



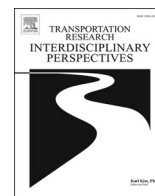
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# Transportation Research Interdisciplinary Perspectives

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## Exploring the relationship between the COVID-19 pandemic and changes in travel behaviour: A qualitative study

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### ABSTRACT

During the COVID-19 crisis, a series of measures were taken to restrict travel and social activities outside the home in order to curb the pandemic and ameliorate its negative effects. These unprecedented measures have had a profound impact on the number and purposes of trips and modes of travel. In China, although the pandemic is now generally under control and transport availability has returned to nearly normal, the extent of the changes in travel behaviour wrought during and after the pandemic still remains unclear. Therefore, the aim of this paper is to investigate the differences in individual travel behaviours during and after the COVID-19 pandemic, using Huzhou as an example. Semi-structured interviews were used to examine the influence of COVID-19 on the travel behaviour and perceptions of different groups. The results indicate that, initially, travel demand was greatly reduced. Second, decreased travel reduced participation in activities, which can have adverse effects on people's health as well as their subjective well-being. Third, the degree and duration of such impacts varied from person to person. Students, lower income cohorts, groups living in small communities with insufficient green spaces, and those working in tourism, catering, informal businesses and transport-related sectors were more vulnerable than others. Policymakers, urban and transport planners should therefore pay attention to the social inequities that arise from unequal access to transport and heterogeneity between individuals. Additionally, public transport systems require further development to promote social cohesion.

### 1. Introduction

Severe viral diseases such as Ebola, the Human Immunodeficiency Virus (HIV), and Severe Acute Respiratory Syndrome (SARS) have drastic impacts on individuals ranging from psychological impacts to physical disability and mortality. These diseases can also drastically change people's lives in other ways, for example through huge financial losses and the disruption of their education or career (Chisholm et al., 2010; Golics et al., 2013; Mitchell et al., 2015). The latest virus to afflict humans, SARS-CoV-2, is caused by the COVID-19 pathogen, and is a highly infectious disease that first emerged in Wuhan and disrupted many aspects of life across the world in 2020 (Chen et al., 2020; Liu et al., 2020a; Zhou et al., 2020). By August 2021, the outbreak had affected >200 countries, and almost 210 million infections had been

confirmed (Worldometer, 2021). Due to the enormous threat it poses to global public health, the World Health Organisation (WHO) officially designated COVID-19 as a pandemic on 11 March 2020, with countries such as China, Italy and the United States suffering the most significant effects at that time. By 19 August 2021, 209,201,939 cases and 4,390,467 deaths had been confirmed worldwide (WHO, 2021). The COVID-19 crisis has resulted in a range of policies and measures aimed at controlling the virus, such as lockdowns, social distancing, school closures and quarantining, severely restricting travel and many other activities globally (Budd and Ison, 2020; De Vos, 2020; Dzisi and Dei, 2020; Ferguson et al., 2020; Iio et al., 2021; Kim, 2021).

Existing studies have demonstrated the links between the external environment, government policies and individuals' travel behaviour (Dirix et al., 2021; Gärling et al., 2000; Lu et al., 2020; Vlek and Michon,

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1992). The external environment may change people's demands, desiderata and obligations, thereby affecting their participation in activities of daily life, which is the major driver of travel (Axhausen and Gärling, 1992). For example, the pandemic has eliminated the obligation for students to attend university; instead, many continue to study at home via online learning. In addition, policies vary in response to the external environment, affecting the options that individuals have available to them. Before the COVID-19 outbreak, car use was more limited because of its high environmental and social costs, including pollution, obesity, energy consumption and other negative externalities (Goodwin, 1996; Sallis et al., 2004). Various mitigation policies had been implemented, such as improving alternative transport modes, changing the location of public facilities, and introducing congestion charges in cities to reduce car usage (Gärling et al., 2000; Odeck and Bråthen, 2008). In China, however, highway tolls were suspended from 17 February 2020 to 6 May 2020 by the Ministry of Transport of the People's Republic of China (MTPRC), to encourage people to travel by car during the pandemic (MTPRC, 2020).

Therefore, COVID-19 has dramatically changed people's daily lives and the relationship between transport and health. Existing studies have illustrated the existence of such links before COVID-19, although there are substantial differences between the situation during and after the pandemic and the period that preceded it. These changes and the related effects resulting from the pandemic may be long-lasting. Thus, it is important to analyse the current situation and discuss the impacts of COVID-19 on different individuals and groups.

The aim of this research is to explore the relationship between the impacts of the COVID-19 pandemic and changes in travel behaviour in Huzhou, China. To address this aim, the following three objectives were set: (1) Investigate the differences between travel behaviours before and after the COVID-19 pandemic; (2) Examine the impacts of social equity on travel behaviour; and (3) Critically review governance and policies during and after the pandemic.

This study is organised as follows. The next section reviews the existing literature regarding transport-related health, social equity and policy. Section 3 introduces the case study and explains the methodology. Section 4 presents the findings and discussion, while the final section summarises the study and provides policy implications.

## 2. Literature review

### 2.1. Transport and health

Transport serves as a vector for virus transmission both on a regional and national scale (Gössling, 2002; Gössling et al., 2020; Hall, 2020; Musselwhite et al., 2020). Crowded conditions on public transport affect transmission in two ways: increasing the proximity between passengers and thereby the probability of exposure to infected travellers (Krishnakumari and Cats, 2020); the confined spaces and poor ventilation on public transport also play a significant role in promoting transmission, as good airflow can reduce the concentration of airborne pathogens (Liu et al., 2020a).

Many studies have discussed the transmission of viruses between passengers using public transport. Gosce and Johansson (2018) argue that people who regularly use the Underground, which is commonly associated with large crowds, have higher risks of contracting influenza-like diseases. The same phenomenon occurs on cruise ships, as was observed with the Diamond Princess in early February 2020. At least 25 cruise ships had been confirmed as carrying infected passengers as of 26 March 2020 (Mallapaty, 2020). Air travel also plays an important role in spreading influenza as it places a large number of travellers in confined spaces for extended periods (Moser et al., 1979; Troko et al., 2011). In China, mass migration via public transport during the Spring Festival (the Chinese New Year travel rush) served to greatly accelerate the transmission of COVID-19 (Phelan et al., 2020).

In addition to worldwide travel by humans, the movement of cargo

due to increasing consumption of high-demand foods and a growing global food supply chain also contributed to the spread of COVID-19 (Gössling et al., 2020; Guan et al., 2020). For instance, the coronavirus was detected on a cutting board used to cut up imported salmon on the evening of 12 June 2020, in a large-scale investigation of the Xinfadi Market in Beijing. On the same day, between 16:00 and 24:00, four newly diagnosed cases of COVID-19 were confirmed in Beijing, all related to this market (Sohu, 2020).

As a result of travel restrictions introduced to slow down the spread of COVID-19, people might have experienced negative feelings that adversely affected their well-being (Passos et al., 2020), although the number of overall drink-driving cases decreased (Watson-Brown et al., 2021). As Brooks et al. (2020) claim, quarantined individuals are prone to experience psychological distress and disorder; they can feel confused, scared, angry, sad, numb, anxious, bored, rejected and stigmatised (Braunack-Mayer et al., 2013; Caleo et al., 2018; Cava et al., 2005). These negative effects can persist after quarantine and isolation in some individuals, and continue to have a lasting adverse impact on their lives (Brooks et al., 2020). In order to minimise these impacts, it has been suggested that effective communication, trust, transparency, a clear quarantine time limit, abundant supplies, entertainment and information disclosure are essential (Braunack-Mayer et al., 2013; Brooks et al., 2020; Caleo et al., 2018; Sustainable Development Policy Institute, 2020).

### 2.2. Transport-related social equity

Older adults were more likely to experience social exclusion during the pandemic. First, older people, especially those over the age of 70, are more susceptible to COVID-19 and have a higher mortality rate if infected (Guan et al., 2020), forcing them to spend more time and energy on social distancing for safety (Ferguson et al., 2020). Second, many older persons have limited mobility and are more reliant on public transport (DETR, 2001), which restricted their travel during the pandemic as public transport was temporarily suspended in many Chinese cities. Even after public transport reopened, the intervals between departure times were longer, with both the frequency and full load rates lower than in pre-pandemic times, making travelling by public transport less convenient (Zheng, 2020). Finally, many older adults have a higher risk of poverty and face labour market discrimination (SEU, 2001), which may make them more vulnerable.

COVID-19 has greatly affected low-income groups in terms of work, entertainment, transport, health and many other aspects of life. Many people are temporarily unemployed or are working from home, as most activities that take place outside the home were suspended (De Vos, 2020). The resultant financial losses (Brooks et al., 2020) may have long-term effects. Individuals or households with lower incomes are more likely to be adversely affected by the temporary loss of income and require more financial and social support (Brooks et al., 2020; Julius et al., 2020). In addition, financial constraints limit both travel choices and mobility, affecting access to healthcare and healthy food. For instance, low-income groups rely more on public transport (Jiang et al., 2017), and therefore they may be more likely to suffer due to a lack of physical activity which can lead to higher levels of obesity and other health problems.

The fallout from the COVID-19 pandemic has also been reflected in the mobility of international students, upending their original plans for study and life abroad (UKCISA, 2020; United Nations, 2020). Educational institutions, including universities and research centres, have been particularly affected, due to the disease's broad and indeterminate impact on global mobility. International students feel less confident to pursue education in countries which are currently the global epicentre of the pandemic or have high rates of infection, in addition to which international air travel has not fully resumed. For instance, Singapore announced that short-term visitors were not allowed to enter or transit through the country from 22 March 2020 (Ministry of Health Singapore,

2020). At the same time, international students in the United States encountered problems with their visas. On 6 July 2020, U.S. Immigration and Customs Enforcement (2020) announced that international students pursuing degrees in the United States might need to leave the country if their universities switched to online-only courses. Both international students who are currently enrolled on courses and students who are still in the process of applying may be affected.

### 2.3. Transport policy

The COVID-19 crisis is threatening public health globally. Before effective vaccines were widely available, nonpharmaceutical interventions (NPIs) were (and still are in some countries) the major strategy used to combat the pandemic by reducing contact rates (Ferguson et al., 2020; Gössling et al., 2020). NPIs help to reduce social contact by decreasing travel demand and lowering the risk of infection on trips. NPIs include social distancing, lockdowns, the closure of public facilities, cancelling or postponing events and bans on gatherings, all of which may significantly decrease the number of trips made by public transport. Other NPIs such as wearing face masks/coverings, and washing or sanitising hands frequently reduce the possibility of infection on journeys but at the same time make travel less convenient (Gössling et al., 2020). The effectiveness of any one of these interventions on its own is limited, requiring multiple measures to be utilised simultaneously (Ferguson et al., 2020).

Control measures such as NPIs have been widely adopted by many countries. For instance, border controls, including temperature screenings or bans on entry and transit of Chinese travellers, have been introduced in many countries, such as Korea (Phelan et al., 2020). In Namibia, for example, most institutions have been closed to avoid public gatherings, except those providing essential services (Julius et al., 2020). Social distancing, frequent hand washing and avoiding touching one's face have been encouraged globally. Furthermore, significant capital has been invested by many countries into COVID-19 research and vaccines have now been developed and are widely available, at least in some countries, including in the UK (Department of Health and Social Care, 2020).

