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Exploring the Relationship between the Impacts of the COVID-19 Pandemic and Changes in Travel Behaviour in Huzhou, China

By Yilin Yang

Supervisor: Matthew Cao

Being a dissertation submitted to the faculty of The Built Environment as part of the requirements for the award of the MSc Transport and City Planning at University College London: I declare that this dissertation is entirely my own work and that ideas, data and images, as well as direct quotations, drawn from elsewhere are identified and referenced.

Yilin Yang

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Abstract

During the COVID-19 crisis, a series of measures have been taken to restrict travel and outdoor activities 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, the pandemic is now under control, and transport availability has largely returned to earlier levels. However, the changes wrought in travel behaviour during and following the pandemic remain unclear. In addition, though different groups may be affected to varying degrees, social equity has not received adequate attention in the existing literature. Therefore, the aim of this dissertation is to investigate the differences in individual travel behaviours during and after the COVID-19 pandemic, using Huzhou as an example. Semi-structured telephone interviews were used to explore the influence of COVID-19 on the travel and perceptions of different groups. The results indicate that at first, travel demand was greatly reduced. Second, decreased travel reduced participation in activities, which may adversely affect health as well as subjective well-being. Third, the degree and duration of such impacts varied from person to person. Students, people with lower incomes, groups living in communities with small size and insufficient green spaces, and those working in tourism, catering, informal businesses and transport-related sectors were more vulnerable than others. The key argument is that changes in travel behaviour due to COVID-19 have caused social inequity, which has been overlooked by local governments. Thus, policymakers must pay more attention to the social inequities that arise from unequal access to transport and individuals' heterogeneity. Additionally, public transport systems in Huzhou require further development to promote social cohesion by expanding networks, increasing running frequency, building and updating infrastructures and introducing new modes of transport, such as light rails.

Keywords

Travel behaviour; COVID-19; Social equity; Transport planning; Transport policy; Transport and health

Highlights:

- COVID-19 has greatly changed travel behaviour in terms of travel demand, the purposes of travel,

the choice of travel mode, and the convenience of travel.

- Socially disadvantaged groups are more likely to experience transport-related exclusion as a result of the COVID-19 crisis.
- Policymakers should pay more attention to social inequities resulting from differential access to transport and individuals' heterogeneity.
- Public transport systems in Huzhou should be further developed by expanding the transport network, increasing its running frequency, constructing and renewing infrastructure, and introducing new modes of travel, such as light rail.

1. Introduction

1.1 Background

Transport is an essential factor affecting health, and local authorities are tasked with planning to improve public health and eliminate health inequalities (Department of the Environment, Transport and the Regions (DETR), 2000). Transport has been regarded as a hidden health threat as it causes traffic accidents, congestion, air and noise pollution. It also reduces social interaction and promotes inequity (Davis, 2005; Watkins and Mindell, 2010). In addition, transport, especially public transport, can act as an intermediary and route for virus transmission (Gossling, 2002; Gossling et al., 2020; Hall, 2020). Conversely, transport also affects health positively through increasing physical activity (walking and cycling), providing social support networks and access to physical resources such as healthy food and medical facilities (Davis, 2005; Jiang et al., 2017; Rojas-Rueda et al., 2013; Watkins and Mindell, 2010).

Severe viral diseases such as Ebola virus disease (Ebola), 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 may change people's entire life from huge financial losses and the disruption of education or career (Chisholm, 2010; Golics et al., 2013; Mailick, 1980; Mitchell et al., 2015; Stucki and Sigl, 2003). The latest virus to afflict humans, SARS-CoV-2, is the causative pathogen of COVID-19, a highly infectious disease that has upended life globally in 2020 (Chen et al., 2020; Gorbalenya et al., 2020; Liu et al., 2020; Zhou et al., 2020). The virus first emerged in Wuhan, China, in December 2019 and rapidly spread across the globe. Due to the enormous threat it poses to global public health, the World Health Organisation officially designated it as a pandemic on 11 March 2020, with countries such as China, Italy and the United States suffering the worst effects. By 4 September 2020, 26,121,999 cases and 864,618 deaths had been confirmed worldwide (WHO, 2020a). The COVID-19 crisis has resulted in a range of policies and measures aimed at controlling the virus, such as lockdown, social distancing, school closures and quarantine, restricting travel and activity globally (De Vos, 2020; Ferguson, 2020).

Existing studies have proven the links between the external environment, derived policies and individuals' travel behaviour (Garling et al., 2000; Vlek and Michon, 1992). The external environment may change people's demands, desiderata and obligations, thereby affecting their activity participation, which is the major driver of travel (Axhausen and Garling, 1992). For example, the pandemic has eliminated the obligation for students to attend school; instead, many remain at home and take online lessons. In addition, policies vary with the external environment, affecting individuals' options. Before the outbreak, car use was limited because of its high environmental and social costs, including pollution, obesity, energy consumption and other negative externalities (Goodwin, 1996). Various mitigation policies have been implemented, such as improving alternative transportation modes, changing the location of public facilities, and mandating congestion charges to reduce car usage (Garling et al., 2000)., In China, however, highway tolls were cancelled from 17 February 2020 to 6 May 2020 in China by the Ministry of Transport of the People's Republic of China (MTPRC), encouraging 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 illustrate such links before COVID-19, though the situation during and after the pandemic may be completely different from the historical status quo. These changes and related effects from the pandemic may be long-lasting. Thus, it is necessary to analyse the current situation and discuss the impacts of COVID-19 on different individuals and groups.

