COVID-19 and public transport services in cities: emerging challenges and research agenda

Aaron Gutiérrez[1]*, Daniel Miravet[23], Antoni Domènech[1]

[1] Universitat Rovira i Virgili, Department of Geography, 43480 Vila-seca, Spain
[2] Consortium of Public Transport of Camp de Tarragona, 43004 Tarragona, Spain
[3] Universitat Rovira i Virgili, Department of Economics, Research Centre on Economics and Sustainability (ECO-SOS), 43204 Reus, Spain
* corresponding author: aaron.gutierrez@urv.cat

Abstract

This article explores the implications that the COVID-19 pandemic will have for public transport services. Three elements are explored. The first involves the short-term effects. The second refers to the global challenges emerging from the pandemic with special attention to the dimensions of cities' public health, urban space management, and planning that will come from the paradigm shift in mobility. Finally, future research directions are assessed with an important focus on how researchers should advance not only in the monitoring of pandemics evolution, but also in the worldwide construction of healthier and more sustainable cities for the improvement of social wellbeing.

Keywords: COVID-19, public transport, sustainable mobility, cities

1. Introduction

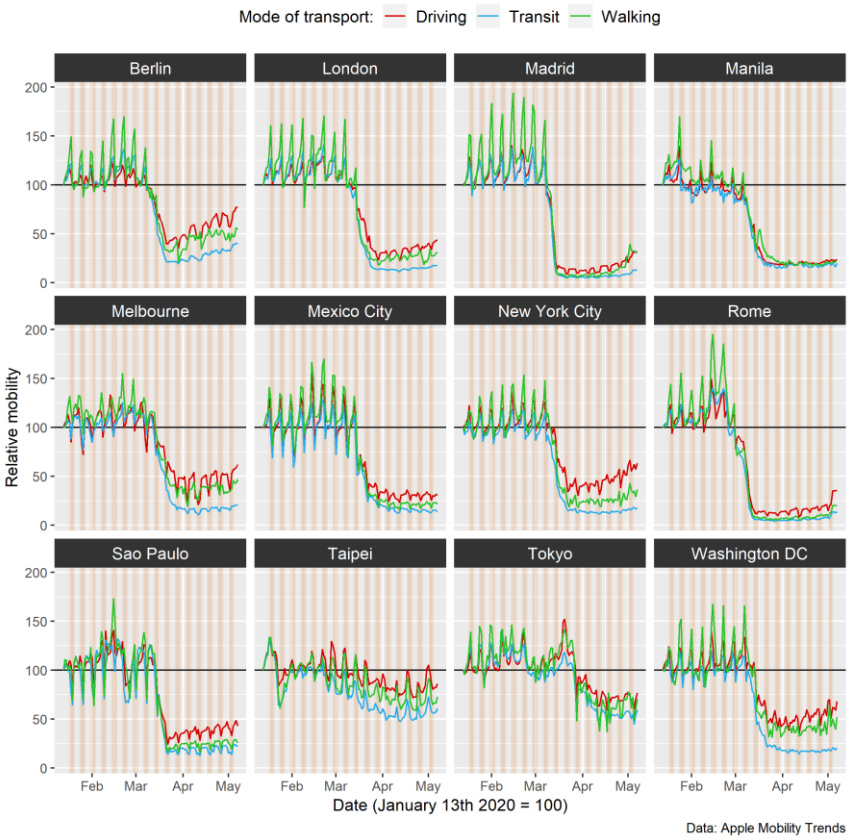
In recent years a wide consensus among researchers and city planners has been reached regarding the benefits of promoting the use of public transport for urban mobility. In the first place, it is key in the decarbonization strategy to mitigate climate change. The direct benefits on individuals' health are not negligible. They encompass the improvement of air quality in densely populated areas, a higher demand for active modes of transport (walking or cycling) as opposed to the use of private vehicles (which more often implies unimodal chains), and finally, it is a less stressful activity in comparison to driving. Finally, public transport is a successful tool to make cities more equal—not only in economic terms but also in terms of access to public services, including healthcare services.