China also has implemented many control policies, and the scale of the cordon sanitaire across Hubei Province has been unprecedented (Phelan et al., 2020). The first strong intervention was the lockdown in Wuhan, beginning on 23 January 2020. During that period, all outbound transport from Wuhan was blocked, and traffic and travel within the city was also suspended (Pan et al., 2020). Many other control measures were implemented, not only in Wuhan but also in other Chinese cities. For instance, the Chinese government and Alipay jointly invented the health code application, which provides electronic proof of a traveller's health status by answering questions using a mobile phone. Based on the individual's answers, relating to past travel routes, the app produces different colours: green means 'safe', orange means 'low risk', and red means 'high risk'. Anyone not wearing a face mask or not showing a green health code is not allowed to visit public places. In addition, all individuals who are infected or suspected of being infected are required to accept centralised quarantine and treatment.

Ferguson et al. (2020) introduced the two fundamental strategies of mitigation and suppression to control the outbreak. Mitigation emphasises slowing the spread of the pandemic without breaking the transmission chain. The purpose is to decrease peak healthcare demand to ensure it does not surpass the capacity of medical systems. By contrast, suppression focuses on reducing the number of infected patients. One of the biggest differences between these two strategies is that the reproduction number ( $R$ ) during mitigation is  $>1$  (outbreak is growing), while the  $R$  number is less than 1 in the case of suppression (outbreak is shrinking).

China is typical of countries using suppression as the predominant strategy to contain the pandemic (Chen and Pan, 2020; Ferguson et al., 2020). China's experience proves that suppression is effective in the

short term (Anderson et al., 2020). However, it is still unclear how long control measures will last or whether subsequent developments can be predicted (De Vos, 2020). Even if suppression is currently the only effective control measure, not all countries can afford the negative impacts in the long term (Ferguson et al., 2020). Ultimately, the choice of major intervention measures varies according to different social contexts and values.

COVID-19 has affected all sectors of the economy and caused massive losses, with high-exposure final-consumption sectors such as tourism and catering most adversely impacted, as a result of reductions in upstream suppliers, decreased demand and travel ban policies (De Vos, 2020; Guan et al., 2020; Julius et al., 2020; World Tourism Organization (UNWTO), (2020)). Other industries, such as manufacturing, informal businesses, foreign trade, finance, transport and logistics have also been significantly affected, which has impacted on livelihoods, particularly in the case of poorer households (Julius et al., 2020; Rodriguez, 2020; WEF, 2020).

The overall global cost of the pandemic depends on the number of countries affected and the duration and strictness of control policies. Due to the global supply chain, countries indirectly affected have also experienced significant losses, with low-income countries more vulnerable to the adverse effects (Guan et al., 2020). It was essential to implement strict measures early in order for them to have a global effect (Ferguson et al., 2020). However, countries that implemented the strictest containment measures early on have experienced the greatest losses, and thus epidemic control has become a public good paradox, resulting in insufficient investment and delays in introducing measures. Therefore, it is necessary to establish a cost-sharing mechanism on a global scale (Guan et al., 2020).

### 2.4. Research gap

The existing literature illustrates that transport was a key factor in relation to health before COVID-19, with both positive and negative effects on the health of individuals. People may be excluded from, or have limited access to, transport systems, services and resources due to personal and spatial heterogeneity. Transport policies can either exacerbate or reduce/eliminate such inequities.

However, the relationship between transport and health has undergone some profound changes during and after the COVID-19 crisis. COVID-19 represents a dramatic and unexpected event in the field of public health worldwide and, as such, has had unpredictable effects on travel behaviour, which may prove to be long lasting. Therefore, it has become necessary to critically discuss the changes in travel behaviour, the resultant impact on social equity, and the policies implemented during and after the pandemic in China. To the best of our knowledge, this is the first study to analyse the effect of the COVID-19 pandemic on transport using a qualitative approach. Doing so can yield valuable insights, which quantitative approaches would not have been able to capture.

## 3. Case study and methodology

### 3.1. Case study of Huzhou

The first case of COVID-19 in Huzhou, a small city located in the east of China with 3,367,579 inhabitants (Zhejiang Provincial Bureau of Statistics, 2021), was diagnosed on 25 January 2020. As of August 2020, 12 people had been confirmed as being infected in Huzhou (Bendibao, 2020), and one of them went on to develop severe symptoms of the disease. Eventually, all of them recovered after being isolated and treated in hospital. The distribution of confirmed cases is shown in Fig. 1.

Huzhou was selected as a case study for this research for several reasons. First, many studies have analysed the impacts of COVID-19 in mega- and well-known cities with large populations, such as Wuhan,



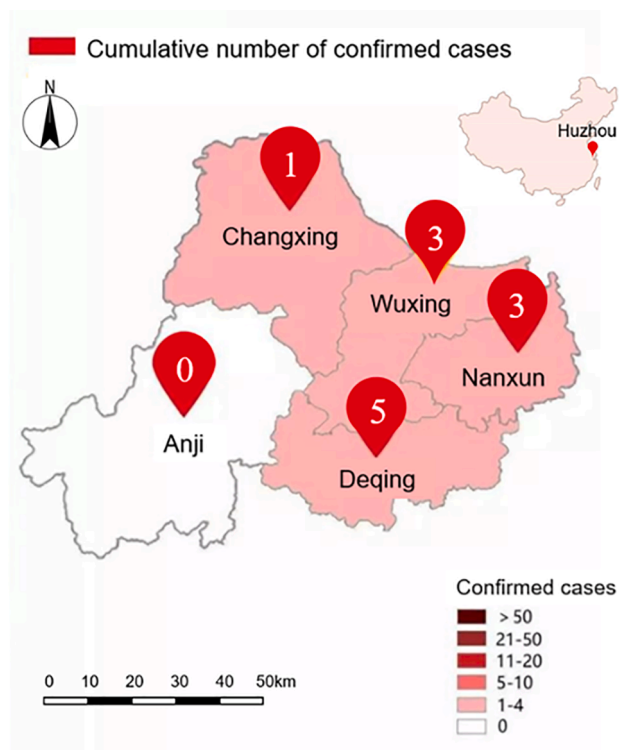


Fig. 1. The Distribution of Confirmed Cases in Huzhou on 12 August 2020. (Source: Authors - the base map was adapted from [Huzhou Cartography](#)).

Beijing and Shanghai (Cheng, 2020; Gouk, 2020; Lau et al., 2020). However, the effects of the outbreak on small Chinese cities have been overlooked. Huzhou is a typical small city with a limited population, which makes it useful as an example with which to enrich knowledge about the pandemic. Second, social inequity is not sufficiently recognised in small cities, as the income gap between residents is not as large as that in big cities. Policymakers therefore need to be more aware of the situation of special groups and more cognizant of social equity issues (Cao and Hickman, 2020). Third, the pandemic is still affecting some areas, although it has essentially been contained in Huzhou. Thus, it is possible to analyse changes in Huzhou during and after the pandemic simultaneously.

### 3.2. Semi-Structured interviews

As Robson (2011) demonstrated, methodology should be chosen based on the data needed for the research. This research focuses on the behaviour and thoughts of citizens before and after the outbreak. Thus, a qualitative approach was deemed most appropriate to acquire data relating to people's perceptions, feelings and descriptions, and their connotations (Bryman, 2016; Neuman and Lincoln, 2006; Punch, 2005).

In this research, semi-structured interviews were conducted by telephone, both via mobile and landline phones, and hence information could be elicited from the interviewees by asking them questions related to the research objectives. Each telephone interview lasted at least 20 min. Telephone interviews were seen as preferable to face-to-face interviews for two reasons. First, they were suitable for people who were difficult to visit (Block and Erskine, 2012; Drabble et al., 2016; Maritan, 2001). During the pandemic, limiting face to face contact with others was the most effective way to reduce the spread of the virus. The telephone interview enables the researcher to collect data while avoiding direct contact with the interviewees. Second, this approach saves time and costs (Bryman, 2016). However, telephone interviews also have some limitations. First, the time spent on a telephone interview is usually shorter than a face-to-face interview (Frey, 2004), as refusal

rates are higher for telephone interviews (Frey, 2004; Frey and Oishi, 1995). Second, the interviewees cannot be observed via telephone interviews (Bryman, 2016) and therefore it is impossible to collect visual or nonverbal subsidiary information (Aquilino, 1994; Garbett and McCormack, 2001; Novick, 2008), such as facial expressions and body language. Third, interviewees are more likely to get distracted by things going on in their own environments and consequently tend to be less attentive (Opdenakker, 2006). Fourth, not everyone has a telephone installed (indeed the number of households in China with a landline phone has decreased over the past 20 years), or has access to one, such as some older adults, low-income cohorts, and individuals with a lower level of education, while people with hearing problems may be unable to use the telephone (Aquilino, 1994; Carr and Worth, 2001; Novick, 2008). Block and Erskine (2012) also mentioned that the growing number of individuals who rely solely on their mobile phones for communication may affect the sample results obtained via telephone interviews. However, it should be noted that we only approached potential interviewees who either used mobile phones or landline phones. Thus, the results of the telephone interviews in this research should not be significantly affected.

### 3.3. Question design

The questions used in the interviews were designed to address the research aims via three objectives. The first focuses on changes in travel behaviour in Huzhou concerning travel demand, purposes, modes and convenience. Therefore, some of the questions were designed to collect data related to changes in travel behaviour and their causes. In addition, the research questions also provided participants with a chance to discuss the impacts of the changes on both their physical and mental health. The second objective emphasises social equity. Conclusions were drawn by comparing the answers given by different interviewees. The third objective aimed to collect data about governance. Thus, several questions were designed to elicit information about policies for containing the pandemic and their effects. The interview questions are shown in Appendix A.

### 3.4. Sampling

A total of 33 interviewees were recruited in Huzhou through purposive sampling, and the interviews were carried out between 8th May and 28th July 2020. This sampling method aims to find cases that are relevant to the research questions or the purpose of the research, as determined by the researchers (Bernard, 2006; Bryman, 2016), and is widely used in studies involving hard-to-reach populations (Bernard, 2006). In this research, interviewees were selected on the basis of their ages and occupations.

Participants comprised males and females aged between 22 and 74 from various backgrounds and with differing experience. Thus, they were representative of the wide range of individuals who experienced the impacts of the COVID-19 pandemic public health crisis in Huzhou. All the interviewees kindly volunteered to be interviewed without receiving any remuneration for their time. Table 1 provides a summary of basic demographic information about the participants.

Regarding the limitations of the sample, to some extent, the small sample size could have reduced the representativeness of the views expressed by the interviewees (Bryman, 2016). However, it should be noted that over 30 interviews are relatively sufficient for a qualitative research. Interviews can provide more detailed information than (on-line) surveys. In addition, older adults only accounted for a relatively small proportion of the sample used in this study. As a group with a relatively higher mortality rate from COVID-19, if more older adults had been interviewed, it may have helped to gain a better understanding of the impacts of COVID-19 on their travel behaviour and the inequalities that they experienced in comparison to the younger generation.