1.2 Research Aim and Objectives

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, three objectives are developed as follows:

(1). Investigate the differences between travel behaviours before and after the COVID-19 pandemic;

(2). Examine the impacts of social equity on travel behaviour;

(3). Critically review governance and policies during and post the pandemic.

1.3 Structure of the Dissertation

This dissertation comprises six chapters. Chapter 1 presents the background and illustrates the research aim and objectives. Chapter 2 critically reviews the existing arguments within the literature related to transport, health and policy. Chapter 3 introduces the case study and explains its rationale. Chapter 4 details the qualitative data collection methodology. Chapter 5 states the findings of telephone interviews and the results of subsequent analyses. Finally, Chapter 6 summarises findings and outlines the contribution and policy implications of the research.

2. Literature Review

2.1 Transport and Health

2.1.1 The Impact of Transport on Health

Transport has important effects on health, both positive and negative (Davis, 2005; Watkins and Mindell, 2010). Such influences are shown in direct or indirect ways, including traffic accidents, physical activity, diseases due to pollution, access to physical resources and well-being (Mackett and Thoreau, 2015).

Traffic accidents, which have been discussed in many studies (Aarts and van Schagen, 2006; McGwin and Brown, 1999; Stutts et al., 2001), take the lives of approximately 1.35 million people annually (WHO, 2020b). The number of non-fatal casualties has increased by 20 to 50 million, and many people have been disabled in non-fatal accidents (WHO, 2020b). Transport policies encourage people to select public transport instead of cars, which contributes to a reduction in traffic casualties (Rojas-Rueda et al., 2013). At the same time, car use contributes to physical inactivity and sedentary habits, leading to obesity, cardiovascular diseases, diabetes, and many other ailments (DETR, 1998; Frank et al., 2004; Rojas-Rueda et al., 2013).

Exposure to air and noise pollution caused by transport is also harmful to health and linked to early mortality (Colvile et al., 2001). Air pollution kills millions of people worldwide every year and causes various maladies including heart disease, asthma and other lung diseases (Krzyżanowski et al., 2005; OECD, 2014; Salam et al., 2008). Moreover, traffic noise is associated with increased morbidity and mortality from cardiovascular and all-cause mortality (Halonen et al., 2015).

While some of its effects are negative, transport also serves to protect health by providing social support networks and access to physical resources, services, and activities (Davis, 2005; Watkins and Mindell, 2010). For instance, transport provides access to healthy foods and facilities where people can exercise or receive medical treatment (Jiang et al., 2017; Mackett and Thoreau, 2015).

Marsden et al. (2007) demonstrate that older adults are able to access public spaces such as parks and squares, via public transport, allowing them to participate in physical activities. For younger people as well, lacking access to transport could hinder participation in recreation and many other activities, adversely affecting health (Rojas-Rueda et al., 2013). Moreover, active transport, including cycling and walking, can increase fitness and benefits health (Andersen et al., 2000; Saelens et al., 2003).

Travel behaviour affects subjective well-being positively and negatively in five aspects (De Vos et al., 2013). First, people can experience optimistic or pessimistic emotions while in travel (Ettema et al., 2010). Second, transport may contribute to inequity and social exclusion, preventing some from participating in activities or obtaining resources and thereby decreasing their well-being (Archer et al., 2013). Third, activities of destination-oriented travel may affect people's feelings on trips (Ettema et al., 2012). Fourth, 'undirected travel' brings happiness and relaxation, and is considered an activity rather than the cost of an activity (Mokhtarian and Salomon, 2001). Finally, individuals' mobility may generate positive feelings such as confidence, improving their well-being (Nordbakke, 2013).

2.1.2 Links Between Transport and Health During the Pandemic

By 2 January 2020, 41 patients admitted to hospitals were confirmed as having COVID-19 (Huang et al., 2020). Subsequently, global transport networks began to spread the virus worldwide. The number of confirmed cases rose sharply, associated with a number of mass events that facilitated the spread of the virus (Anderson et al., 2020). By April, the outbreak had affected more than 200 countries, and confirmed infections approached two million (Gossling et al., 2020).

A minimum of three transmission routes appear available to the SARS-CoV-2 virus: (1) inhaling liquid droplets produced by infected patients, (2) coming into close contact with confirmed cases and (3) touching surfaces contaminated with SARS-CoV-2 (Ferguson et al., 2020; Guan et al., 2020; Liu et al., 2020). The former two are conventional pathways of transmission of SARS-CoV (Lei et al., 2018;

Otter et al., 2016; Zumla et al., 2015). Moreover, the virus deposition on surfaces is a potential route of transmission that occurs more often in confined spaces (WHO, 2020c).

Transport serves as a vector for virus transmission at regional and national scales (Gossling, 2002; Gossling et al., 2020; Hall, 2020). The crowding on public transport affects transmission in two aspects: raising the possibility of exposure to infected travellers and increasing the proximity to passengers, which eventually expands the transmission probability (Krishnan, 2020). In addition, the confined spaces on public transport are also a significant factor in promoting transmission, as good airflow can decrease airborne pathogen (Liu et al., 2020).