The scenario has dramatically changed with the spread of SARS-CoV-2. Along with limitations of human mobility, cities and metropolitan areas have discouraged or even imposed restrictions to the use of public transport (Tian et al., 2020). It has been signaled as a driver of the spread of the infection in densely populated cities (Buja et al., 2020). Moreover, as studies in previous SARS pandemics reveal (Wang, 2014), the fear of getting infected generates more reluctance to use public transport services. **Fig.1** shows the trends of modal change in twelve large cities. Within the global pattern of drastic mobility reduction, a more severe decline in public transport use is noticed.

The latest projections portray a scenario in which, with no available vaccine or effective treatment, regular physical distancing measures will still be necessary until 2022 (Kissler et

al., 2020). Cities must deal with a paradigm change as some of the implications from the pandemic will likely result in long-lasting effects.

Figure 1. Relative mobility trends by transport mode according to requests for directions in Apple Maps from January 13th to May 13th 2020.



Notes: Data indexed to 100 (January 13th 2020). Weekends shown as vertical orange bars. Transit refers to public transport in cities (bus, metro and ferry). The data is aggregated from requests for directions in Apple Maps.
Source: Apple Mobility Trends Reports (https://www.apple.com/covid19/mobility)

2. COVID-19 short-term effects on public transport services

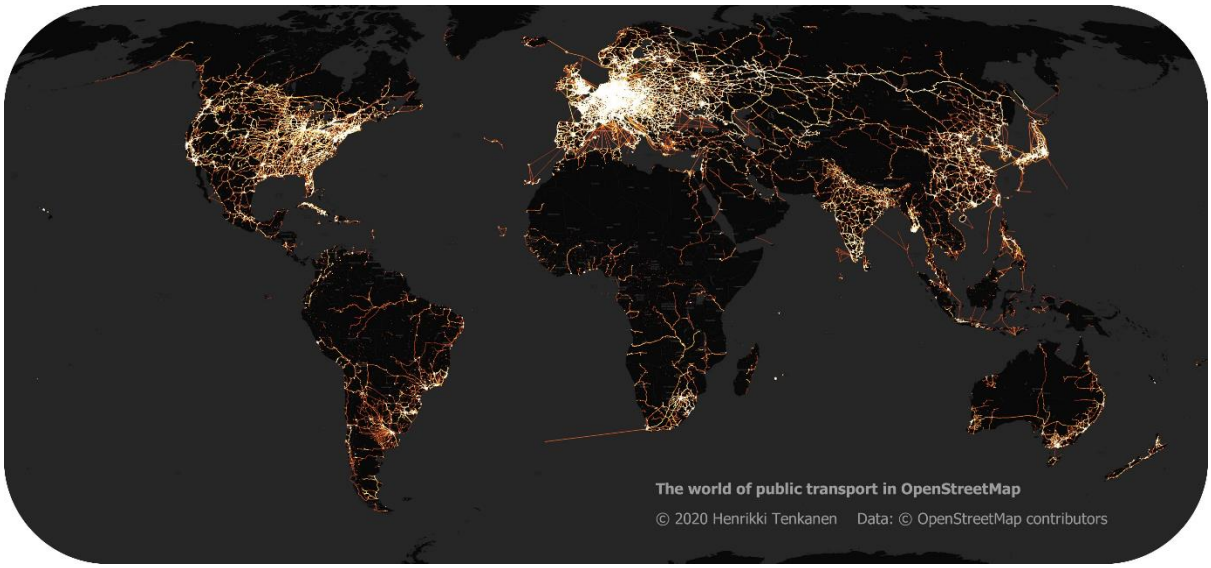
Measures to contain the spread of SARS-CoV-2 have resulted in unprecedented restrictions in the use of public space and mobility. These restrictions have been more severe for public transport as it is seen as a vector of transmission. The alarm messages released by public authorities to avoid the use of public transport (such as UK PM Johnson's "avoid public transport if at all possible") have been assimilated by citizens with a twofold outcome. On the one hand, fast growth of micromobilities—based on active modes, temporary planning measures involving pedestrianization, creation of new bike lanes, and road closures—has emerged. On the other hand, the use of public transport is attached to a risk for health and inflicts stress on its users—hence, a shift from public transport to private vehicles has been reported (see **Fig.1**).