**Table 1**  
Profiles of Participants.

Number	Gender	Age	Job
1	Male	21–25	Student
2	Female	21–25	Government employee
3	Female	21–25	Student
4	Male	21–25	Police officer
5	Female	21–25	Student
6	Female	21–25	Unemployed
7	Female	21–25	Student
8	Female	26–30	Financial analyst
9	Male	26–30	Student
10	Female	26–30	Student
11	Female	26–30	Government employee
12	Male	26–30	Student
13	Female	26–30	Beauty therapist
14	Male	31–35	Engineer
15	Female	31–35	Beauty therapist
16	Female	31–35	Courier
17	Female	31–35	Unemployed
18	Male	31–35	Catering
19	Male	31–35	Tourism
20	Male	46–50	Security guard
21	Female	46–50	Teacher
22	Male	46–50	Catering
23	Male	46–50	Retail
24	Female	51–55	Police officer
25	Male	51–55	Retail
26	Female	51–55	Housewife
27	Male	51–55	Teacher
28	Female	56–60	Retired
29	Male	56–60	Police officer
30	Male	>60	Retired
31	Female	>60	Retired
32	Male	>60	Cleaner
33	Female	>60	Nurse

3.5. Thematic analysis

Thematic analysis was used to interpret the interview results. Thematic analysis is a basic qualitative methodology which has the potential to reveal patterns or themes in the data, and is an essential tool for data reduction (Braun and Clarke, 2006; Bryman, 2016; Maguire and Delahunt, 2017; Marshall and Rossman, 1999; Fig. 2). Three themes are primarily discussed in this research. First, the interview findings regarding changes in travel behaviour offer insights into the impacts of COVID-19 on transport. Second, the interview findings showing that there were greater impacts on certain groups could be regarded as evidence of social exclusion and inequity. Third, the findings relating to the advantages and limitations of existing policies, and suggestions for ways

in which policies could be improved and changes made to public transport in Huzhou in order to reduce social exclusion in the future could be helpful to policymakers and transport planners.

4. Findings and discussion

4.1. Travel behaviour during and after COVID-19

According to the findings of the interviews, travel demand in Huzhou dropped significantly, and the purposes of travel also changed greatly during the period between January and March 2020, which aligns with the conclusions reached by De Vos (2020). Most of the interviewees avoided making unnecessary trips and travelled only when they had to, for example to buy essential supplies, such as food and face masks. Online shopping and home delivery food services also decreased travel frequency (Shi et al., 2019). Trips for commuting, recreation and other purposes were also significantly reduced. For instance, during the Spring Festival, family reunions are usually the main concern of every Chinese citizen and people enjoy a lavish dinner with their relatives. However, this year many people cancelled their plans and chose to stay at home with their families instead:

*“I hardly went outside, except to go shopping in the supermarket.”*

(Interviewee 30, male, 13/06/2020)

*“I planned to travel to Europe with my friends in February, but due to COVID-19, we had to get a refund on tickets and hotels we’d booked.”*

(Interviewee 8, female, 25/06/2020)

The main reason for such changes was concerns that participating in any activities outside of the home during the pandemic would increase social contact and infection risk. A plethora of channels through which information was disseminated made it easy for people to understand the transmission pathways of COVID-19, which encouraged them to minimise the number of trips they made. In addition, residents were also more inclined to shorten their travel time and avoid crowded places when planning travel routes. Concerns about health not only made people stay at home but also encouraged them to persuade their relatives to decrease their frequency of travel too:

*“Every time I went out, I made a shopping list in advance. Then I could go back home as soon as possible.”*

(Interviewee 16, female, 17/06/2020)

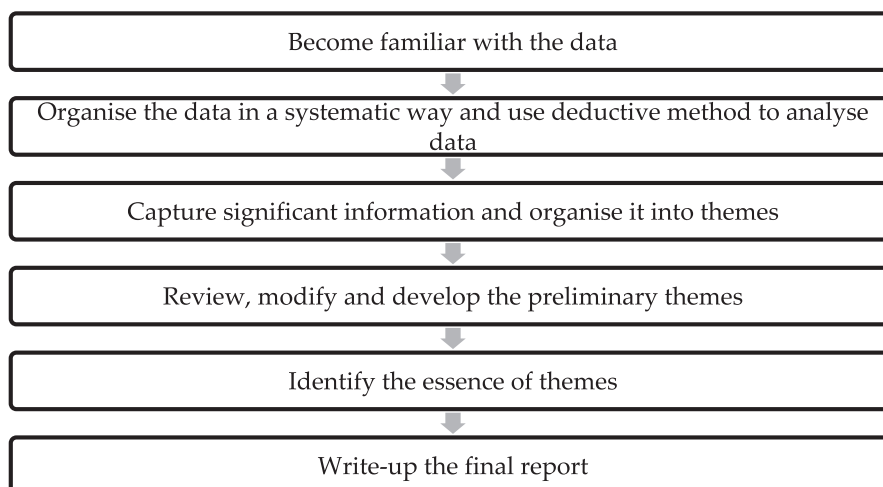


Fig. 2. Six-phase Framework for Thematic Analysis. (Source: Authors, adapted from Braun and Clarke, 2006).

*“I felt a little uncomfortable one day, but I did not go to the hospital because I thought it was the most dangerous place. All confirmed cases were contained there.”*

(Interviewee 15, female, 09/06/2020)

As can be seen from these excerpts, travel behaviour changed because of people's concerns and other psychological factors. However, research by Kroesen and Chorus (2020) showed that there do not seem to be strong connections between attitudes and behaviours. Therefore, containment measures also contributed to changes in travel behaviour. On the one hand, some policies directly changed travel demand in Huzhou. For example, during the lockdown, the local government issued certificates called ‘travel passes’. Without them, people were not allowed to engage in daily activities outside the home, with the exception of staff and volunteers providing essential social services, such as police officers and doctors. Each household was only entitled to two ‘travel passes’, regardless of the number of family members. Each ‘travel pass’ could only be used once by one person, which dramatically reduced travel demand. On the other hand, some containment measures indirectly restricted travel by suspending many everyday activities and thus removing people's motivation to travel (Axhausen and Gärling, 1992). For instance, parents did not need to pick up their children on weekdays during the pandemic because of school closures:

*“Government staff and volunteers, including me, patrolled every day in January to prevent people without the proper credentials from going out.”*

(Interviewee 27, male, 13/06/2020)

Travel mode choices are affected by different determinants, such as individual and household characteristics, seasonal and weather-related characteristics, trip characteristics, and so on (Ton et al., 2019). As one of these determinants, COVID-19 also changed travel mode choices. During the pandemic, all the interviewees tended to avoid public transport for two reasons. First, the congestion and confined conditions on public transport were perceived as making it a hotbed for viruses (Gössling et al., 2020; Krishnakumari and Cats, 2020). Second, restrictions had been introduced on public transport systems, making them impossible or difficult to access. For example, all inter-provincial and inter-city buses and most buses operating within Huzhou had been suspended since late January 2020. From mid-February, public transport gradually resumed operating, but the waiting time increased, while the frequency of services and full load rate were reduced in comparison to the pre-pandemic period. In addition, many interviewees were more inclined to drive because it helped them avoid social contact with strangers. Cycling and walking were also popular choices for travelling short distances. Most participants claimed that they would not deliberately avoid public transport after the pandemic but would pay more attention to protection when using it:

*“You had no idea if there was an infected person next to you on the bus, which made me feel unsafe.”*

(Interviewee 20, male, 09/06/2020)

*“I tried to minimise the number of trips. And if I had to go out, I drove.”*

(Interviewee 11, female, 17/06/2020)

People were required to take necessary protective measures when travelling, which made trips less comfortable and convenient. To reduce the probability of infection, the local government required businesses and facilities to adopt the policy of ensuring that masks or face coverings were worn by the public in public spaces. Checking people's temperatures and health code status were other aspects of the policy, although they were not mandatory, to prevent infected people from accessing places with large populations. Furthermore, alcohol-based hand sanitisers were provided at the entrances to many buildings to prevent the spread of infection and decrease the risk of people becoming ill.

Overall, residents' travel behaviours changed significantly in

Huzhou in the short term, which was similar to what happened in other cities around the world. The most significant effect of the pandemic was the dramatic reduction in traffic demand, not only in small cities like Huzhou, but also in large cities, such as London (Manca et al., 2021) and Chicago (Shamshiripour et al., 2020). More specifically, the number of non-compulsory/non-essential trips, such as international travel and shopping markedly decreased (De Vos, 2020; Gössling et al., 2020; Shamshiripou et al., 2020; UNWTO, 2020). In terms of transport mode choice, there was a large reduction in the use of public transport worldwide (Tirachini and Cats, 2020; Molloy et al., 2021) compared to before the pandemic, because public transport was believed to act as a conduit for potential virus transmission (De Vos, 2020; Troko et al., 2011). Instead, transport modes that involved less close personal contact, such as bikes, walking and driving were favoured (CDC, 2021).

Since April 2020, the COVID-19 crisis has largely been brought under control in Huzhou. Consequently, people's travel patterns have gradually moved closer to levels seen before the pandemic. The most obvious change is that traffic demand has greatly increased. Another significant difference is that people are returning to public transport in increasing numbers, especially in the case of inter-city and inter-provincial transit services. The convenience and cheapness of public transport for long-distance travel makes it more attractive than driving, cycling and other travel modes:

*“I often travel to Hangzhou by high-speed rail, because the tickets are affordable and driving is too tiring.”*

(Interviewee 14, male, 06/07/2020)

However, public transport in Huzhou is a relatively unattractive option for journeys within the city due to insufficient network coverage and low density. City public transport is effective when bus stations are located close to both the point of trip origin and trip destination. When this is not the case, many interviewees said they preferred to use other modes of transport as they were unwilling to spend a substantial amount of time walking to and transferring between a limited number of stations and routes, which concurred with findings from Ton et al. (2019). For instance, people are more inclined to walk or cycle for exercise when visiting nearby places. When the travel distance is slightly longer - approximately three to five kilometres - electric motorcycles become more attractive, and driving is the most popular way to travel long distances. To promote the use of public transport, new bus stops and routes should be added to transport systems, and the existing infrastructure should be upgraded. This finding was broadly in agreement with the study carried out by Ha et al. (2020), which found that travel time significantly influences mode choice, and also suggested that policies should be elaborated with a view to creating new infrastructure, in order to facilitate a modal shift away from driving to public transit. In addition, more public transport modes, including underground and light rail, should be introduced. It would also be beneficial to introduce more active transport modes such as shared bicycle schemes, as these increase fitness and improve mental health (Andersen et al., 2000; Liu et al., 2020b; Martin et al., 2014):

*“I usually go to work using my electric motorcycle, though I also walk occasionally. Taking the bus is not an attractive option for me, as I would have to spend half an hour on it due to the traffic jams and boarding/alighting time, whereas it only takes 10 to 15 min by electric motorcycle.”*

(Interviewee 20, male, 09/06/2020)

*“Compared to using the bus, I prefer to walk when the destination is nearby, as it is healthy, and I do not need to think about parking. However, when I go somewhere a bit further, it is more convenient to drive, as I do not have to transfer or carry things in my hands, which are requirements that could not be fulfilled by bus.”*

(Interviewee 24, female, 25/06/2020)

#### 4.2. The impacts of COVID-19 on travel behaviour in the long run

The impacts of COVID-19 are multidimensional, including economic losses, environmental benefits (from reduced transport usage) as well as both negative and positive effects on health and well-being. However, overall the disadvantages outweigh the benefits.

Economic losses have been one of the most significant negative effects of COVID-19. From a national perspective, the development and operation of various industries have been hindered, causing massive economic losses. No sector was immune from the impacts of the pandemic. Among the sectors affected, manufacturing, informal businesses, foreign trade, finance, transport and logistics were particularly hard hit (Julius et al., 2020; WEF, 2020). For example, to encourage driving and reduce social contact, highway tolls were suspended for 79 days, resulting in a daily loss of about 1.5 billion CNY (0.16 billion GBP) (Xinhuanet, 2020). In addition, investment relating to COVID-19 could also be regarded as an economic loss. As of 13 March 2020, investment in the field of medical research had reached 116.9 billion CNY (12.9 billion GBP), most of which was used for vaccine research, medical supplies, drug reserves, hospital construction and other aspects related to pandemic prevention and treatment (Chinese Government Website, 2020). From an individual perspective, restrictions on movement and sluggish economic conditions have resulted in a series of substantial knock-on effects (Spurling et al., 2019), such as the cost of quarantine and necessary testing, job losses and wage reductions:

*“During the pandemic, the beauty salon where I worked was closed. Even though I was not fired, I had no income as I did nothing. At the same time, I still needed to pay rent.”*

(Interviewee 13, female, 09/06/2020)

Conversely, the pandemic also brought about some benefits. Decreased travel demand in Huzhou resulted in less congestion during the period of the pandemic. In January and February 2020 in particular, there were very few vehicles and pedestrians on the roads, except for those who were responsible for testing people's temperature at intersections (using a non-contact digital infrared thermometer). Consequently, air and noise pollution underwent a significant reduction during that time, as was the case globally, which may have resulted in some health co-benefits (Venter et al., 2020), although clearly this was not sustainable.