There are many studies discussing the transmission between passengers using public transport. Gosce and Johansson (2018) argue that people who regularly use the underground, which is always associated with large crowds, have higher risks of influenza-like disease. The same scenario occurs on cruise ships, beginning 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, massive migration through public transport during the Spring Festival was expected to greatly accelerate the transmission of COVID-19 (Phelan et al., 2020).

In addition to travellers' movements worldwide, cargo movements due to increasing consumption of higher-order foods and a growing global food supply chain also contribute to the spread of COVID-19 (Gossling et al., 2020; Guan et al., 2020). For instance, the coronavirus was detected on the cutting board of imported salmon on the evening of 12 June 2020, in a large-scale investigation of the Xinfadi Market in Beijing. On June 12, between 16:00 and 24:00, Beijing added four newly diagnosed cases of COVID-19, all related to this market (Souhu, 2020).

People are restricted from travelling to slow down the spread of COVID-19 and might experience negative feelings that adversely affect their well-being. 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; Wang et al., 2011). These negative effects can persist after quarantine and isolation for some individuals, having a lasting adverse impact on their lives (Brooks et al., 2020). To decrease such impacts, 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

2.2.1 The Impact of Transport on Social Exclusion

Transport plays a significant role in economic and social development. However, it also produces and exaggerates inequity and social exclusion, with multidimensional effects (Cao and Hickman, 2019; Lucas, 2011, 2012; Mackett and Thoreau, 2015; SEU, 2003). Kenyon et al. (2003) define transport-related social exclusion as a process by which individuals fail or have difficulties getting fully involved in economic, social and political life due to insufficient access to services, resources and opportunities. Church et al. (2000) identify seven specific characteristics of transport systems that lead to social exclusion, which proves the multidimensional nature of exclusion. These seven characteristics, described below, can be divided into two categories: place-based and people-based exclusions.

People may be excluded from transport systems due to the physical features of places in travel, which can be regarded as place-based exclusions. These exclusions consist of four types: The first is physical exclusion, whereby physical obstacles, such as a lack of facilities and information for disabled travellers, limit the accessibility of transport systems (Church et al., 2000). For instance, blind people are physically excluded from driving themselves and must perforce travel by public transport or be dependent on others (Church et al., 2000; Jolly et al., 2006). The second is geographical exclusion, where living places hinder access to transport networks (Church et al., 2000). As Brown (2008) claims, insufficient transport networks prevent individuals in the countryside from participating in activities. The third is the exclusion from facilities, whereby excessive distances between essential facilities and

individuals' homes make it difficult to enjoy services (Church et al., 2000). The fourth is space exclusion, where security or management of space prevents some people from accessing public areas (Church et al., 2000). The gated community is a typical residential development that is fenced, restricting public access (Atkinson and Flint, 2004). In essence, it provides residents with a refuge to avoid unnecessary social interaction (Atkinson and Flint, 2004).

Individuals may also be unable to access transport services due to their own characteristics, which can be regarded as people-based exclusions. Such exclusions comprise three categories: The first is economic exclusion, wherein the economic costs of transport prevent people from using services and exploiting opportunities (Church et al., 2000). Furthermore, rising public transport fares may be unaffordable for low-income groups (Maddison et al., 2014), while average car ownership in low-income groups is lower than in high-income groups, restricting travel options and opportunities (Lucas, 2012; SEU, 2003). The second is the time-based exclusion, whereby insufficient time available for travel limits transport choices (Church et al., 2000). The third is fear-based exclusion, whereby some passengers, such as women, people with disabilities or members of ethnic minorities, are concerned for their personal safety and opt out of transport services, limiting their access to opportunities (Church et al., 2000; Passenger Transport Executive Group, 2010).

2.2.2 Vulnerable Groups During the Pandemic

Older adults are more likely to experience social exclusion during the pandemic. First, old 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 lack mobility and rely on public transport (DETR, 2001), which restricts their travel during the pandemic as public transport was once suspended in many Chinese cities. Even after transport reopened, departure intervals for public transport were longer, with both the frequency and full load rates lower than in pre-pandemic times, reducing the convenience of travel (Zheng, 2020). Finally, many older adults have a higher risk of

poverty and face labour market discrimination compared to the youth (SEU, 2001), which makes it harder for them to face risks.

COVID-19 has greatly affected low-income groups concerning work, entertainment, transport, health and many other aspects. Many people are temporarily unemployed or are working from home, as most outdoor activities have been cancelled (De Vos, 2020). The resultant financial losses (Brooks et al., 2020) may have long-term effects. Individuals or households with lower income are more likely to be 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 depend on public transport more (Jiang et al., 2017), which may cause them to become more sedentary when these systems become less available.

The effects of the pandemic on international students have been profound, upending their original plans for study and life (UK Council for International Student Affairs (UKCISA), 2020; United Nations, 2020). A number of international students have had difficulty returning to their home countries as a result of flight cancellations or increasingly stringent border controls. For instance, Singapore announced that short-term visitors were not allowed to enter or transit through the country from 22 March 2020. At the same time, international students in the United States have encountered problems with 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 and students whose applications are still in process may be affected.

