

Special issue on “multi-scale and multimodal human mobility: pre, peri and post COVID-19 pandemic”

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Special issue on “multi-scale and multimodal human mobility: pre, peri and post COVID-19 pandemic”

1. Introduction

The COVID-19 pandemic has dramatically reshaped human mobility at global, national, regional, and individual levels, as evidenced by many studies (Chang et al. 2021; Cheng et al. 2022; Chinazzi et al. 2020; Hou et al. 2021; Santana et al. 2023; Xiong et al. 2020). Governments around the world have implemented containment measures such as lockdowns, travel restrictions, border closures, public transport reductions, and self-isolation for vulnerable groups. These interventions have led to effects that vary by location, timing, travel modes, and demographic characteristics.

As restrictions lift and we move toward recovery, it remains to be seen whether mobility will revert to pre-pandemic patterns or if new behaviors will arise, potentially affecting other urban life aspects like decarbonization and urban crime. This uncertainty fuels research across multiple disciplines, emphasizing the relevance of this special issue titled “Multi-scale and multi-mode human mobility: pre, peri, and post COVID-19 pandemic”.

This special issue comprises eight articles that delve into four pivotal topics on mobility influenced by COVID-19: the pandemic’s impact on human mobility; mobility patterns’ effects on COVID-19 spread and infection rates; public transport resilience during and after the pandemic; and the consequences of mobility changes on transport decarbonization and urban crime. The topics are introduced as follows.

2. Mobility and COVID-19 pandemic

2.1. *The impact of COVID-19 pandemic on human mobility*

This issue features two articles exploring COVID-19’s impact on mobility. The first, by Zhao et al. (2023), titled “Epidemiological-survey-based multidimensional modeling for understanding daily mobility during the COVID-19 pandemic across urban-rural gradient in the Chinese mainland,” analyses mobility patterns and socioeconomic factors using epidemiological survey data from China’s urban-rural spectrum. It identifies crucial mobility indicators and associated socio-demographic factors, noting age and city size as significant, while gender showed no statistical

significance. The pandemic’s impact was found to be more severe in medium and small cities compared to larger ones, highlighting the importance of epidemiological data in modeling mobility during health crises.

The second article by Carter and Tao (2023), “Evaluating COVID-19’s impacts on Puerto Rican travel behaviors,” uses GPS data and a modified gravity model to study travel patterns from Puerto Rico to the continental U.S. The findings indicate varied travel behaviors among different socioeconomic groups, with the elderly in Puerto Rico traveling more during the pandemic and single-parent and below-poverty households more active during the 2020 holiday season. These insights are vital for future travel policy and planning.

2.2. *The impact of human mobility patterns on the COVID-19 infection rate*

Understanding the influence of human mobility on the COVID-19 infection rate is crucial. Xia et al. (2023) in “Population mobility change for controlling the transmission of COVID-19: Mobile phone data analysis in nine cities of China” examines the impact of mobility restrictions on travel and infection rates, using mobile data from China’s Great Bay Area. They report an approximately 80% reduction in mobility during the 2020 lockdown and find a correlation between mobility and infection numbers, suggesting the effectiveness of mobility restrictions.

In a similar vein, Zhang et al. (2022) use Tencent’s Wechat App data in “Quantitative spatiotemporal impact of dynamic population density changes on the COVID-19 pandemic in China’s mainland” to build models estimating the impact of population density and other factors on COVID-19 spread. They find a direct correlation between population density increases and COVID-19 cases and deaths, offering insights into the role of human mobility in disease transmission and containment strategies.

2.3. *The resilience of public transport systems during and after COVID-19 pandemic*

Assessing the resilience of public transport systems is crucial for sustaining urban life, particularly when such systems are heavily impacted by a crisis like the

COVID-19 pandemic. Gaining this insight is key for shaping strategies that ensure urban mobility in the face of future public health emergencies. In this context, two articles from this special issue focus on understanding the variations in public transport usage during and after the pandemic.

Gao, Chen, and Haworth (2023) present “A spatio-temporal analysis of the impact of lockdown and coronavirus on London’s bicycle hire scheme: from response to recovery to a new normal,” which examines the bike share system in Greater London. They employed a Gaussian mixture model to categorize bike share trips from 2019 by duration and distance, establishing a baseline for comparing changes over the next two years. The findings reveal a nearly 30% decrease in bike share usage during the initial lockdown, with a significant rebound post-restrictions. Moreover, there was a notable shift in usage patterns, with a more even distribution throughout the day replacing the typical morning and evening peaks, suggesting a potential lasting change in travel behaviors and urban transportation dynamics.