Indeed, the positive effect of improved environmental conditions on people's health proved to be limited in Huzhou as it gradually disappeared with the increase in traffic demand over the longer term. In addition, a lack of physical activity due to quarantine and isolation requirements caused many people to gain weight, which is consistent with studies carried out in Lithuania and America (Kriaucioniene et al., 2020; Rundle et al., 2020; Zachary et al., 2020). The growth in online entertainment during the pandemic, including the gaming industry, (Zhou, 2020; Statista, 2020), shows that people spent considerable time using mobile phones, computers and other electronic devices for home entertainment. The adverse effects of excessive use of electronic devices could include damaged eyesight or diabetes from a sedentary lifestyle (Wang et al., 2020):

*“I spent almost all-day playing computer games, watching videos or reading eBooks. If there was no online class the next morning, I might not go to bed until midnight.”*

(Interviewee 1, male, 09/06/2020)

*“After being quarantined for 14 days, I gained 3 kg because I stayed in the room all day and did not have the opportunity to exercise.”*

(Interviewee 5, female, 21/06/2020)

As well as the increase in weight, travel restrictions, quarantine measures and/or lock downs, also had negative effects on people's mental health and subjective well-being (Meyer et al., 2020). Boredom

was the most common negative emotion experienced, as most people were not allowed to socialise during the outbreak. Being forced to spend long periods of time together put a strain on domestic relationships within families, according to some of the participants. However, other interviewees believed that the pandemic provided them with a rare opportunity to spend a significant amount of time with their families, which brought them closer together. Additionally, few of the participants felt frightened as the number of confirmed cases in Huzhou was minimal. Another reason for their confidence was that the inhabitants of Huzhou were able to access timely information relating to COVID-19 in many ways, including about transmission pathways, pandemic prevention and control methods, and the latest policies. However, although few people were fearful about their own situation, it was common for them to be worried that family members or friends in other cities might be infected. In addition, anxiety was one of the negative emotions experienced by many people, especially in relation to financial concerns and difficulties with job hunting:

*“The pandemic trapped me at home and prevented me from keeping a proper distance from my parents. Different living habits made us quarrel occasionally.”*

(Interviewee 10, female, 21/06/2020)

*“This was the longest Spring Festival holiday I have ever had. I was very happy to spend time with my family and to see my children growing.”*

(Interviewee 14, male, 06/07/2020)

*“I should have been looking for a job this spring. A lot of recruitment was cancelled or delayed because of COVID-19, which completely disrupted my plans. I felt very anxious and frustrated as I also needed to write up my research at the same time in addition to looking for a job.”*

(Interviewee 7, female, 02/07/2020)

Compared to other large cities in China, such as Beijing and Shanghai, Huzhou was only affected by COVID-19 to a limited extent. The relatively small population and lack of visitors, as well as the effective measures used to control the virus, resulted in a relatively low rate of infection. Up to the 15th of July 2021, only 12 people had been infected in Huzhou (Pengpai, 2021) and the infection rate was around 3.6 infections per million inhabitants (ipm) which is similar to other cities of a comparable size, such as Quzhou (6.6 ipm), Shantou (4.7 ipm) and Zhanjiang (5.9 ipm) (Bendibao, 2021; Guangdong Provincial Bureau of Statistics, 2021; Jiupai News, 2021; Tencent, 2021; Zhejiang Provincial Bureau of Statistics, 2021). These infection rates were much lower than those of mega cities, such as Beijing (49 ipm) and Shanghai (92 ipm) (Baidu APP, 2021; The People's Government of Beijing Municipality, 2021; Shanghai Municipal People's Government, 2021). In addition, the measures adopted by large cities covered a wider area and were generally stricter. For example, Shanghai, as a major international city, had to implement new border entry and exit policies during the pandemic, which smaller cities like Huzhou were not required to do. Furthermore, the impacts of COVID-19 in smaller cities were often shorter in duration. By April 2020, residents in Huzhou only had to wear face masks when entering shopping malls, hospitals and using public transport. However, in Shanghai, people were generally expected to wear face masks everywhere outside of their own homes. Now, the changes seen in terms of travel demand, travel purpose and mode choice in Huzhou and other Chinese cities during the pandemic have all disappeared, although it remains unknown how long these effects will last for in other countries.

#### 4.3. Social inequity due to COVID-19

The COVID-19 crisis has affected almost all individuals and groups in Huzhou, although to varying degrees. First, students, people on lower incomes and those working in tourism, catering, informal businesses and



transport-related sectors were more vulnerable than other sectors of society (Julius et al., 2020; WEF, 2020). Second, spatial heterogeneity, including individuals' personal living environments and previous travel routes, also played a significant role in affecting people's health and well-being (Song et al., 2021).

Many students studying abroad and those who planned to apply to study at a foreign university in 2020 encountered difficulties (UKCISA, 2020; United Nations, 2020). For the former, difficulties in returning home was the most common issue. In the early stages of the outbreak, universities did not implement any specific measures in response to COVID-19, such as alternative means of assessments to exams. Concerns about becoming infected while away from home and worries that subsequent studies might be affected after returning home created a dilemma for them. This hesitation caused them to miss the opportunity to return home in the early stages of the pandemic, forcing them to spend more money and energy on returning home at a later date, due to significantly increased ticket prices and new border policies. In the case of the latter, many prospective students chose not to study abroad or defer their offers due to constantly changing policies, health concerns, travel restrictions and the increasingly tense international situation, or the fact that teaching would be online only. Such conflicts were exacerbated by anxiety and boredom due to travel restrictions. It was not only the students themselves who suffered, but also their families, anxiously waiting at home:

*"I was so worried that my daughter's flight may be suddenly cancelled, or she might be infected by COVID-19 on the way back, which caused me insomnia at that time."*

(Interviewee 21, female, 15/06/2020)

*"Alternative assessments to exams were not decided on by my university before 20 March 2020. Thus, I did not book flights early. I very much regret that as the plane ticket in early April cost me about 50,000 CNY (about 5,500 GBP). If I had bought a ticket fifteen days earlier, I would only have spent one-tenth of this money."*

(Interviewee 5, female, 21/06/2020)

*"During that time, there was a lot in the news that some returning international students did not follow containment measures. Thus, some people misunderstood us and did not want us to come back. However, the students who featured in these reports were not representative. Most international students, at least people around me, were willing to follow instructions and obey commands."*

(Interviewee 12, male, 26/06/2020)

Research has shown that people of different income levels and age groups react instinctively (Ha et al., 2020). Although older adults were more likely to be infected by COVID-19, this does not mean that they were in a more difficult situation. The combination of public health and travel restrictions and other containment measures resulted in the probability of both old and young people being infected approaching zero. With regard to travel, the changes in public transport had a greater impact on older adults than young people because older adults rely on it more. These effects did not last for long, however. In economic terms, the Huzhou government provided financial support and regular care services for >120,000 older people (Wang, 2020), helping the relatively poor among this group to maintain a good standard of living. Thus, older adults were affected by the pandemic to a greater extent than young people, but it is inappropriate to regard them as the primary vulnerable group.

People working in tourism, catering, informal businesses, and the transport and logistics industries suffered substantial economic losses (Julius et al., 2020; WEF, 2020). Travel restrictions and decreasing demand were the major reasons for the decline in these industries. Some informal business sectors did not fully comply with the government's regulatory provisions, which meant that their income and welfare was

not guaranteed by law (Qian, 2019). By contrast, civil servants, such as police officers and doctors, did not suffer serious economic losses, as their salaries are paid from state finances and are fixed, regardless of their workload:

*"In previous years, many customers came to my restaurant for dinner during the Spring Festival, which brought me much money. However, people were forbidden to gather during the Spring Festival this year. They cancelled the dinners they had booked. All the ingredients I prepared were wasted."*

(Interviewee 18, male, 12/07/2020)

Poverty exacerbated the extent and duration of the negative impacts due to COVID-19 and travel restrictions. First, many poorer people do not own a car because they cannot afford one, which reduced their travel choices and caused inconvenience, especially during the period when public transport was restricted. Second, people in a better financial situation have more contingency plans and options available to them in an emergency. For instance, international students from wealthy families could spend significant amounts of money on buying several plane tickets simultaneously in case some flights were cancelled, but for those students with relatively low family incomes, this was not an option. Thus, the cost of transport may cause social exclusion (Church et al., 2000). Third, poorer people have limited capacity to deal with risks as they generally do not have sufficient funds to maintain their previous standard of living when faced with a loss of or reduced income (NAACP, 2020). Finally, the impacts of financial losses on the poor are likely to be more serious and last for longer. As Brooks et al. (2020) claim, people on lower incomes were more likely to be adversely affected by the temporary economic losses and to require additional levels of support:

*"I lost my job during the pandemic, but I was not too worried about that at the beginning, as I still had 20,000 CNY in savings at that time. I did not need to work and could play computer games all day, which made me really happy at first. However, I gradually became anxious, because I had to pay for my rent and spend money on purchasing necessities, such as food and face masks without having any income."*

(Interviewee 6, female, 19/06/2020)

*"Some students bought several flight tickets at the same time and did not really care if their tickets were refundable or not; however, I only bought one ticket at a time and only chose flights that I could get a refund on if they were cancelled. I remember that I bought a ticket from a third-party platform called Qunar, but it could not be used, because of the restricted entry policy in Singapore. Qunar was only willing to refund customers with vouchers instead of cash. I spent nine months using various methods including phone calls, emails, and making complaints to the company and the government, and eventually got my refund in cash."*

(Interviewee 5, female, 21/06/2020)

There is no evidence to indicate that there were differences between urban and rural residents in terms of health and well-being as a result of the impacts of travel restrictions. Before COVID-19, people living in rural areas were more likely to suffer social exclusion due to inadequate transport services, which negatively affected their participation in activities and well-being (Church et al., 2000; Feng, 2011). However, the pandemic has minimised existing inequities, as it meant that people could work from home and had little or no need to travel, regardless of where they lived. In fact, people living in villages may have been at a slight advantage, as they were more likely to have green spaces available, such as courtyards or gardens, which resulted in higher levels of life satisfaction as well as increasing their physical activity and well-being (Benton et al., 2018; Bowler et al., 2010; Lee and Maheswaran, 2010).

In addition, the travel routes that people had used in the previous 14 days affected the degree to which they were excluded. Those who had visited areas with a high number of confirmed cases might be

stigmatised or alienated by others. Even if the majority of these people were healthy, they were still labelled as a 'risk group' due to geographical reasons (Peng, 2020). Panic about the disease could sometimes turn into alienation or even hostility towards this group, which might continue for some time after they had been quarantined.