2.3 Transport Policy

2.3.1 Nonpharmaceutical Interventions (NPIs)

The COVID-19 crisis is threatening global public health. Without effective vaccines and enough medical capacity, nonpharmaceutical interventions (NPIs) are the major strategy to combat the

pandemic by reducing contact rates (Ferguson et al., 2020; Gossling et al., 2020). NPIs help reduce social contact by decreasing travel demands and lowering infection risks on trips. For instance, NPIs include social distancing, lockdown, public facilities closures, cancelling or postponing events and bans on gatherings (Gossling et al., 2020), which can significantly decrease the number of trips . Also, NPIs consist of wearing masks, washing hands frequently and many other measures that reduce the possibility of infection on journeys yet decrease the convenience of travel (Gossling et al., 2020). The effectiveness of a single intervention 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 commenced 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 the face have been encouraged globally. Furthermore, significant capital has been invested by many countries for COVID-19 research and vaccine development, including 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 23 January 2020. During that period, all outbound transport from Wuhan was blocked, and traffic 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 is an electronic proof of a traveller's health condition generated by answering questions through a mobile phone. According to the individual's answers related to past travel routes, the app presents different colours (green means safe, orange means low risk, and red means high risk). Anyone not wearing a mask or showing a green health code is not allowed to visit public places. In addition, all individuals infected or suspected are required to accept centralised quarantine and treatment.

2.3.2 Fundamental Strategies

Ferguson et al. (2020) introduced mitigation and suppression as two fundamental strategies 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) of mitigation is over 1 (outbreak is growing), while the R of suppression is less than 1 (outbreak is shrinking).

China is a typical country using suppression as the predominant strategy to contain the pandemic (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). The ultimate choice of major intervention varies according to different social contexts and values.

2.3.3 Policy Impacts

COVID-19 has affected all sectors and caused massive losses, with high-exposure final-consumption sectors such as tourism and catering most adversely impacted, resulting from reductions from upstream suppliers, decreased demand and travel ban policies (De Vos, 2020; Guan et al., 2020; Julius et al., 2020). Other industries, such as manufacturing, informal businesses, foreign trade, finance, transport and logistics have also been strongly affected, which impacts livelihoods, particularly for poor households (Julius et al., 2020; Rodriguez, 2020; World Economic Forum (WEF), 2020).

The overall global cost of the pandemic is associated with the number of countries affected and the duration and the strictness of control policies (Guan et al., 2020). Due to the global supply chain, countries indirectly affected also have experienced significant losses, with low-income countries more

vulnerable to be affected (Guan et al., 2020). It is essential to implement strict measures early to have a global effect (Ferguson et al., 2020). However, countries conducting the strictest containment early experienced the greatest losses, which turns epidemic control into a public goods paradox, resulting in insufficient investment and delayed measures (Guan et al., 2020). Therefore, it is necessary to establish a cost-sharing mechanism on a global scale (Guan et al., 2020).

2.4 Summary

The existing literature illustrates that transport was the key to health before COVID-19, affecting the health of individuals both positively and negatively. People may be excluded from transport systems, services and resources due to personal and spatial heterogeneity. Transport policies have the ability to either exacerbate or eliminate such inequities.

However, the relationship between transport and health during and after the COVID-19 crisis may be completely different. COVID-19 – as a sudden change in the field of public health worldwide – has had unpredictable influences on travel behaviour, which may last in the long term. Therefore, there is a need 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.

3. Case Study in Huzhou

3.1 Brief Introduction

The first case of COVID-19 in Huzhou, a city located in the east of China, was diagnosed on 25 January 2020. As of August 2020, 12 people have been confirmed to be infected in Huzhou, and one of them has developed severe disease. Eventually, all of them have recovered after being isolated and treated in the hospital. The distribution of confirmed cases is shown in Figure 1:

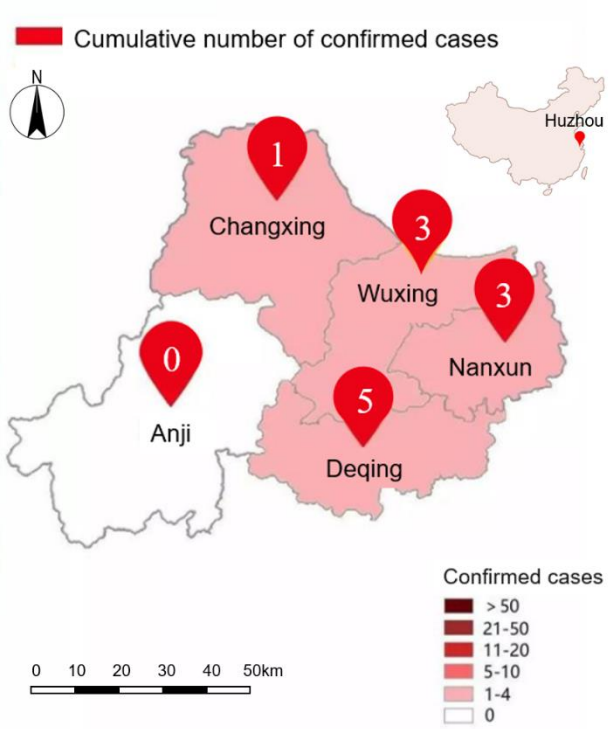

Figure 1: The Distribution of Confirmed Cases in Huzhou on 12 July 2020

(Source: Author, the base map adopted from Huzhou Cartography)

