in comparison to 30.0% for ride-hailing services and 6% for chartered taxis prior to the pandemic. However, when asked on their mode preferences between these same modes during the pandemic, the proportion willing to use para-transit dropped to 28.6%, with the modal share for ride-hailing rising to 59.0%, and that of taxis also increasing to 12.4%.

Non-parametric tests (marginal homogeneity and McNemar’s tests)

Marginal Homogeneity and McNemar’s tests which are used in testing the homogeneity between paired data were employed in determining the statistical significance of the changes in mode preferences. The results suggest that there was a statistically significant

![Figure 2. Changes in mode preferences during COVID-19 pandemic.](image-url)
difference between mode preferences before and during the outbreak, \( p = 0.001 \). A post-hoc analysis in the form of an exact McNemar test was further conducted to determine the statistical significance of differences between the various sub-groups. The results indicated statistically significant differences as well between trotro and ride-hailing preference, \( p = 0.001 \) and between trotro and chartered taxi preference, \( p = 0.001 \) before and during the outbreak. The test however determined that there was no statistically significant difference in the proportions of ride-hailing and taxi preference, \( p = 0.268 \) before and during the pandemic. The results are summarized in Table 2.

### Changes in mode preference across different age groups

Changes in mode preference during the period were also cross analyzed across the different age groups. Figure 3 shows the shifts in mode preference across all age groups. Table 3 shows a breakdown in mode preferences across the various public transportation options. The percentage change in mode preference has also been indicated for each of the modes. The results show that, across all groups, shifts in mode preference towards ride-hailing were consistent. Reduction in the preference of trotro was also consistent among all age groups.

### Discussion

While the role of public transportation in the spread of COVID-19 has remained in dispute (Ardila-Gomez, 2020), this perception has only evolved with increased use of public transport systems post lockdown (Schwartz, 2020). Earlier attempts at curbing the spread of COVID-19 involved the adoption of best practice learned during the SARS pandemic in 2003 (Wang, 2014; Wilder-Smith et al., 2020). For public transport, this meant the use of in-vehicle physical distancing and face masks as mitigation measures (Ansah, 2020; Dzisi & Dei, 2020). Additionally, public transport operators were expected to ensure certain levels of enhanced hygiene. Besides all these measures, there were also state-issued lockdowns aimed at reducing movement and possible spread of the disease, with calls for shutdowns (Frimpong, 2020) and reduced operations of public transit (GNA, 2020).

In Ghana, earlier studies showed heightened concerns about possible infection (Serwaal et al., 2020) during the pandemic, which were consistent with concerns about public transport use in other parts of the world (Skinner, 2020). These concerns have without doubt impacted on public transport, and perhaps mode choice among commuters in Ghana as well.

| Table 2. Pairwise comparison of mode preferences before and after COVID-19. |
|---------------------------------------------------------------|
| Before: After | p-Value | Test statistic |
| Trotro vs Ride-hailing vs Taxi | 0.001 | −16.458 |
| **Post-hoc analysis (McNemar test)** | | |
| Trotro vs Ride-hailing | 0.001 | 274.776 |
| Trotro vs Taxi | 0.001 | 61.455 |
| Ride-hailing vs Taxi | 0.268 | 1.225 |
In the absence of noticeable changes to encourage non-motorized transport (NMT) use (Athumani, 2020; Kaufman & Tanzilli, 2020; UN-Habitat, 2020), public transport options remained in Ghana, some of the primary means by which transport deprived groups could still make essential trips during the outbreak of COVID-19. It was therefore important to assess public transport preferences of commuters, to determine potential transport-related behavioral changes as a result of the pandemic. Focus was especially placed on longer distance trips, since these types of trips represented the average trip lengths between trip attraction zones in urban Ghana.

Under pandemic situations, advantages and disadvantages of various modes of transport become even more apparent to commuters, and choice of modes that seem presumably ‘safer’ may supersede typical choice of such modes in non-pandemic times. In this study, changes in preference of modes for intracity long distance trips (Agyemang, 2017) are considered. Significantly, the study notes a change in paratransit (trotro) preference, with a reduction from 64.0% to 28.6% during the pandemic. Taking its place in modal share was ride-hailing which experienced an increase in preference from 30.0% prior to the pandemic to 59.0% during the pandemic. Chartered taxis also experienced a growth in preference from 6.0% to 12.4% during the course of the pandemic. The changes in mode preference among these modes despite the fixed cost and travel time presented to commuters suggests that the outbreak of COVID-19 had some impact on travel mode preferences. The significance of these changes in mode preferences were also