Overall, travel restrictions due to the pandemic exacerbated social inequalities for disadvantaged groups, but minimised social exclusion in a transport-related sense, as in the case of differences between people living in urban and rural areas. Students (UKCISA, 2020), older adults (Kuy et al., 2020), unemployed people (Julius et al., 2020), low income workers (Brooks et al., 2020), people working in tourism (Guan et al., 2020), catering (Guan et al., 2020), informal businesses and transport-related sectors (Julius et al., 2020) were more likely to suffer adverse financial consequences, as well in terms of health and personal development, for example with regard to further study or career progression. There is also some evidence to suggest that the aforementioned effects lasted for longer among people in these categories compared to other groups in society. In addition, these people often experienced more transport-related restrictions, because their financial circumstances, physical condition and other social disadvantages limited their travel mode choices, which in turn may have negatively affected their physical and mental health.

#### 4.4. Governance during the pandemic crisis

Containment measures implemented by the Huzhou government could be divided into two categories. The first aimed to curb the spread of COVID-19 and reduce the threat to public health by encouraging driving, making face masks mandatory and other methods. The second aimed to stimulate consumption and promote economic recovery by issuing consumer vouchers, reducing loan interest rates and providing financial subsidies.

In the first half of 2020, the Huzhou government introduced a series of measures to prevent transmission of the virus. First, the local government reduced unnecessary trips and social contact to cut off the pathway of transmission through school closures, shutdowns, lockdowns, quarantine and isolation. Second, the government took action to reduce the possibility of infection in situations where outdoor activity was unavoidable. For instance, people in Huzhou were encouraged to drive, walk and cycle instead of travelling by public transport, which is consistent with recommendations by CDC (2021). Third, the price and the sale of medical supplies such as surgical masks were monitored by the Huzhou government to ensure sufficient supply to hospitals and medical professionals during the pandemic. Fourth, people who were infected had to isolate and were also entitled to receive free medical treatment. Fifth, scientific information about the pandemic was provided to residents via television, social media, newspapers and other channels to help them protect themselves more effectively.

After the pandemic, the Huzhou government took action to stimulate consumption to try to restore economic growth. From a corporate perspective, the Huzhou government encouraged recruitment and the development of enterprises by reducing rents or exempting companies from them for three months, decreasing loan interest rates, and granting subsidies for companies that produced pandemic prevention materials (China Daily, 2020). Furthermore, the resumption of tolls on expressways signalled that the government was no longer encouraging people to drive as they did during the pandemic, which also had the effect of increasing Huzhou's revenue from transport. Some vulnerable groups, including orphans, older people, people with disabilities and the less well-off, were entitled to receive financial support from the government. However, not everyone in these groups was given enough support, which illustrates that there is still scope for improvement in the development of social welfare and laws to reduce social exclusion in Huzhou.

In addition to the economic consequences and the effects on people's physical health, citizens' mental health and subjective well-being also play an essential role in social cohesion, though these elements have not

yet received enough attention. During the pandemic, the Huzhou government did not take effective measures to prevent the stigmatisation of some groups such as international students, which may have resulted in social exclusion and inequity. Moreover, as discussed in Section 2.1, other negative feelings due to the pandemic were not correctly recognised and seriously addressed. The income gap between residents in Huzhou is not as large as that in bigger cities, which may explain why the local government was not sufficiently aware of social inequity.

The COVID-19 crisis presented enormous challenges, but also opportunities. It offered a chance to pause the predominantly urban way of life and consider the limitations and drawbacks of the ways in which society has been run over the past few decades (Chatterton, 2020). The first half of 2020 witnessed a series of measures taken by the Huzhou government to reduce the negative impacts of COVID-19. Measures related to travel behaviours could be divided into two types: measures to reduce the number of trips; and measures to reduce the risks of being infected while travelling. They had a common purpose, which was to protect people's physical health. However, the mental toll that the pandemic and the measures designed to combat it took on people, and on disadvantaged groups in particular, is one area that has received scant attention from the government.

The long term measures taken by the government were multi-dimensional. From the perspective of combating COVID-19, free vaccinations for citizens, information disclosure and measures designed to reduce the risk of being infected while travelling, including social distancing, showing a health code and wearing a face mask, were among the most important, nationwide. From the perspective of improving social equity, the Huzhou government should be more proactive in its efforts to reduce social exclusion and existing inequities in terms of transport. For instance, offering discounted bus fares for people aged between 60 and 69 and for students, as well as free bus travel for various different vulnerable categories of people, such as those with disabilities and those older than 70 (FM1035 Huzhou Traffic Broadcast, 2018), are good examples of long term measures. From the perspective of protecting the environment, policymakers should be formulating regulations to encourage sustainable forms of transport, such as the purchase and usage of new energy vehicles (Ministry of Finance of the People's Republic of China, 2021), promoting walking by building greenways (Department of Housing and Urban-Rural Development of Zhejiang Province, 2021) and increasing the charges for using highways in order to reduce driving.

Most of the measures introduced to combat COVID-19 are transferable. In the short term, measures such as shutting down public facilities, decreasing trips, encouraging active travel, information disclosure, quarantine and isolation, social distancing, wearing face masks, working from home and online learning, were useful and functioned well in China during the pandemic, and can also be applied to other cities/countries, which is echoed by existing studies (e.g., Brooks et al., 2020; CDC, 2021; De Vos, 2020). In the long term, encouraging people to have vaccinations, information disclosure, maintaining social distancing and wearing face masks are conducive to preventing any rebound effects of the pandemic. Such measures can also be used by other countries during the post pandemic era. However, some of the stricter measures, such as locking down entire cities, might prove unsuitable for certain countries due to local contextual differences. People living in tight cultures (e.g., China) are more likely to comply with governmental guidance, whereas those living in loose cultures (e.g., Europe, North America) may resist these kinds of constraints on their civil liberties and thus be less cooperative (Gelfand et al., 2021).

## 5. Conclusions

This study discussed how COVID-19 affected travel behaviour in Huzhou and has shown which groups were more vulnerable to the effects of travel restrictions, economic losses and other adverse consequences of the pandemic, resulting in health issues and social inequity.

Policies implemented by the Huzhou government during and after the pandemic were also examined.

During the COVID-19 crisis, travel behaviour in Huzhou changed in four respects: the demand for travel, the purpose for which travel was undertaken, the modes of travel, and the convenience of travel. Most inhabitants, except those working in essential occupations such as police officers and doctors, minimised their travel. Most travel was undertaken for the purposes of shopping, and the number of trips undertaken for other reasons, such as commuting or leisure, was greatly reduced. Moreover, public transport became the least popular mode of transport, as both confined spaces and crowding increase the risk of transmission (Krishnakumari and Cats, 2020; Liu et al., 2020a). Additionally, some protective measures, including wearing surgical masks, showing health codes and checking people's temperature, became mandatory when entering public spaces or using public facilities, making travel less convenient. The decreased travel demand led to a lack of physical activity and psychological distress in the case of some individuals, with adverse effects on their health. These changes in travel behaviour, including a reduction in the number of trips, changes in travel purpose and travel mode choices and the related negative impacts on health also occurred in other cities and countries, such as London and Chicago (Brooks et al., 2020; De Vos, 2020; Manca et al., 2021; Shamshiripour et al., 2020).

In Huzhou, the pandemic has generally been brought under control since April 2020. The demand for and purposes of travel, as well as the choice of transport modes, have gradually returned to pre-crisis levels. Unlike the aforementioned transport-related changes, the requirements for protective measures remain in place after the pandemic, and it is unclear how long these requirements will last.

The effects of travel restrictions and social inequality were reciprocal during the pandemic (Zhang and Cao, 2020). On the one hand, travel restrictions both caused and exacerbated social inequality. Some groups of people suffered injustices because of personal and spatial heterogeneity. Students, lower income cohorts and those working in tourism, catering, informal businesses and transport-related sectors were more vulnerable to disruption to their education and careers, economic loss, poor physical health, negative emotions and decreased well-being (Julius et al., 2020; NAACP, 2020; WEF, 2020). However, travel restrictions decreased existing social inequities relating to transport between people living in rural areas and urban areas in Huzhou. On the other hand, vulnerable groups were likely to face more restrictions than others, with regard to their travel choices, due to their financial circumstances and physical condition, potentially resulting in negative effects on their physical and mental health as well.

After the pandemic, local governments loosened travel restrictions and took action to promote consumption and boost the economy. Some vulnerable individuals and groups received financial support from the government, but this was insufficient to overcome the social injustice caused and exacerbated by the pandemic. In addition to material differences, inequities in mental and psychological health and well-being also need to be given more attention.

Regarding the impacts of COVID-19, the infection rates in small cities were generally lower compared to large cities, and the influence of the pandemic was also more likely to last longer in the latter than in medium and small cities. Measures introduced to combat COVID-19 in large cities were also generally stricter and had a wider coverage. However, the measures taken in most Chinese cities were similar, and many of them such as social distancing, wearing face masks, minimising unnecessary trips, information disclosure, and reducing the use of public transport are also transferable to other regions and countries, although certain measures, like locking down entire cities, may be not suitable for some countries due to differences in cultural and social norms

This research investigated previously unexamined aspects of the pandemic, such as the effects of long-term lockdowns on physical and mental health, using a qualitative approach. The findings confirm the views expressed in previous literature that participation in activities

plays a significant role in people's subjective well-being (Archer et al., 2013; De Vos et al., 2013).

This study focused on the impacts of COVID-19 in small Chinese cities, whereas most of the existing literature places more emphasis on the effects of COVID-19 on cities with large populations (Cheng, 2020; Gouk, 2020; Lau et al., 2020). In addition, there has already been considerable discussion of social inequity and exclusion due to transport-related factors and individuals' heterogeneity in megacities such as Beijing, Melbourne and London (Cao and Hickman, 2019a, Cao and Hickman, 2019b; Cuthill et al., 2019; Zhao et al., 2020). However, the inequities resulting from these factors in small cities have been overlooked. The findings show that social inequity in Huzhou has not yet received adequate attention – a state of affairs that needs to be improved.

In addition, countries and regions worldwide have varied widely in their ability to reduce mortality and infection rates during the pandemic. Understanding what caused these variations is not only important for this research, but also matters in terms of being able to select the most effective interventions in the future (Gelfand et al., 2021).

The outbreak of COVID-19 caused the temporary suspension of many aspects of urban life and led to a new perspective, demonstrating that providing economic assistance to vulnerable groups and increased public participation are conducive to maintaining social cohesion. Policymakers and transport planners should value these goals more highly whilst recognising the limitations of reducing social inequity due to transport and individual heterogeneity. Public transport systems in Huzhou and other Chinese cities should be further developed via the expansion of networks, increasing the service frequency, extending and upgrading the infrastructure and introducing new modes of transport such as light rail. Moreover, it is also beneficial to introduce active methods of travel such as shared bicycle schemes, as these increase fitness and well-being (Andersen et al., 2000; Lyu et al., 2020; Martin et al., 2014).

#### CRediT authorship contribution statement

**Yilin Yang:** Conceptualization, Data curation, Formal analysis, Methodology, Visualization, Writing – original draft. **Mengqiu Cao:** Conceptualization, Formal analysis, Funding acquisition, Methodology, Supervision, Writing – original draft. **Long Cheng:** Validation, Writing – review & editing. **Keyu Zhai:** Validation, Writing – review & editing. **Xu Zhao:** Validation, Writing – review & editing. **Jonas De Vos:** Validation, Writing – review & editing.

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#### Appendix A: List of Semi-Structured interview questions

1. Could you please describe the differences in your travel behaviour before and after the pandemic?
2. What types of transport do you often use and why?
3. Did you change the frequency of using public transport during and after the pandemic compared to in the past?
4. What are the impacts of the pandemic on your work, study, and entertainment?
5. Did the pandemic cause you economic losses?
6. Did the pandemic affect your well-being?
7. What policies did the Huzhou government adopt during and after the pandemic?