3.2 Rationale for the Choice of Case Study

This dissertation selects Huzhou as a case study for several reasons. First, many studies analyse the impacts of COVID-19 in big cities with large populations, such as Wuhan, Beijing and Shanghai (Cheng, 2020; Gouk, 2020; Lau et al., 2020). However, how the outbreak affects small cities in China is seldom discussed. Huzhou is a typical small city with a limited population, which makes it useful as

an example to enrich the knowledge related to the pandemic. Second, social inequity is not sufficiently recognised in small cities, as the income gap among residents is not as large as that in big cities. Policymakers should be more aware of the situation in special groups and be cognizant of social equity issues. Third, the pandemic still affects some areas, though it has essentially been contained in Huzhou. Thus, changes during and after the pandemic in Huzhou could be analysed simultaneously.

4. Methodology

4.1 Semi-Structured Telephone Interviews

As Robson (2011) demonstrates, methodology should be chosen based on the data needed for the research. This research emphasised the behaviour and thoughts of citizens before and after the outbreak. Thus, it followed a qualitative approach to access people's perceptions, connotations, feelings and descriptions (Bryman, 2008; Neuman and Lincoln, 2006; Punch, 2005).

This research employed semi-structured interviews by telephone so information could be collected through questions related to the research objectives (Bryman, 2008). Each telephone interview lasted at least 20 minutes. Telephone interviewing rather than face-to-face interviews was selected for two reasons. First, it was suitable for people who are difficult to visit (Drabble et al., 2016). During the pandemic, people are encouraged not to gather. The telephone interview could collect data while avoiding direct contact. Second, under the same conditions, it is far cheaper and quicker than in-person interviews as researchers do not need to spend much time and money on travelling (Bryman, 2008). However, the method suffers from limitations as well. The length of the telephone interview is usually shorter than face-to-face interviews (Frey, 2004). Also, the success rates achieved by telephone interviews are believed to be slightly lower (Frey, 2004; Frey and Oishi, 1995).

4.2 Question Design

The questions in the interview were designed to address research aims with three objectives. The first focuses on changes in travel behaviour in Huzhou concerning travel demands, purposes, modes and the convenience of travel. Therefore, some questions were designed to collect data related to changes and their causes. In addition, research questions also provide participants with a chance to discuss the impacts of changes on physical health, well-being and other aspects. The second objective emphasises social equity. Conclusions could be drawn by comparing the answers of different interviewees. The third objective aims to collect data about governance. Thus, several questions were designed to study policies for containing the pandemic and their influence. Questions are shown in Appendix 1.

4.3 Sampling

In this research, 33 interviewees were recruited in Huzhou comprising males and females from 22 to 74 with various backgrounds and experience. Thus, they were representative of the wide range of individuals who experienced the COVID-19 health crisis in Huzhou. The data are summarised in Table1.

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	Policemen
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 industry
14	Male	31–35	Engineer
15	Female	31–35	Beauty industry
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	Policemen
25	Male	51–55	Retail
26	Female	51–55	Housewife
27	Male	51–55	Teacher
28	Female	56–60	Retirement
29	Male	56–60	Policemen
30	Male	>60	Retirement
31	Female	>60	Retirement
32	Male	>60	Cleaner
33	Female	>60	Nurse

4.4 Pilot Study

A pilot study was conducted with three individuals in Huzhou before the formal interviews to ensure that the questions could collect useful data. Questions with unclear ideology or weak connections to the themes were further revised until they could collect appropriate information. This practice helps investigators accumulate experience and confidence (Bryman, 2008). Moreover, researchers can estimate the average length of an interview through the pilot study, which may contribute to better organisation of interviews and increase the probability of participation.

4.5 Research Ethics

This research has no risk as it used telephone interviews as the main method to collect qualitative data, avoiding social contact and eliminating the risk of infection. Moreover, all the participants were informed of the aim and the content of the interview before answering questions. Instead of written

consent, verbal agreement from the interviewees was obtained at the beginning of the research. In addition, the content of the conversation was completely recorded to ensure the authenticity of the data. Furthermore, the identities and other personal information of interviewees are protected and anonymised by the interviewer.

4.6 Thematic Analysis

Thematic analysis aims to identify themes arising from qualitative data, such as interviewees' perceptions (Braun and Clarke, 2006; Bryman, 2004; Maguire and Delahunt, 2017; Marshall and Rossman, 1999). This dissertation primarily discusses three themes. First, the interview findings of changes in travel behaviour help analyse the impacts of COVID-19 on transport. Second, the interview findings of greater impacts on certain groups could be regarded as evidence of social exclusion and inequity. Third, findings related to the advantages and limitations of existing policies and suggestions for ways in which changes to public transport in Huzhou could decrease social exclusion in the future might be helpful to policymakers.