**Figure 3.** Changes in mode preference across age groups.

![Changes in mode preference across age groups](image-url)
examined with the Marginal Homogeneity and McNemar tests for statistical significance. The results suggest that, indeed, the change in mode preference were statistically significant, although the post-hoc analysis showed the changes in preference between taxi and ride-hailing were not statistically significant, $p= 0.268$. A cross analysis of the different age groups also revealed that increased preference for ride-hailing was consistent across all age groups, and decreases in trotro preference were also consistent across all age categories. Asked about the impact of COVID-19 on mode choice, 73.2% stated the outbreak had temporarily changed their mode choice, although 26.8% stated otherwise. Put together, the results suggest the outbreak of COVID-19 had a significant impact on traveler mode preference around the period of the lockdowns in Ghana.

For ride-hailing this implies certain traveler groups may have been more willing to adopt this mode of transport, potentially opening up new markets among certain commuter groups. For minibuses (trotro), this also suggests a change in mode choice for some commuters, some of whom view the service as their primary mode of transport. The permanence of these mode changes however requires further examination. However, it could be assumed changes in preference are for the short term, and that users would likely opt for the most affordable transport options so long as ‘safety’ is no longer a concern.

**Building resilience of public transport operations for COVID-19 and future pandemics**

Some of the most significant changes that can be made in public transport operations beyond the pandemic include the incorporation of technologies such as metered pricing
systems, Global Positioning System (GPS) tracking and Automatic Vehicle Location (AVL) systems in public transport options. Although ambitious for a public transportation service that is mainly run by the informal sector, these could significantly help improve the amount of information travelers have on their mode of choice especially during public health crises (such as Ebola or COVID-19). The incorporation of some level of technology could further be used in enhancing contact tracing efforts and increase the amount of trust commuters have in the transport system even during pandemics. These changes could also contribute in making public transport more resilient. However, these measures require thorough planning, a retrofitting of solutions to local contexts, and large-scale investments for best outcomes.

**Conclusion**

In conclusion, although choice between different modes of transport is dependent upon fares, car ownership, service quality, salaries, etc., in the event of global pandemics, additional factors may inform commuter mode choices. When presented with three public transport options, commuters showed greater inclination towards ride-hailing as their mode of choice during COVID-19 for intracity long distance (≥10 km) trips. This happened despite ride-hailing being an alternative that was more expensive as compared to minibus taxis (trotros). Ride-hailing was also preferred over chartered taxis, perhaps because it was comparatively cheaper and significantly more convenient to access, as compared to the latter. Based on these findings, it can be concluded that the outbreak of COVID-19 had a significant impact in mode choice considerations of commuters across all age groups in Ghana. However, these changes are not anticipated to be permanent.

**References**

Abane, A. M. (2011). Travel behaviour in Ghana: Empirical observations from four metropolitan areas. *Journal of Transport Geography, 19* (2), 313–322. [http://www.sciencedirect.com/science/article/B6VG8-504TP3C-1/2/c8ceff56d2a626604f9b81df36c3e11c](http://www.sciencedirect.com/science/article/B6VG8-504TP3C-1/2/c8ceff56d2a626604f9b81df36c3e11c)

Agyemang, E. (2017, October). Mode choice for long distance trips: Evidence from the Greater Accra Metropolitan Area of Ghana. *Journal of Transport Geography, 64*(2017), 150–157. [https://doi.org/10.1016/j.jtrangeo.2017.09.003](https://doi.org/10.1016/j.jtrangeo.2017.09.003)

Amoh-Gyimah, R., & Aidoo, E. N. Mode of transport to work by government employees in the Kumasi metropolis, Ghana. (2013, July). *Journal of Transport Geography 31*, 35–43. [https://doi.org/10.1016/j.jtrangeo.2013.05.008](https://doi.org/10.1016/j.jtrangeo.2013.05.008)

Ansah, M. (2020). COVID-19 commercial vehicles ordered to carry fewer passengers. Retrieved from Citinewsroom.com website [https://citinewsroom.com/2020/03/commercial-vehicles-ordered-to-carry-fewer-passengers-to-curb-spread-of-covid-19/](https://citinewsroom.com/2020/03/commercial-vehicles-ordered-to-carry-fewer-passengers-to-curb-spread-of-covid-19/)