8. Did the Huzhou government provide subsidies during and after the pandemic?
9. Could you please describe the most impressive thing you encountered during the pandemic?

## References

- Andersen, L., Schnohr, P., Schroll, M., Hein, H., 2000. All-cause mortality associated with physical activity during leisure time, work, sports, and cycling to work. *Archives of Internal Medicine* (1960) 160 (11), 1621–1628.
- Anderson, R., Heesterbeek, H., Klinkenberg, D., Hollingsworth, T., 2020. How will country-based mitigation measures influence the course of the COVID-19 epidemic? *The Lancet (British edition)* 395 (10228), 931–934.
- Aquillino, W.S., 1994. Interview mode effects in surveys of drug and alcohol use: A field experiment. *Public Opinion Quarterly* 58, 210–240.
- Archer, M., Paletti, R., Konduri, K.C., Pendyala, R.M., Bhat, C., 2013. Modeling the connection between activity-travel patterns and subjective well-being. *Transportation Research Record* 2382 (1), 102–111.
- Axhausen, K., Gärling, T., 1992. Activity-based approaches to travel analysis: conceptual frameworks, models, and research problems. *Transport Reviews* 12 (4), 323–341.
- Baidu APP. (2021) Coronavirus: Real-time big data report of the pandemic (Online) Available at: <[https://voice.baidu.com/act/newpneumonia/newpneumonia/?from=osari\\_aladin\\_banner](https://voice.baidu.com/act/newpneumonia/newpneumonia/?from=osari_aladin_banner)> (Accessed 21 July 2021) (in Chinese).
- Bendibao (2020) The situation of COVID-19 in Huzhou on 30th August 2020. (Online) Available at: <<http://hz.bendibao.com/news/2020830/92605.shtml>> (Accessed 15 September 2020) (in Chinese).
- Bendibao (2021) The situation of COVID-19 in Quzhou on 16th April 2021. (Online) Available at: <<http://hz.bendibao.com/news/2021416/101586.shtml>> (Accessed 26 July 2021) (in Chinese).
- Benton, J., Anderson, J., Cotterill, S., Dennis, M., Lindley, S., French, D., 2018. Evaluating the impact of improvements in urban green space on older adults' physical activity and well-being: protocol for a natural experimental study. *BMC Public Health* 18 (923), 1–15.
- Bernard, H., 2006. *Research Methods in Anthropology: Qualitative and Quantitative Methods*, 4th ed. AltaMira Press, Walnut Creek, California.
- Block, E., Erskine, L., 2012. Interviewing by telephone: Specific considerations, opportunities, and challenges. *International Journal of Qualitative Methods* 11 (4), 428–445.
- Bowler, D., Buyung-Ali, L., Knight, T., Pullin, A., 2010. A systematic review of evidence for the added benefits to health of exposure to natural environments. *BMC Public Health* 10 (456), 1–10.
- Braunack-Mayer, A., Toohar, R., Collins, J., Street, J., Marshall, H., 2013. Understanding the school community's response to school closures during the H1N1 2009 influenza pandemic. *BMC public health* 13 (1), 344.
- Braun, V., Clarke, V., 2006. Using thematic analysis in psychology. *Qualitative Research in Psychology* 3 (2), 77–101.
- Brooks, S., Webster, R., Smith, L., Woodland, L., Wessely, S., Greenberg, N., Rubin, G., 2020. The psychological impact of quarantine and how to reduce it: Rapid review of the evidence. *The Lancet (British edition)* 395 (10227), 912–920.
- Bryman, A., 2016. *Social Research Methods*, 5th ed. Oxford University Press, Oxford.
- Budd, L., Ison, S., 2020. Responsible transport: A post-COVID agenda for transport policy and practice. *Transportation Research Interdisciplinary Perspectives* 6, 100151.
- Caleo, G., Duncombe, J., Jephcott, F., Lokuge, K., Mills, C., Looijen, E., Theoharaki, F., Kremer, R., Kleijer, K., Squire, J., Lamin, M., Stringer, B., Weiss, H., Culli, D., Di Tanna, G., Greig, J., 2018. The factors affecting household transmission dynamics and community compliance with Ebola control measures: a mixed-methods study in a rural village in Sierra Leone. *BMC public health* 18 (1), 248.
- Cao, M., Hickman, R., 2020. Transport, Social Equity and Capabilities in East Beijing. In: Chen, C.-L., Pan, H., Shen, Q., Wang, J. (Eds.), *Handbook on Transport and Urban Transformation in China*. Edward Elgar, Cheltenham.
- Cao, M., Hickman, R., 2019a. Understanding travel and differential capabilities and functionalities in Beijing. *Transport Policy* 83, 46–56.
- Cao, M., Hickman, R., 2019b. Urban transport and social inequities in neighbourhoods near underground stations in Greater London. *Transportation Planning and Technology* 42 (5), 419–441.
- Carr, E., Worth, A., 2001. The use of the telephone interview for research. *Nursing Times Research* 6, 511–524.
- Cava, M., Fay, K., Beanlands, H., McCay, E., Wignall, R., 2005. The Experience of Quarantine for Individuals Affected by SARS in Toronto. *Public Health Nursing* 22 (5), 398–406.
- Centers for Disease Control and Prevention (CDC). (2021) Employer information for office buildings. (Online) Available at: <<https://www.cdc.gov/coronavirus/2019-ncov/community/office-buildings.html>> (Accessed 28 July 2021).
- Chatterton, P. (2020) Coronavirus: we're in a real-time laboratory of a more sustainable urban future. [online] Available at: <<https://ptrc-training.co.uk/News/ArtMID/6886/ArticleID/27697/Coronavirus-were-in-a-real-time-laboratory-of-a-more-sustainable-urban-future>> (Accessed 26 July 2020).
- Chen, L., Liu, W., Zhang, Q., Xu, K., Ye, G., Wu, W., Sun, Z., Liu, F., Wu, K., Zhong, B., Mei, Y., Zhang, W., Chen, Y., Li, Y., Shi, M., Lan, K., Liu, Y., 2020. RNA based mNGS approach identifies a novel human coronavirus from two individual pneumonia cases in 2019 Wuhan outbreak. *Emerging Microbes and Infections* 9 (1), 313–319.
- Chen, Q., Pan, S., 2020. Transport-related experiences in China in response to the Coronavirus (COVID-19). *Transportation Research Interdisciplinary Perspectives* 8, 100246.
- Cheng, E. (2020) Sudden, new coronavirus cluster in Beijing points to the growth challenges ahead for China. (Online) Available at: <<https://www.cnbc.com/2020/06/17/coronavirus-cluster-in-chinas-capital-beijing-raises-growth-concerns.html>> (Accessed 20 July 2020).
- China Daily. (2020) Important news! Huzhou issued the "Eight policies" in response to the COVID-19 crisis to support the development of enterprises. (Online) Available at: <<http://ex.chinadaily.com.cn/exchange/partners/82/rss/channel/cn/columns/j3u3t6/stories/WS5e38225fa3107bb6b579cf85.html>> (Accessed 30 July 2020) (in Chinese).
- Chinese Government Website. (2020) Press Conference of the Joint Prevention and Control Mechanism of the State Council. (Online) Available at: <<http://www.gov.cn/xinwen/gwylflkjz56/mobile.htm>> (Accessed 26 July 2020) (in Chinese).
- Chisholm, D., Stanciole, A., Tan Torres Edejer, T., Evans, D., 2010. Economic impact of disease and injury: counting what matters. *British Medical Journal Publishing Group (BMJ)* 340, c924.
- Church, A., Frost, M., Sullivan, K., 2000. Transport and social exclusion in London. *Transport Policy* 7 (3), 195–205.
- Cuthill, N., Cao, M., Liu, Y., Gao, X., Zhang, Y., 2019. The association between urban public transport infrastructure and social equity and spatial accessibility within the urban environment: An investigation of Tramlink in London. *Sustainability* 11 (5), 1229.
- Department of the Environment, Transport and the Regions (DETR). (2001) *Older People: Their Transport Needs and Requirements*. London: Department of the Environment, Transport and the Regions.
- Department of Health and Social Care. (2020) Policy paper: Coronavirus action plan: A guide to what you can expect across the UK. (Online) Available at: <<https://www.gov.uk/government/publications/coronavirus-action-plan/coronavirus-action-plan-a-guide-to-what-you-can-expect-across-the-uk#fnref:8>> (Accessed 11 July 2020).
- Department of Housing and Urban-Rural Development of Zhejiang Province. (2021) Letter on soliciting opinions on "Zhejiang Provincial Greenway Network Planning (2021-2035)" and "Technical Guidelines for Greenway Planning and Design of Zhejiang Province (2020 Revised Edition)" (Online) Available at: <[http://jst.zj.gov.cn/art/2020/9/28/art\\_1229159359\\_58923128.html](http://jst.zj.gov.cn/art/2020/9/28/art_1229159359_58923128.html)> (Accessed 22 July 2021) (in Chinese).
- De Vos, J., Schwanen, T., Van Acker, V., Witlox, F., 2013. Travel and subjective well-being: A focus on findings, methods and future research needs. *Transport Reviews* 33 (4), 421–442.
- De Vos, J., 2020. The effect of COVID-19 and subsequent social distancing on travel behavior. *Transportation Research Interdisciplinary Perspectives* 5, 100121.
- Dirix, H., Ross, V., Brijs, K., Vermeiren, E., Timmermans, C., Alhajjaseen, W., Brijs, T., Wets, G., Spooren, A., 2021. The appraisal of roadway environment and infrastructure by drivers with autism: A qualitative study. *Transportation Research Part F: Traffic Psychology and Behaviour* 78, 280–298.
- Drabble, L., Trocki, K., Salcedo, B., Walker, P., Korcha, R., 2016. Conducting qualitative interviews by telephone: Lessons learned from a study of alcohol use among sexual minority heterosexual women. *Qualitative Social Work* 15 (1), 118–133.
- 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.
- Feng, W., 2011. Social exclusion of the elderly in contemporary China: one empirical study based on the surveys in six provinces. Revised Organisation for Economic Co-operation and Development paper.
- Ferguson, N., Laydon, D., Nedjati-Gilani, G., Imai, N., Ainslie, K., Baguelin, M., Bhatia, S., Boonyasiri, A., Cucunubá, Z., Cuomo-Dannenburg, G., Dighe, A., Dorigatti, I., Fu, H., Gaythorpe, K., Green, W., Hamlet, A., Hinsley, W., Okell, L., van Elsland, S., Thompson, H., Verity, R., Volz, E., Wang, H., Wang, Y., Walker, P., Walters, C., Winskill, P., Whittaker, C., Donnelly, C., Riley, S., Ghani, A., 2020. Impact of non-pharmaceutical interventions (NPIs) to reduce COVID19 mortality and healthcare demand. Imperial College London, London.
- FM1035 Huzhou Traffic Broadcast. (2018) Good news! Huzhou bus launched IC card to realize the interconnection of 190 cities in China. (Online) Available at: <[https://www.sohu.com/a/237235435\\_167383](https://www.sohu.com/a/237235435_167383)> (Accessed 29 July 2021) (in Chinese).
- Frey, J., 2004. Telephone Surveys. In: Lewis-Beck, M.S., Bryman, A., Liao, T.F. (Eds.), *The Sage Encyclopedia of Social Science Research Methods*. Sage, Thousand Oaks, CA.
- Frey, J., Oishi, S., 1995. *How to Conduct Interviews by Telephone and in Person*. Sage, Thousand Oaks, CA.
- Garbett, R., McCormack, B., 2001. The experience of practice development: An exploratory telephone interview study. *Journal of Clinical Nursing* 10, 94–102.
- Gärling, T., Gärling, A., Johansson, A., 2000. Household choices of car-use reduction measures. *Transportation Research Part A* 34 (5), 309–320.
- Gelfand, M., Jackson, J., Pan, X., Nau, D., Pieper, D., Denison, E., Dagher, M., Van Lange, P., Chiu, C., Wang, M., 2021. The relationship between cultural tightness-looseness and COVID-19 cases and deaths: A global analysis. *The Lancet Planetary Health* 5 (3), 135–144.
- Golics, C., Basra, M., Finlay, A., Salek, S., 2013. The impact of disease on family members: a critical aspect of medical care. *Journal of the Royal Society of Medicine* 106 (10), 399–407.
- Goodwin, P., 1996. Simple arithmetic. *Transport Policy* 3 (3), 79–80.
- Gosce, L., Johansson, A., 2018. Analysing the link between public transport use and airborne transmission: mobility and contagion in the London underground. *Environmental Health* 17 (1).