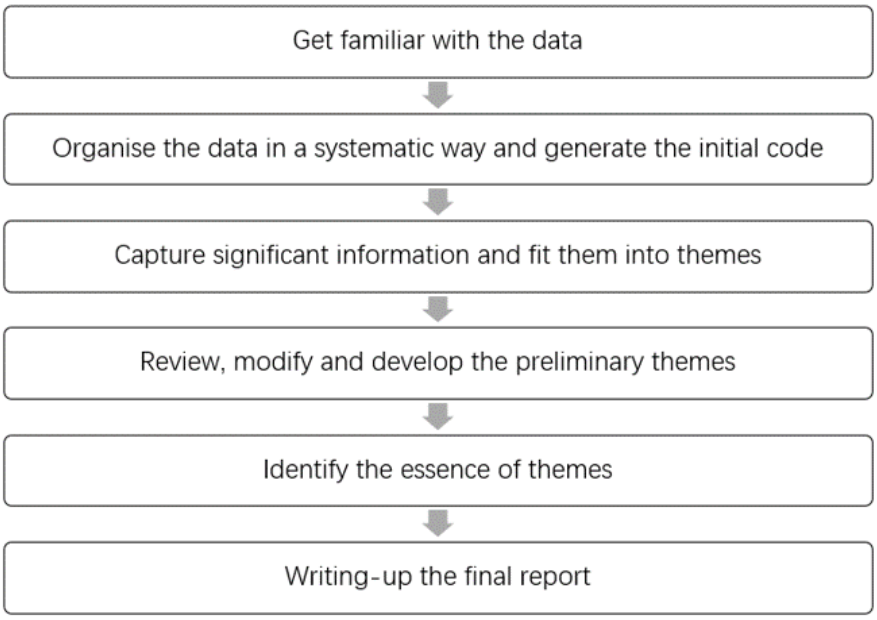

Figure 2. Six-phase Framework for Thematic Analysis.

(Source: Author, adapted from Braun and Clarke, 2006)

5. Findings and Discussion

5.1 Changes in Travel Behaviour

According to interviews, travel demand in Huzhou dropped significantly, and travel purposes also changed greatly during the period between January and March 2020, which aligns with the conclusions of De Vos (2020). Most interviewees avoided unnecessary trips and travelled only when they needed to buy important supplies, such as food and masks. Some purchased goods online and used home-delivery services to decrease the number of shopping trips (Shi et al., 2019). Trips for commuting, recreation and other purposes were greatly reduced. For instance, it is customary to gather for dinner with relatives during the Spring Festival. However, many citizens chose to stay at home with their families and cancelled the activity this year.

> *'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 refund tickets and hotels we booked'.*
>
> *(Interviewee 8, female, 25/06/2020)*

The main reason for such changes was concern over participation in outdoor activities during the pandemic increasing social contact and infection risk. A plethora of information dissemination channels made it easy for people to understand the transmission pathways of COVID-19, which encouraged them to minimise the number of trips. In addition, residents were also more inclined to shorten their travel time and avoid crowded places when planning travel routes. The concern for health not only made people stay at home but also encouraged them to persuade their relatives to decrease the frequency of travel.

> *'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)

'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)

Containment measures also contributed to changes in travel behaviour. On the one hand, some policies directly changed the frequency of trips in Huzhou. For example, during the lockdown, the local government issued 'travel passes', which were certificates without which people were not allowed to attend daily out-of-home activities, except for staff and volunteers who offered necessary social services, such as policemen and doctors. Each household could only receive two 'travel passes', regardless of the number of family members. Each 'travel pass' could only be used by one person once, which remarkably reduced travel demands. On the other hand, some containment measures indirectly restricted travel by cancelling activities and thus eliminating motivation (Axhausen and Garling, 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 credentials from going out'.

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

COVID-19 also changed travel mode choices. During the pandemic, all interviewees tended to avoid public transport for two reasons. First, the congestion and confinement of public transportation was seen to make them a hotbed for viruses (Gossling et al., 2020; Krishnan, 2020). Second, public transport systems had undergone some adjustments, making it 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 operation, but the waiting time became longer, and the frequency and full load rate were reduced compared to the situation before the pandemic. In addition, many interviewees were inclined to drive because it helped

them avoid social contact with strangers. Cycling and walking were also popular choices over short distances. Most participants calimed that they would not avoid public transport purposely 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 in travel, which caused trips to be less comfortable and convenient. To reduce the probability of infection, everyone was supposed to wear surgical masks when entering public spaces and facilities. Temperature measurements and health code presentations were also needed to prevent infected people from accessing places with large populations. Furthermore, alcohol-based hand sanitizers were provided at the entrances to many buildings, helping prevent citizens from being infected by touching their faces after contacting polluted surfaces.

Since April, 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 variation is that increasingly more people are returning to public transport, especially inter-city and inter-provincial transit services. The convenience and cheapness of public transport for long-distance travel makes it more competitive than driving, cycling and other travel modes.

'I often travel to Hangzhou by high-speed rail because the tickets are cheap and driving is too tiring'.