Renewed social and health imbalances emerge between those who are able to avoid mass public transport services (those able to telework or travel by private car) and those who must

travel daily by public transport. Preliminary reports on the uneven COVID-19 impact in cities such as Barcelona, Paris, and New York suggest the imbalances as explanatory factors of the higher impact of the disease in working-class neighbourhoods.

Inequalities and negative effects are further accentuated in cities of the Global South immersed in a context of massive urbanization, increased population density, shortages of medical protection, and lack of preparedness to detect and cope with COVID-19. Although public transport networks are generally more limited in the Global South (see **Fig.2**), the existence of paratransit services—informal transportation which operates between the public and individual private sphere (Behrens et al. 2015)—may act also as vectors of transmission of the disease, since drivers tend to overcrowd vehicles to maximise benefits.

Figure 2. The world public transport network



Source: Henrikki Tenkanen with Pyrosm tool

3. New global challenges for public transport services

While writing this commentary we are still in the early stages of the pandemic. The level of uncertainty is huge and the debate on the long-term effects is just emerging. Nevertheless, the global dimension of the COVID-19 crisis allows us to forecast some critical mid- and long-term transformations and new global challenges (see **Fig.3** where the effects and challenges around COVID-19 and public transport in cities are summarized).

3.1. Provision of safe and reliable public transport services as a critical issue

Transport operations will have to guarantee that the risk of contagion is under control both on-board and during passenger wait times. Masks will be part of the usual landscape. Services must be flexible to satisfy users' needs; at the same time, must adjust to limitations on occupation rates to enforce physical distance. Technology may also play a role with the implementation of contactless systems and investments in air renovation and filtering systems.

It is not just a matter of mitigating the risk of contagion, but also of helping people feel comfortable in relying on the safety of public transportation. The fear of getting infected due to

public transport is real and important, as it is associated with unpleasant and stressful situations that might lead to more serious mental health problems.

A shift in users' preferences towards less crowded and more flexible systems is highly likely. Transport operators' success will be contingent on their responsiveness to augment capacities (even though part of this capacity is intendedly left unused), the widening of multimodal systems with integrated fare systems, and the use of up-to-date technologies to provide services and to communicate with their users. Multimodality and co-modality will be required, since the most suitable transport combination may vary as the risk level evolves.

3.2. Sustainable and healthy urban mobilities now require new efforts

The disruptive moment of the pandemic could be used to reconfigure healthier and more sustainable cities as much as possible. As previously mentioned, many cities have considerably increased the space available for pedestrians and cyclists. This is not difficult when mobility as a whole has plummeted. As soon as mobility approaches pre-crisis levels, making these decisions permanent will not be easy. Nevertheless, there is a clear open opportunity: current temporary actions could inspire permanent policies.

Public transport demand will be shaped by its interaction with other modes of transport. It is not only a matter of competitiveness, multimodality, or even co-modality; how public spaces are redistributed is a cornerstone. Cities will be forced to decide which modes of transport they intend to support and promote.

The increase of space dedicated to public transit has so far been small, mainly because its demand is still far below pre-COVID-19 levels. Ideally, the combined on-street preponderance of active modes of transport together with public transport should decisively favour more sustainable and healthy modal choices when mobility grows again.