- Gössling, S., 2002. Global environmental consequences of tourism. *Global Environmental Change* 12 (4), 283–302.
- Gössling, S., Scott, D., Hall, M., 2020. Pandemics, tourism and global change: A rapid assessment of COVID-19. *Journal of Sustainable Tourism* 1–20.
- Gouk, R. (2020) Impact of COVID-19 on Restaurants in Shanghai (April 2020). (Online) Available at: < <https://rachelgouk.com/impact-of-covid-19-on-restaurants-in-shanghai/>> (Accessed 20 July 2020).
- Guan, D., Wang, D., Hallegatte, S., Huo, J., Li, S., Bai, Y., Lei, T., Xue, Q., Davis, S., Coffman, D., Cheng, D., Chen, P., Liang, X., Xu, B., Lu, X., Wang, S., Hubacek, K., Gong, P., 2020. Global economic footprint of the COVID-19 pandemic. *Nature Human Behaviour* 4, 577–587.
- Guangdong Provincial Bureau of Statistics (2021) Public Report on the Seventh National Census of Guangdong (No.2). (Online) Available at: < <http://stats.gd.gov.cn/attachment/0/421/421374/3284452.pdf>> (Accessed 26 July 2021) (in Chinese).
- Ha, J., Lee, S., Ko, J., 2020. Unraveling the impact of travel time, cost, and transit burdens on commute mode choice for different income and age groups. *Transportation Research Part A: Policy and Practice* 141, 147–166.
- Hall, C., 2020. Biological invasion, biosecurity, tourism, and globalisation. In: Timothy, D. (Ed.), *Handbook of Globalization and Tourism*. Edward Elgar, Cheltenham, pp. 114–125.
- Huzhou Cartography (2020) Latest pandemic situation: 1 new case was confirmed in Huzhou, and a total of 10 cases were confirmed. Anji is the only uninfected county in Huzhou. (Online) Available at: < <https://kuaiyibao.qq.com/s/20200208A0749200?refer=spider>> (Accessed 20 April 2020) (in Chinese).
- Iio, K., Guo, X., Kong, X., Rees, K., Wang, X.B., 2021. COVID-19 and social distancing: Disparities in mobility adaptation between income groups. *Transportation Research Interdisciplinary Perspectives* 10, 100333.
- Jiang, B., Liang, S., Peng, Z.R., Cong, H., Levy, M., Cheng, Q., Wang, T., Remais, J., 2017. Transport and public health in China: the road to a healthy future. *The Lancet* 390 (10104), 1781–1791.
- Jiupai News. (2021) No new confirmed cases and asymptomatic infections in Shantou on 24th July 2021. (Online) Available at: < <https://baijiahao.baidu.com/?id=1706239846386656696&wfr=spider&for=pc>> (Accessed 26 July 2021) (in Chinese).
- Julius, E., Nuugulu, S., Julius, L., 2020. Estimating the Economic Impact of COVID-19: A Case Study of Namibia. *Munich Personal RePEc Archive (MPRA) Paper* 99641.
- Kim, K., 2021. Impacts of COVID-19 on transportation: Summary and synthesis of interdisciplinary research. *Impacts of COVID-19 on transportation: Summary and synthesis of interdisciplinary research. Transportation Research Interdisciplinary Perspectives* 9, 100305.
- Kriauciuniene, V., Bagdonaviciene, L., Rodríguez-Pérez, C., Petkeviciene, J., 2020. Associations between changes in health behaviours and body weight during the COVID-19 quarantine in Lithuania: The Lithuanian COVIDiet study. *Nutrients* 12 (10), 3119.
- Krishnakumari, P. and Cats, O. (2020) (2020) Virus spreading in public transport networks: the alarming consequences of the business as usual scenario. (Online) Available at: < <https://www.linkedin.com/pulse/virus-spreading-public-transport-networks-alarming-usual-krishnan/?trackingId=81NAitHwKOR9oaO1GNGswQ%3D%3D>> (Accessed 10 May 2020).
- Kroesen, M., Chorus, C., 2020. A new perspective on the role of attitudes in explaining travel behavior: A psychological network model. *Transportation Research Part A: Policy and Practice* 133 (C), 82–94.
- Kuy, S., Tsai, R., Bhatt, J., Chu, Q., Gandhi, P., Gupta, R., Gupta, R., Hole, M., Hsu, B., Hughes, L., Jarvis, L., Jha, S., Annamalai, A., Kotwal, M., Sakran, J., Vohra, S., Henry, T., Correa, R., 2020. Focusing on vulnerable populations during COVID-19. *Academic Medicine* 95 (11), e2–e3.
- Lau, H., Khosrawipour, V., Kocbach, P., Mikolajczyk, A., Schubert, J., Bania, J., Khosrawipour, T., 2020. The positive impact of lockdown in Wuhan on containing the COVID-19 outbreak in China. *Journal of Travel Medicine* 27 (3).
- Lee, A., Maheswaran, R., 2010. The health benefits of urban green spaces: A review of the evidence. *Journal of Public Health (Oxford, England)* 33 (2), 212–222.
- Liu, Y., Ning, Z., Chen, Y., Guo, M., Liu, Y., Gali, N., Sun, L., Duan, Y., Cai, J., Westerdahl, D., Liu, X., Kan, H., Fu, Q., Lan, K., 2020a. Aerodynamic Characteristics and RNA Concentration of SARS-CoV-2 Aerosol in Wuhan Hospitals. *Nature* 582, 557–560.
- Liu, Y., Wang, R., Lu, Y., Li, Z., Chen, H., Cao, M., Zhang, Y., Song, Y., 2020b. Natural outdoor environment, neighbourhood social cohesion and mental health: Using multilevel structural equation modelling, streetscape and remote-sensing metrics. *Urban Forestry and Urban Greening* 48, 126576.
- Lu, Y., Fu, X., Lu, C., Guo, E., Tang, F., Zhu, J., Li, H., 2020. Effects of route familiarity on drivers' psychological conditions: Based on driving behaviour and driving environment. *Transportation Research Part F: Traffic Psychology and Behaviour* 75, 37–54.
- Lyu, Y., Cao, M., Zhang, Y., Yang, T., Shi, C., 2020. Investigating users' perspectives on the development of bike-sharing in Shanghai. *Research in Transportation Business and Management*, p. 100543.
- Maguire, M., Delahunt, B., 2017. Doing a thematic analysis: A practical, step-by-step guide for learning and teaching scholars. *All Ireland Journal of Teaching and Learning in Higher Education* 9 (3), 3351–3364.
- Mallapaty, S., 2020. What the cruise-ship outbreaks reveal about COVID-19. *Nature* 580 (7801), 18.
- Manca, F., Sivakumar, A., Pawlak, J., Brodzinski, N., 2021. Will we fly again? Modeling air travel demand in light of COVID-19 through a London case study. *Transportation Research Record: Journal of the Transportation Research Board*. <https://doi.org/10.1177/03611981211025287>.
- Marshall, C., Rossman, G., 1999. *Designing qualitative research*, 3rd ed. Sage Publications, London.
- Martin, A., Goryakin, Y., Suhrcke, M., 2014. Does active commuting improve psychological well-being? Longitudinal evidence from eighteen waves of the British Household Panel Survey. *Preventive Medicine* 69, 296–303.
- Maritan, C., 2001. Capital investment as investing in organizational capabilities: An empirically grounded process model. *Academy of Management Journal* 44 (3), 513–531.
- Meyer, J., McDowell, C., Lansing, J., Brower, C., Smith, L., Tully, M., Herring, M., 2020. Changes in physical activity and sedentary behavior in response to COVID-19 and their associations with mental health in 3052 US adults. *International Journal of Environmental Research and Public Health* 17 (18), 6469.
- Ministry of Finance of the People's Republic of China. (2021) The notice of the Ministry of Finance on issuing the 2021 energy saving and emission reduction subsidy fund budget. (Online) Available at: < <http://jjs.mof.gov.cn/zxzyzf/jnjbzzj/202104/t202104283694214.htm>> (Accessed 22 July 2021) (in Chinese).
- Ministry of Health Singapore. (2020) Additional border control measures to reduce further importation of Covid-19 cases. (Online) Available at: < <https://www.moh.gov.sg/news-highlights/details/additional-border-control-measures-to-reduce-further-importation-of-covid-19-cases>> (Accessed 22 July 2020).
- Ministry of Transport of the People's Republic of China (MTPRC). (2020) Announcement of the Ministry of Transport on the resumption of toll road toll collection. (Online) Available at: < [https://xxgk.mot.gov.cn/2020/jigou/glj/202006/t20200623\\_3313231.html](https://xxgk.mot.gov.cn/2020/jigou/glj/202006/t20200623_3313231.html)> (Accessed 4 July 2020) (in Chinese).
- Mitchell, P., Al-Janabi, H., Richardson, J., Iezz, A., Coast, J., 2015. The relative impacts of disease on health status and capability well-being: A multi-country study. *PLoS* 10 (12), e0143590.
- Molloy, J., Schatzmann, T., Schoeman, B., Tchervenkov, C., Hintermann, B., Axhausen, K., 2021. Observed impacts of the Covid-19 first wave on travel behaviour in Switzerland based on a large GPS panel. *Transport Policy* 104, 43–51.
- Moser, M., Bender, T., Margolis, H., Noble, G., Kendal, A., Ritter, D., 1979. An outbreak of influenza aboard a commercial airliner. *American Journal of Epidemiology* 110 (1), 1–6.
- Musselwhite, C., Avineri, E., Susilo, Y., 2020. Editorial JTH 16 –The Coronavirus disease COVID-19 and implications for transport and health. *Journal of Transport and Health* 16, 100853.
- National Association for the Advancement of Colored People (NAACP) (2020) Ten Equity Implications of the Coronavirus COVID-19 Outbreak in the United States. The imperative for civil rights advocacy, monitoring, and enforcement. (Online) Available at: < <https://eastsideforall.org/wp-content/uploads/2020/03/Ten-Equity-Considerations-of-the-Coronavirus-COVID-19-Outbreak-in-the-United-States-FINAL.pdf>> (Accessed 6 August 2020).
- Neuman, W., Lincoln, A., 2006. *Workbook for Neuman Social research methods: qualitative and quantitative approaches*, sixth edition. Allyn and Bacon, Boston, Mass.; London.
- Novick, G., 2008. Is there a bias against telephone interviews in qualitative research? *Research in Nursing and Health* 31, 391–398.
- Odeck, J., Bråthen, S., 2008. Travel demand elasticities and users attitudes: A case study of Norwegian toll projects. *Transportation Research Part A: Policy and Practice* 42 (1), 77–94.
- Opendakker, R. (2006) Advantages and disadvantages of four interview techniques in qualitative research. (Online) Available at: < <https://www.qualitative-research.net/index.php/fqs/article/view/175/391>> (Accessed 24 July 2021).
- Pan, A., Liu, L., Wang, C., Guo, H., Hao, X., Wang, Q., Huang, J., He, N., Yu, H., Lin, X., Wei, S., Wu, T., 2020. Association of Public Health Interventions with the Epidemiology of the COVID-19 Outbreak in Wuhan, China. *The Journal of the American Medical Association (JAMA)* 323 (19), 1915–1923.
- Passos, L., Prazeres, F., Teixeira, A., Martins, C., 2020. Impact on mental health due to COVID-19 pandemic: Cross-sectional study in Portugal and Brazil. *International Journal of Environmental Research and Public Health* 17 (18), 6794.
- Pengpai. (2021) Announcement of COVID-19 in Huzhou on 15th July 2021. (Online) Available at: < [https://m.thepaper.cn/baijiahao\\_13596355](https://m.thepaper.cn/baijiahao_13596355)> (Accessed 26 July 2021) (in Chinese).
- Peng, S. (2020) Pay attention to the “new vulnerable groups” emerging during the COVID-19 outbreak. (Online) Available at: < <http://www.gsm.pku.edu.cn/info/1316/21637.htm>> (Accessed 20 July 2020).
- Phelan, A., Katz, R., Gostin, L., 2020. The novel coronavirus originating in Wuhan, China: challenges for global health governance. *JAMA* 323 (8), 709–710.
- Punch, K., 2005. *Introduction to Social Research: Quantitative and Qualitative Approaches*, 2nd ed. Sage, London.
- Qian, J. (2019) Why Informal Workers Are Opting Out of China's Welfare System. (Online) Available at: < <https://www.sixthtone.com/news/1004594/why-informal-workers-are-opting-out-of-chinas-welfare-system>> (Accessed 4 August 2020) (in Chinese).
- Robson, C., 2011. *Real World Research: a resource for users of social research methods in applied settings*, 3rd ed. Wiley, Chichester.
- Rodriguez, C. (2020), COVID-19 Impacts on Demurrage and Detention. (Online) Available at: < <https://www.internationaltradeinsights.com/2020/04/covid-19-impacts-supply-chain-creating-demurrage-and-detention-issues>> (Accessed 10 August 2020).
- Rundle, A., Park, Y., Herbstman, J., Kinsey, E., Wang, Y., 2020. COVID-19-related school closings and risk of weight gain among children. *Obesity (Silver Spring)* 28 (6), 1008–1009.
- Sallis, J.F., Frank, L.D., Saelens, B.E., Kraft, M.K., 2004. Active transportation and physical activity: opportunities for collaboration on transportation and public health research. *Transportation Research Part A: Policy and Practice* 38 (4), 249–268.