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

However, public transport in Huzhou is relatively unattractive 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 trip origin and trip destination. When this is not the case, many interviewees prefer other modes of transport as they are unwilling to spend a substantial amount of time walking and transferring resulting from limited stations and routes. For instance, people are more inclined to walk or cycle for exercise when visiting places nearby. When the travel distance is slightly longer, such as 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. In addition, more public transport modes, including underground and light rail, should be introduced. It is also beneficial to introduce active transport modes such as shared bicycles, as these increase fitness and improve psychological well-being (Andersen et al., 2000; Martin et al., 2014).

5.2 Effects of Changed Travel Behaviour

The impacts of COVID-19 are multidimensional, including economic losses, environmental improvement (from reduced transport) as well as negative and positive effects on health and well-being. Compared to the benefits, disadvantages play a more important role in these effects.

Economic losses were 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, investments related to COVID-19 could also be regarded as an economic loss. As of 13 March 2020, investments in the medical field have reached 116.9 billion CNY (12.9 billion GBP), which were mainly used for vaccine research, medical supplies, drug reserves, hospital construction and other aspects related to pandemic prevention and treatment (Chinese

Government Website, 2020). From individual perspectives, movement restrictions and sluggish economic conditions have caused a series of substantial knock-on effects, such as the cost of quarantine and necessary tests, job losses and wage reductions.

'I was fired a few months ago, and I am still unemployed. It is hard to find a good job now'.

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

'During the pandemic, the beauty salon where I worked was closed. Even if 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 has offered some benefits at the same time. Decreased travel demand in Huzhou resulted in environmental improvements during the pandemic. The most evident effect of changed travel behaviour was reduced congestion during peak hours. In January and February in particular, there were scant vehicles or pedestrians on the road, except for those who were responsible for temperature measurement at intersections. Consequently, less air and noise pollution were produced. In addition to decreased traffic, the prohibition of gathering activities also reduced noise pollution. For example, square dancing is a popular activity performed in public spaces in China, which may cause nearby residents to suffer from noise pollution and other negative externalities (Xiao et al., 2020). Travel restrictions during the pandemic reduced the noise from this source.

In addition to environmental progress and economic losses, the effects of changed travel behaviour also concerned physical health. On the one hand, less pollution and lowered congestion provided people with a better living environment, which was beneficial for health. However, the positive effect of environmental improvement on health was limited as it would slowly vanish with the increase in traffic demands in the long term. On the other hand, a lack of physical activity due to quarantine and isolation contributed to weight increase (Brindal, 2020). The growth of 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.

Adverse effects from high device use could include damaged eyesight or diabetes from a sedentary lifestyle.

> *'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)*

Restrictions on travel also had effects on mental health and subjective well-being (Brindal, 2020). Boredom was the most common negative emotion as most people were not allowed to socialise during the outbreak. Compulsorily staying together for a long period strained domestic relationships between some participants with their families. However, part of interviewees believed that the pandemic provided them with a rare opportunity to spend significant time with their families, which brought them closer together. Additionally, few participants felt frightened as the number of confirmed cases in Huzhou was minimal. Another reason for their confidence was that citizens in Huzhou could access timely information related to COVID-19 in many ways, including transmission pathways, pandemic prevention and control methods, and the latest policies. Even if few people were frightened over their own situation, it was common for some citizens to be worried that families or friends in other cities might be infected. Besides, anxiety was one of the negative emotions, especially for people with financial concerns and difficulties in 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 am very happy to spend time with my family and to witness the growth of my children'.

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

'I should have been looking for a job this spring. Many recruitments were cancelled or delayed because of COVID-19, which completely disrupted my plans. I felt very anxious and frustrated as I also needed to write my dissertation at the same time in addition to looking for a job'.

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

Compared to other cities in China, such as Wuhan and Beijing, Huzhou has only been affected by COVID-19 to a limited extent for three reasons. First, Huzhou is a small city with a limited population and visitors, resulting in fewer large-scale events and less social contacts with strangers. These factors resulted in a relatively lower rate of infection in Huzhou, and the control of the pandemic was easier. Second, the strictness and timeliness of the containment measures have minimised the negative impacts of the outbreak. Third, sufficient information and effective communication between individuals and the local government enabled citizens to be willing to follow instructions and believe that they could survive this difficulty.

5.3 Social Inequity Due to COVID-19

The COVID-19 crisis has affected almost all individuals and groups in Huzhou, though some of them have had to manage more problems than others. First, students, people with lower incomes and those working in tourism, catering, informal businesses and transport-related sectors were more vulnerable than others in society (Julius et al., 2020; WEF, 2020). Second, spatial heterogeneity, including personal living environment and past travel routes, also played a significant role in affecting health and well-being.

Many students studying abroad and those who planned to apply for an offer from a foreign school in 2020 have encountered difficulties (UKCISA, 2020; United Nations, 2020). For the former, the difficulty of returning home is the most common issue, which results from a combination of internal factors and external constraints. In the early stage of the outbreak, schools did not issue measures in response to COVID-19, such as alternative assessments to exams. Concerns about being infected in a place away from home and worries that subsequent studies might be affected after returning home put them in a dilemma. This hesitation as an internal factor caused them to miss the opportunity to return home in the early stages of the pandemic, forcing them to face subsequent difficulties due to external constraints. Expensive ticket was one of the main obstacles to returning home. For instance, from March to May, the average price of an economy class ticket from London to Shanghai reached 30,000 to 50,000 CNY (about 3,300 to 5,500 GBP). Even if students spent significant money on a ticket, their flights were likely to be cancelled because of constantly changing policies.