3.3. The potential exacerbation of inequalities

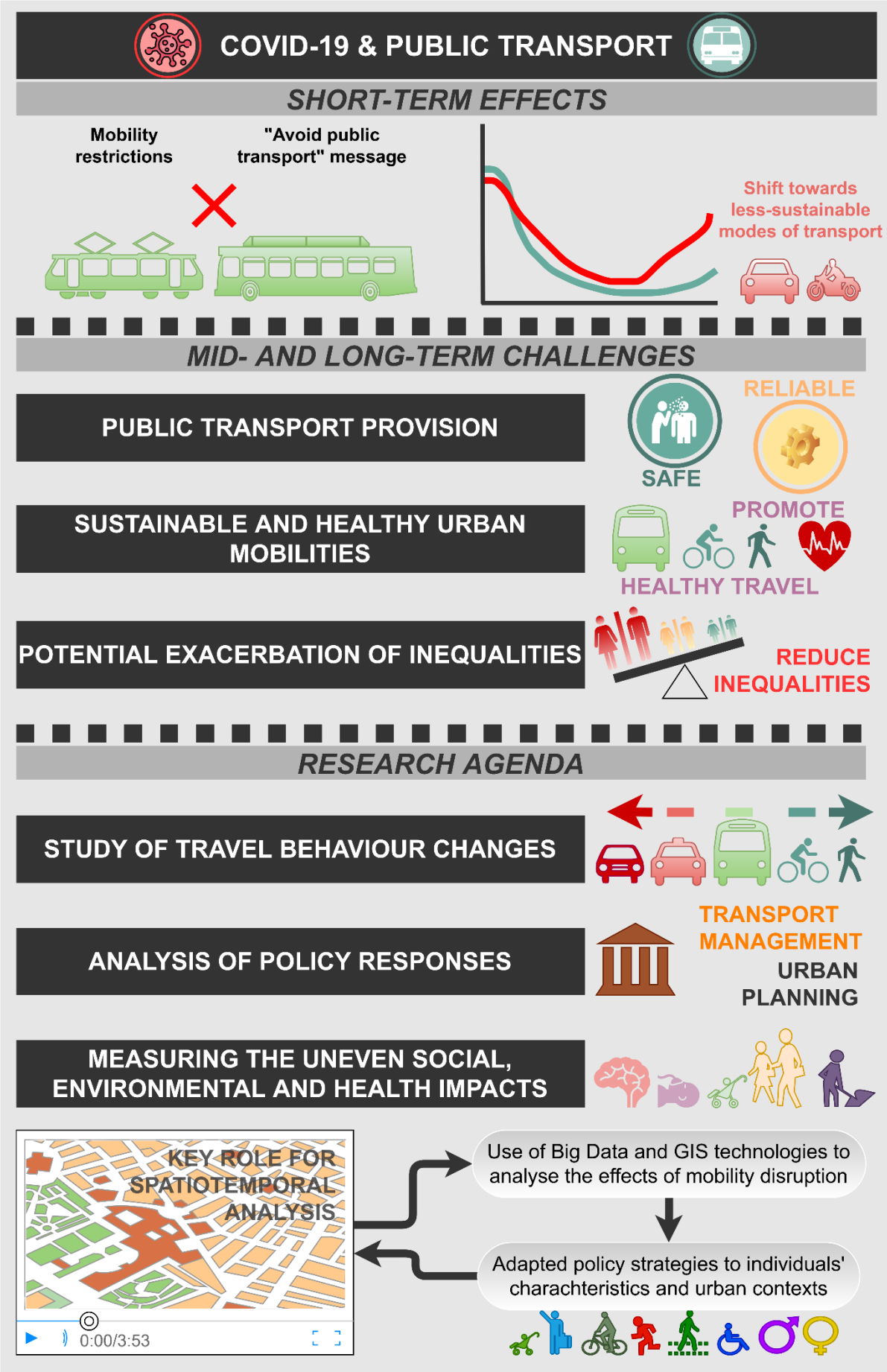
As in all crises, the resilience of different groups is uneven; the most vulnerable social groups are typically the most affected. The pandemic can, therefore, contribute to exacerbating the negative externalities caused by residential segregation and neighbourhood effects in cities. As mentioned previously, evidence shows that SAR-CoV-2 has been more widespread in deprived neighbourhoods, where residents tend to be more highly employed in less qualified jobs involving physical mobility and on-site work. Moreover, deprived neighbourhoods usually have more densely occupied urban spaces and are less able to meet the emerging requirements of physical distancing and transport system reorganisation.