Ardila-Gomez, A. (2020). In the fight against COVID-19, public transport should be the hero, not the villain. Retrieved from World Bank Blog website [https://blogs.worldbank.org/transport/fight-against-covid-19-public-transport-should-be-hero-not-villain](https://blogs.worldbank.org/transport/fight-against-covid-19-public-transport-should-be-hero-not-villain)

Asinor, P. (2020). COVID-19 and the e-commerce surge. Business and Financial Times Online. Retrieved from TheBFTOnline.com website [https://thebftonline.com/2020/editors-pick/covid-19-and-the-e-commerce-surge/](https://thebftonline.com/2020/editors-pick/covid-19-and-the-e-commerce-surge/)

Athumani, H. (2020). With lockdown ban on cars, bike business booms in Uganda voice of America. Retrieved from VOAnews website [https://www.voanews.com/africa/lockdown-ban-cars-bike-business-booms-uganda](https://www.voanews.com/africa/lockdown-ban-cars-bike-business-booms-uganda)
Bird, J., Kriticos, S., & Tsivanidis, N. (2020). Impact of COVID-19 on public transport. International Growth Centre (IGC). Retrieved from IGC website: http://www.ncbi.nlm.nih.gov/pubmed/32699574%0Ahttp://www.pubmedcentral.nih.gov/articlerender.fcgi?artid=PMC7370821

Collins, C. M., & Chambers, S. M. (2005). Psychological and situational influences on commuter-transport-mode choice. *Environment and Behavior, 37*(5), 640–661. https://doi.org/10.1177/0014018704265440

De Vos, J. (2020). The effect of COVID-19 and subsequent social distancing on travel behavior. *Transportation Research Interdisciplinary Perspectives, 5*, 100121. https://doi.org/10.1016/j.trip.2020.100121

Dzisi, E. K., Ackaah, W., Aprimah, B. A., & Adjei, E. (2020). Understanding demographics of ride-sourcing and the factors that underlie its use among young people. *Scientific African, 7*, e00288. https://doi.org/10.1016/j.sciaf.2020.e00288

Dzisi, E. K. J., & Dei, O. A. (2020). Adherence to social distancing and wearing of masks within public transportation during the COVID 19 pandemic. *Transportation Research Interdisciplinary Perspectives, 7*, 100191. https://doi.org/10.1016/j.trip.2020.100191

Frimpong, E. D. (2020). Citizen Ghana proposes shutdown of “trotro” system, other measures to prevent Coronavirus spread - Graphic Online. Modern Ghana. Retrieved from Graphic Online website: https://www.graphic.com.gh/news/general-news/citizen-ghana-proposes-shutdown-of-trotro-system-other-measures-to-prevent-coronavirus-spread.html

GNA. (2020). Coronavirus stop trotro from fully loading passengers to avoid spread. Retrieved from Modernghana.com website: https://www.modernghana.com/news/990650/coronavirus-stop-trotro-from-fully-loading-passen.html

Grillo, B. (2020). Quarantine takes its toll on Brazil’s public transport companies. Retrieved from The Brazilian report website: https://brazilian.report/business/2020/04/12/quarantine-takes-toll-brazil-public-transport-companies/

Howard, J., Huang, A., Li, Z., Tufekci, Z., Zdimal, V., & Westhuizen, H. von Delft, A., Price, A., Fridman, L., Tang, L., Tang, V., Watson, G. L., Bax, C. E., Shaikh, R., Questier, F., Hernandez, D., Chu, L.F., Ramirez, C.M., Riomoin, A.W. 2020. Face masks against COVID-19 : An evidence review, April, 1–8. https://doi.org/10.20944/preprints202004.0203.v1

IEA. (2020). Changes in transport behaviour during the Covid-19 crisis. International Energy Agency. https://doi.org/10.1111/j.1539-6924.2006.00753.x

Indexmundi. (2020). Ghana demographics profile. IndexMundi.com. https://www.indexmundi.com/ghana/demographics_profile.html

Jain, D., & Tiwari, G. (2013). NMT infrastructure in India: Investment, policy and design. UNEP Riso Centre on Energy, Climate and Sustainable Development.