- Shamshirpour, A., Rahimi, E., Shabanpour, R., Mohammadian, A., 2020. How is Covid-19 reshaping activity-travel behavior? Evidence from a comprehensive survey in Chicago. *Transportation Research Interdisciplinary Perspectives* 7, 100216.
- Shanghai Municipal People's Government. (2021) Main data of the seventh national census in Shanghai. (Online) Available at: < <https://www.shanghai.gov.cn/nw12344/20210518/001a0cef127c499eb381fa8dc3208e95.html>> (Accessed 28 July 2021) (in Chinese).
- Shi, K., De Vos, J., Yang, Y., Witlox, F., 2019. Does e-shopping replace shopping trips? Empirical evidence from Chengdu, China. *Transportation research. Part A: Policy and practice* 122, 21–33.
- Social Exclusion Unit (SEU), 2001. Preventing Social Exclusion. Cabinet Office, London.
- Sohu (2020) Suddenly! Detailed explanation of 46 new positive infections in Beijing, new crown virus detected in imported salmon. (Online) Available at: < [https://www.sohu.com/a/401812226\\_485393](https://www.sohu.com/a/401812226_485393)> (Accessed 8 July 2020) (in Chinese).
- Song, X., Cao, M., Zhai, K., Gao, X., Wu, M., Yang, T., 2021. The effects of spatial planning, well-being and behavioural changes during and after the COVID-19 pandemic. *Frontiers in Sustainable Cities* 3, 686706.
- Spurling, D., Spurling, J., Cao, M., 2019. *Transport Economics Matters: Applying Economic Principles to Transportation in Great Britain*. Brown Walker Press, Boca Raton.
- Statista. (2020), Coronavirus: impact on the gaming industry worldwide. (Online) Available at: < <https://www.statista.com/study/72150/coronavirus-impact-on-the-video-game-industry-worldwide/>> (Accessed 12 August 2020).
- Sustainable Development Policy Institute (2020) Combating COVID 19: Policy Options for Pakistan. Sustainable Development Policy Institute.
- Tencent. (2021) The situation of COVID-19 in Zhanjiang on 24th July 2021. (Online) Available at: < <https://new.qq.com/rain/a/20210720A0E00100>> (Accessed 26 July 2021) (in Chinese).
- The People's Government of Beijing Municipality. (2021) Public report on the seventh national census of Beijing (No. 1). (Online) Available at: < <https://www.shanghai.gov.cn/nw12344/20210518/001a0cef127c499eb381fa8dc3208e95.html>> (Accessed 28 July 2021) (in Chinese).
- Tirachini, A., Cats, O., 2020. COVID-19 and public transportation: Current assessment, prospects, and research needs. *Journal of Public Transportation* 22 (1), 1–21.
- Ton, D., Duives, D.C., Cats, O., Hoogendoorn-Lanser, S., Hoogendoorn, S.P., 2019. Cycling or walking? Determinants of mode choice in the Netherlands. *Transportation Research Part A: Policy and Practice* 123, 7–23.
- Troko, J., Myles, P., Gibson, J., Hashim, A., Enstone, J., Kingdon, S., Packham, C., Amin, S., Hayward, A., Nguyen Van-Tam, J., 2011. Is public transport a risk factor for acute respiratory infection? *BMC Infectious Diseases* 11 (16), 1–6.
- UK Council for International Students Affairs (UKCISA). (2020) Coronavirus (Covid-19): info for international students. [Online] Available at: < <https://www.ukcisa.org.uk/Information-Advice/Studying-living-in-the-UK/Coronavirus-Covid-19-info-for-international-students#layer-6725>> (Accessed 15 August 2020).
- United Nations. (2020) COVID-19 creates challenges for international students in Iceland. [Online] Available at: < <https://www.un.org/en/coronavirus/covid-19-creates-challenges-international-students>> (Accessed 15 August 2020).
- U.S. Immigration and Customs Enforcement. (2020) SEVP modifies temporary exemptions for nonimmigrant students taking online courses during fall 2020 semester. (Online) Available at: < <https://www.ice.gov/news/releases/sevp-modifies-temporary-exemptions-nonimmigrant-students-taking-online-courses-during>> (Accessed 15 August 2020).
- Venter, Z., Aunan, K., Chowdhury, S. and Lelieveld, J. (2020) COVID-19 lockdowns cause global air pollution declines. *Proceedings of the National Academy of Sciences of the United States of America*. 117(32), 18984–18990.
- Vlek, C., Michon, J., 1992. Why we should and how we could decrease the use of motor vehicles in the near future. *IATSS Research* 15, 82–93.
- Wang, N. (2020) During the pandemic, Wu Xing is particularly concerned about them. (Online) Available at: < <http://www.am810.net/6175047.html3>> (Accessed 31 July 2020) (in Chinese).
- Wang, X., Lei, S., Le, S., Yang, Y., Zhang, B., Yao, W., Gao, Z., Cheng, S., 2020. Bidirectional influence of the COVID-19 pandemic lockdowns on health behaviors and quality of life among Chinese adults. *International Journal of Environmental Research and Public Health* 17 (15), 5575.
- Watson-Brown, N., Truelove, V., Parker, E., Davey, J., 2021. Drink driving during the COVID-19 pandemic. *Transportation Research Part F: Traffic Psychology and Behaviour* 78, 369–380.
- World Economic Forum (WEF). (2020) This is how COVID-19 is affecting informal workers. (Online) Available at: < <https://www.weforum.org/agenda/2020/07/coronavirus-impact-informal-workers-world-bank/>> (Accessed 14 August 2020).
- World Health Organization (WHO). (2021) WHO Coronavirus (COVID-19) Dashboard. (Online) Available at: < <https://covid19.who.int/>> (Accessed 6 June 2021).
- World Tourism Organization (UNWTO). (2020) Impact Assessment of the Covid-19 Outbreak on International Tourism. (Online) Available at: < <https://www.unwto.org/impact-assessment-of-the-covid-19-outbreak-on-international-tourism>> (Accessed 25 July 2021).
- Xinhuanet (2020) During the pandemic, highways were free for 79 days. How much tolls have been underpaid? (Online) Available at: < <http://henan.163.com/20/0507/14/FC11SHAS04398SNM.html>> (Accessed 28 July 2020) (in Chinese).
- Zachary, Z., Brianna, F., Brianna, L., Garrett, P., Jade, W., Alyssa, D., Kerekes, M., 2020. Self-quarantine and weight gain related risk factors during the COVID-19 pandemic. *Obesity Research and Clinical Practice* 14 (3), 210–216.
- Zhang, Y., Cao, M., 2020. How will transit station closures affect Londoners? *Focus* 22 (10), 52–53.
- Zhao, P., Liu, D., Yu, Z., Hu, H., 2020. Long commutes and transport inequity in China's growing megacity: New evidence from Beijing using mobile phone data. *Travel behaviour and society* 20, 248–263.
- Zhejiang Provincial Bureau of Statistics. (2021) Public report on the seventh national census of Zhejiang. (Online) Available at: < [http://tjj.zj.gov.cn/art/2021/5/13/art\\_1229129205\\_4632764.html](http://tjj.zj.gov.cn/art/2021/5/13/art_1229129205_4632764.html)> (Accessed 26 July 2021) (in Chinese).
- Zheng, H. (2020) Bus and subway full load rate is less than 50% Guangzhou readjusts public transportation frequency [Online] Available at: < [http://gd.ifeng.com/a/20200216/8431271\\_0.shtml](http://gd.ifeng.com/a/20200216/8431271_0.shtml)> (Accessed 11 May, 2020).
- Zhou, P., Yang, X., Wang, X., Hu, B., Zhang, L., Zhang, W., Si, H., Zhu, Y., Li, B., Huang, C., Chen, H., Chen, J., Luo, Y., Guo, H., Jiang, R., Liu, M., Chen, Y., Shen, X., Wang, X., Zheng, X., Zhao, K., Chen, Q., Deng, F., Liu, L., Yan, B., Zhan, F., Wang, Y., Xiao, G., Shi, Z., 2020. A pneumonia outbreak associated with a new coronavirus of probable bat origin. *Nature* 579 (7798), 270–273.
- Zhou, Y. (2020) An Analysis on the Influences of COVID-19 Epidemic on China's Pan-Entertainment Industry. Research Department of Industrial Economy, Development Research Center of the State Council of the People's Republic of China (DRC). No.25. (Online). Available at < [http://en.drc.gov.cn/2020-03/24/content\\_37534641.htm](http://en.drc.gov.cn/2020-03/24/content_37534641.htm)> (Accessed 28 July 2020).