The asymmetric effect of the pandemic may be reinforced or softened by the way cities handle public space and the provision of public transport services. Cities which maintain or increase the space devoted to private vehicles and/or reduce public transport offerings could condemn those who cannot afford to travel by car to use more crowded public transport services. In this case, seniors could become also a high-risk collective due to their greater use of public transport and their much higher fatality rate.

4. Future research agenda at the aftermath of COVID-19

This pandemic is reshaping the multiple connections between transport, public health, and environmental protection. The accumulation of transformations and their potential mid- and long-term implications let us foresee an emerging and renewed research agenda in sustainable and healthy urban mobility and establish solid guidelines for future pandemics (see **Fig.3** where a research agenda around COVID-19 and public transport in cities is presented). First, the pandemic could redefine individual relationships with transportation in general and public transport in particular. Second, new policies in urban and transport planning are emerging. Their scopes and long-term effects need to be examined. Third, the multiple social, health, and environmental implications of a new urban transport context require in-depth analysis. Updated research evidence will help policymakers to introduce informed and adapted measures to promote sustainable, healthier, and fairer urban mobilities in the post-COVID-19 era.

Figure 3. Diagram of the effects, challenges, and research agenda around COVID-19 and public transport in cities


COVID-19 & PUBLIC TRANSPORT
SHORT-TERM EFFECTS
Mobility restrictions
"Avoid public transport" message
Shift towards less-sustainable modes of transport
MID- AND LONG-TERM CHALLENGES
PUBLIC TRANSPORT PROVISION
SAFE
RELIABLE
SUSTAINABLE AND HEALTHY URBAN MOBILITIES
PROMOTE
HEALTHY TRAVEL
POTENTIAL EXACERBATION OF INEQUALITIES
REDUCE INEQUALITIES
RESEARCH AGENDA
STUDY OF TRAVEL BEHAVIOUR CHANGES
ANALYSIS OF POLICY RESPONSES
TRANSPORT MANAGEMENT
URBAN PLANNING
MEASURING THE UNEVEN SOCIAL, ENVIRONMENTAL AND HEALTH IMPACTS
KEY ROLE FOR SPATIOTEMPORAL ANALYSIS
0:00/3:53
Use of Big Data and GIS technologies to analyse the effects of mobility disruption
Adapted policy strategies to individuals' charachteristics and urban contexts

Source: Own elaboration

4.1. Study of the multiple travel behaviour changes

The multiple reconfigurations of travel behaviour will be a key emerging field of study. We need to understand how and why the new constraints and difficulties will affect different social groups, and if they result in deepening social, gender, age, and spatial imbalances. All indicate that uneven accessibility and availability of multiple transport mode choices between neighbourhoods and individuals will result in a renewed mobility that might increase socioeconomic inequalities and segregation. On the other hand, another key topic will be the detection and analysis of the diverse subjectivities related to the fear of contagion on buses, metros, and railways, their implications for well-being and mental health, and their influence on changes in travel behaviour.

4.2. Analysis of policy responses to the new context

The first line of research will assess the effectiveness of worldwide actions in mitigating the risk of on-board and while-waiting contagion. More precise estimations of the real contribution of public transport to the spread of the disease are needed. In this vein, the effectiveness of each of the policy strategies implemented has to be determined, and the role of technology (contactless technologies, big data, new means of communication) has to be analysed. Another suggested topic of research relates to the provision of public transport services, which depends on public funds and, on most occasions, with operating results that indicate an overall loss. Thus, a balance between required actions and their costs is needed. This will likely oblige transport operators to remodel the financial structure of the services to be more efficient.