Kaufman, B., & Tanzilli, M. (2020). COVID-19 made cities more bike-friendly – How to keep them that way. Retrieved from World Economic Forum website: https://www.weforum.org/agenda/2020/06/covid-19-made-cities-more-bike-friendly-here-s-how-to-keep-them-that-way/

Keeling, M. J., Hollingsworth, T. D., & Read, J. M. (2020). Efficacy of contact tracing for the containment of the 2019 novel coronavirus (COVID-19). *Journal of Epidemiology and Community Health, 74*(10), 861–866. https://doi.org/10.1136/jech-2020-214051

KPMG Ghana. (2020). COVID-19 evolving frauds in consumer markets. KPMG International Cooperative. https://home.kpmg/gh/en/home/insights/2020/04/covid-19-evolving-frauds-in-consumer-markets.html

Limtanakool, N., Dijkstra, M., & Schwanen, T. (2006). The influence of socioeconomic characteristics, land use and travel time considerations on mode choice for medium- and longer-distance trips. *Journal of Transport Geography, 14*(5), 327–341. https://doi.org/10.1016/j.jtrangeo.2005.06.004

Mhalla, M. (2020). The impact of novel coronavirus (COVID-19) on the global oil and aviation markets. *Journal of Asian Scientific Research*, 10(2), 96–104. https://doi.org/10.18488/journal.2.2020.102.96.104

Naveen, D., & Anders, G. (2020, January). Effects of COVID-19 on business and research. *Journal of Business Research*, 117(2020), 284–289. https://doi.org/10.1016/j.jbusres.2020.06.008
Nyrop, M., Alexander, N., Lindquist, M. B., & Karlsen, J. T. (2020). COVID-19 will permanently change e-commerce in Denmark. in deloitte https://webcache.googleusercontent.com/search?q=cache:AMitYU0Y_QMJ:https://www2.deloitte.com/content/dam/Deloitte/dk/Documents/strategy/e-commerce-covid-19-onepage.pdf+&cd=14&hl=en&ct=clnk&gl=gh&client=firefox-b-d

Poku-Boansi, M., & Adarkwa, K. K. (2013). The determinants of demand for public transport services in Kumasi, Ghana. Journal of Science and Technology, 33(3), 60–72. https://doi.org/10.4314/just.v33i3.7

Ratten, V. (2020). Coronavirus (covid-19) and entrepreneurship: Changing life and work landscape. Journal of Small Business and Entrepreneurship, 32(5), 1–14. https://doi.org/10.1080/08276331.2020.1789933

Schwartz, S. (2020). Transit safe and vital to reopen. New York Daily News. https://www.nydailynews.com/opinion/ny-oped-our-covid-response-could-worsen-unrest-20200608-af5nwb66nawffu77kkvurhq6q-story.html

Serwaa, D., Lamptey, E., Appiah, A. B., Kumi Senkyire, E., & Ameyaw, J. K. (2020). Knowledge, risk perception and preparedness towards coronavirus disease-2019 (COVID-19) outbreak among Ghanaians a quick online cross-sectional survey. Pan African Medical Journal, 35(2), 44. https://doi.org/10.11604/pamj.supp.2020.35.2.22630

Shereen, M A., Khan, S., Kazmi, A., Bashir, N., & Siddique, R. (2020). COVID-19 infection: Origin, transmission, and characteristics of human coronaviruses. Journal of Advanced Research, 24 (2020): 91–98 24.03.005 doi:10.1016/j.jar.2020.03.005

Skinner, G. (2020). Britons least likely to believe the economy and businesses should open if Coronavirus not fully contained. Ipos MORI. https://www.ipsos.com/ipsos-mori/en-uk/britons-least-likely-believe-economy-and-businesses-should-open-if-coronavirus-not-fully-contained

UN-Habitat. (2020). Uganda’s capital promotes cycling to protect against COVID-19. United Nations Human Settlements Programme. https://unhabitat.org/uganda’s-capital-promotes-cycling-to-protect-against-covid-19

Wang, K.-Y. (2014). How change of public transportation usage reveals fear of the sars virus in a city. Plos One, 9(3), e89405. https://doi.org/10.1371/journal.pone.0089405

Wharton Business School. (2020). Startups are finding the sweet spot in a downturn. Wharton School of the University of Pennsylvania. Retrieved from Wharton Business Daily website: https://knowledge.wharton.upenn.edu/article/mollick-pandemic-startups/

Wilder-Smith, A., Chiew, C. J., & Lee, V. J. (2020). Can we contain the COVID-19 outbreak with the same measures as for SARS? The Lancet Infectious Diseases, 20(5), e102–e107. https://doi.org/10.1016/S1473-3099(20)30129-8