In another study, titled “Lockdown lifted: measuring spatial resilience from London’s public transport demand recovery”, Sharma, Zhong, and Wong (2023) investigate the post-lockdown recovery of London’s public transport. They utilized spatial and geographically weighted regression models to explore the association between transport resilience and socioeconomic factors. The study underscores the importance of income, car ownership, and the density of public transport facilities as key determinants of public transport resilience. Interestingly, the data indicates a quicker rebound of public transport usage in outer London compared to inner London, prompting the authors to suggest that policymakers take into account the impact of remote work and ensure funding to maintain a crucial level of public transport service.

2.4. The impact of pandemic-induced mobility changes on transport decarbonisation and crime

Considering the critical role of mobility in urban life, its transformation inevitably leads to shifts in nearly all facets of urban living. This special issue includes two articles that examine this aspect.

The issue of transport decarbonization during the pandemic is addressed by Zhang and Cheng (2022) in the article titled “The impacts of the COVID-19 pandemic on multimodal human mobility in London: A perspective of decarbonizing transport”. The study assesses the pandemic’s effect on different travel modes and the implications for decarbonization efforts. Findings indicate significant shifts in multimodal travel and traffic flows, with public transport usage declining markedly,

while car use was less affected. The initial rise in active travel eventually decreased as the pandemic progressed, posing more challenges for achieving decarbonization objectives.

Addressing the intersection of mobility and crime, Wu and Li (2022) in their article “‘Hot street’ of crime detection in London borough and lockdown impacts” utilize Kernel Density Estimation (KDE) to pinpoint crime hotspots at the street level. They then apply Geographically Weighted Regression to assess the lockdown’s impact on crime rates. The study concludes that changes in mobility and land use during the lockdown significantly influenced the variations in crime patterns. These insights offer valuable guidance for local authorities and policymakers to refine crime prevention strategies.

3. Conclusions and future directions

In conclusion, the eight papers presented cover a range of research areas concerning the relationship between the COVID-19 pandemic and human movement. These studies are pertinent to scholars, policy developers, and the public.

The effects of COVID-19 on mobility are varied, displaying distinct trends across countries, with age and income appearing as more influential factors than gender. The observation from Puerto Rico that the elderly, single-parent, and low-income households tended to travel more during the pandemic starkly contrasts with findings from the United Kingdom (Cheng et al. 2022), where younger and less affluent individuals in London, potentially due to a lack of car ownership, stayed home more than their older counterparts. These contrasting findings highlight the importance of developing a more nuanced understanding of how COVID-19 affects mobility, taking into account variables such as age, gender, income, and the disparities between urban and rural areas. This underscores the need for a multi-scaled perspective to comprehensively analyze and address the complex dynamics of mobility during a pandemic.

In relation to the impact of dynamic mobility and population density, these studies highlight the importance of mobility control measures and how a reduction in population density has played a crucial role in containing the spread of the COVID-19 virus, both within cities and on a broader national and global scale. However, it’s important to note that while these measures have been effective in limiting the spread of the virus, they have also had significant repercussions on the economy and the well-being of individuals. Lockdowns and travel restrictions have disrupted economic activities, leading to job losses, business closures, and economic downturns in many regions. Moreover, the psychological and social impacts of prolonged restrictions on

human well-being, including mental health challenges and disruptions to social interactions, have also been a concern. Therefore, there is a need for further research and exploration into the economic and societal consequences of these mobility control measures. It is essential to strike a balance between containing the virus and mitigating the adverse effects on people's livelihoods and mental health, which is an important aspect of managing a pandemic effectively.

Regarding public transport resilience amidst and following the pandemic, London witnessed a downturn in public transport patronage paired with a significant uptick in cycling. The persistence of work-from-home (WFH) policies has disrupted conventional rush-hour patterns, fostering more evenly spread travel throughout the day. Moreover, this shift has precipitated a swifter resurgence of transport use in London's outer regions than in its core. The persistent influence of WFH on travel habits is a subject ripe for continued exploration.

Furthermore, the pandemic has had a noticeable impact on multimodal transportation, especially on the environmental goal of decarbonization. This is evidenced by the decreased use of trains, tubes, and buses, while car usage has remained comparatively steady. A more intricate comprehension of the changes in individual travel behaviors is necessary. Additionally, the pandemic's effect on urban crime, propelled by the alterations in mobility during lockdowns and further complicated by the WFH trend, requires further scrutiny.

Fundamentally, the COVID-19 pandemic has significantly redefined mobility patterns, both during the emergency and as we emerge from it. The persistent effects of work-from-home (WFH) practices on mobility, as well as their broader influence on land use, urban functionality, and socio-economic outcomes, are important areas for further inquiry. This special issue offers a preliminary exploration of these shifts, encouraging ongoing research in this domain. It is our hope that the collection of articles presented will spur further research into human mobility and contribute to improved preparedness for future pandemics.

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