A second line of research will compare and critically review urban planning and transport management policies. The first actions implemented during the COVID-19 crisis have been oriented to promote active modes and reduce space for private vehicles. However, there is uncertainty around the policies that will be implemented in the mid and long term, and how those policies will influence both pedestrians and public transport. Hence, new knowledge production and planning practices evaluation will be required.

4.3. Measuring the uneven social, environmental, and health impacts

The social, environmental, and health impacts of changes in travel behaviour due to individual and collective responses to the pandemic will also be a critical issue. The renewed social and health inequalities fueled by changes in individual mobilities, local and global environmental impacts of shifts in modal choices, redefinitions of distance and frequency of daily and occasional or leisure travels, social and spatial reconfigurations in cities functions, and the role of public transport systems in all of them will be, among others, some emerging research lines.

Within this context the more intense application of information technologies, Big Data, and Geographical Information Systems (GIS), offers an unprecedented opportunity to dynamically monitor human mobilities in multiple spatial and temporal scales. Its combination with qualitative information sources also allows a detailed and longitudinal analysis of the uneven effects on different groups. Therefore, there is a promising research direction towards the

development of complex and reliable data-driven systems enabling rapid knowledge acquisition and reinforcing the parameterization of models and methods, especially when providing support for social management to promote the formulation of relevant and adapted-to-reality policies (Zhou et al. 2020).

Funding

Research funded by the Spanish Ministerio de Ciencia e Innovación [grant number CSO2017-82156-R], the AEI/FEDER,UE, the Departament d'Innovació, Universitats i Empresa, Generalitat de Catalunya [grant number 2017SGR22], the Escola d'Administració Publica de Catalunya, Generalitat de Catalunya [grant number 2018 EAPC 00002], and the Spanish Ministerio de Educación, Cultura y Deporte [Doctoral Research Grant FPU15/06947 – Formación de Profesorado Universitario].

Disclosure statement

No potential conflict of interest was reported by the authors.

References

Behrens, R.; McCormick, D. & Mfinanga, D. (2015). Paratransit in African Cities: Operations, Regulation and Reform. Routledge.

Buja, A.; Paganini, M.; Cocchio, S.; Scioni, M.; Rebba, V. & Baldo, V. (2020). Demographic and socio-economic factors, and healthcare resource indicators associated with the rapid spread of COVID-19 in Northern Italy: An ecological study. medRxiv. doi: 10.1101/2020.04.25.20078311

Kissler, S.M.; Tedijanto, C.; Goldstein, E.; Grad, Y.; Lipsitch (2020). Projecting the transmission dynamics of SARS-CoV-2 through the pandemic period. Science. doi: 10.1126/science.abb5793

Tian, H.; Liu, Y.; Li, Y.; Wu, C-H; Moritz, B.C.; Kraemer, U.G.; Li, B.; Cai, J.; Xu, B.; Yang, Q.; Wang, B.; Yang, P.; Cui, Y.; Song, Y.; Zheng, P.; Wang, W.; Bjornstad, O.N.; Yang, R.; Grenfell, B.T.; Pybus,O.G. & Dye, C. (2020). An investigation of transmission control measures during the first 50 days of the COVID-19 epidemic in China. Science, 368 (6491). doi: 10.1126/science.abb6105

Wang, K. Y. (2014). How change of public transportation usage reveals fear of the SARS virus in a city. *PloS one*, *9*(3). 10.1371/journal.pone.0089405

Zhou, C.; Su, F.; Pei, T.; Zhang, A.; Du, Y.; Luo, B.; Cao, Z.; Wang, J.; Yuan, W.; Zhu, Y.; Song, C.; Chen, J.; Xu, J.; Li, F.; Ma, T.; Jiang, L.; Yan, F.; Yi, J.; Hu, Y.; Liao, Y.; Xiao, H. (2020). COVID-19: Challenges to GIS with Big Data. Geography and Sustainability, 1 (1), pp. 77-87. doi: 10.1016/j.geosus.2020.03.005.