Chinese students studying in America have encountered problems related to visas. As U.S. Immigration and Customs Enforcement (2020) announced on 6 July 2020, international students were not allowed to study online only; otherwise, they might need to leave the country. After returning home, this group of students could face misunderstanding and even blame from some compatriots. Some people considered these students as one of the sources of the virus, which might delay resuming work and cause more economic losses. Such conflicts were exacerbated by anxiety and boredom due to travel restrictions. For students who intended to study abroad in 2020, their plans might also be disrupted due to health concerns, visa obstacles and the increasingly tense international situation.

> *'Alternative assessments to exams were not decided by my school before 20 March 2020. Thus, I did not book flights early. I am very regretful for that as the air 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 spend one-tenth of this money'.*
>
> *(Interviewee 5, female, 21/06/2020)*

'During that time, there was much news that some returned international students did not follow containment measures. Thus, some people misunderstood us and did not want us to come back. However, students in these reports were not representative. Most international students, as least people around me, were willing to follow instructions and obey commands'.

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

In addition to international students, domestic students in China were also affected by the outbreak. For high school students, the biggest impact was that the National College Entrance Examination was delayed for a month (Ministry of Education of the People's Republic of China, 2020). The delay was an opportunity for high school students with self-discipline but also a challenge for students who were not self-disciplined or had poor stress resistance. The Unified National Graduate Entrance Examination was also affected by postponing, changing from on site to online, with alternatives to some test items. Also, students who graduated during the pandemic encountered difficulties in job hunting. Because of economic losses, many companies postponed or cancelled job fairs, and some chose to reduce the number of recruits. Moreover, the return of international students increased competition for jobs. Another significant impact was that all schools had postponed the start of the new semester. Consequently, the remainder of the students could only study online during that period, which might affect the absorption of knowledge. As a result, some students were revealed not to have a good command of the subject matter.

'Because of network delays, I could not interact with my students well. And some students might be distracted as they used their mobile phones for entertainment while taking online lessons on personal computers'.

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

'Compared with previous years, the time for UNGEE was delayed by a few months. During that time, I was very anxious every day because I did not know how the test would be conducted'.

(Interviewee 3, female, 12/06/2020)

Although older adults were more likely to be infected by COVID-19, this does not mean that they were in a more difficult situation. Regarding health, travel restrictions and other containment measures resulted in the probability of both old and young people being infected approaching zero. As for travel, the changes in public transport had more impacts on older adults than youth as older adults rely on it more. Such effects did not last a long time, however. Concerning the economy, the Huzhou government provided financial support and regular care services for more than 120,000 old people (Wang, 2020), helping the relatively poor in this group maintain a good standard of living. Thus, older adults were relatively more affected by the pandemic, but it is inappropriate to regard them as the primary vulnerable group.

People engaged in tourism, catering, informal businesses, transport and logistics industries have suffered great economic losses (Julius et al., 2020; WEF, 2020). Travel restrictions and decreasing demand were major reasons for the decline of these industries. Some informal business sectors were not complying partly or fully with the regulatory provisions of the government, which caused their income and welfare not to guaranteed by law (Qian, 2019). On the contrary, civil servants in China, such as policemen and doctors, did not suffer serious economic losses as their salary comes from state finances and is fixed, having little connection with the 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 in the Spring Festival this year. They cancelled the dinner booked. All the ingredients I prepared were wasted'.*
>
> *(Interviewee 18, male, 12/07/2020)*

Poverty might exacerbate the extent and duration of the negative impacts due to COVID-19 and travel restrictions. First, many poor people do not own a car because they cannot afford one, which decreases travel choices and invites inconveniences, especially during a period of restricted public transport. Second, people with better financial conditions have more alternative plans to deal with emergencies. For instance, international students from wealthy families could spend significant money to buy

several tickets simultaneously if some flights were cancelled. For those students with relatively low family income, this was not an option. Thus, the cost of transport may generate social exclusion (Church et al., 2000). Third, people with poor financial conditions possess limited capacity to resist risks as their deposits are insufficient to maintain their previous standard of living when they face frozen or reduced income (National Association for the Advancement of Colored People (NAACP), 2020). Finally, the impacts of financial losses on the poor might be stronger and last longer. As Brooks et al. (2020) claim, people with lower income were more likely to be influenced by the temporary economic losses and required additional levels of support.

> *'My mother had a sudden illness during the Spring Festival. We drove her to the hospital in time, and she has now recovered. It is hard to imagine what to do without a car'.*
>
> *(Interviewee 3, female, 12/06/2020)*

During the pandemic, the degree of individuals' safety and well-being was not connected to location but the size of their communities and green spaces. Before COVID-19, people living in rural areas were more likely to suffer social exclusion due to insufficient transport services, negatively affecting their participation in activities and well-being (Brown, 2008; Church et al., 2000; Feng, 2011). However, there is no evidence that people in urban areas were less affected by COVID-19 and travel restrictions compared to those in the countryside.

In Chinese urban areas, the gated community is a common form of almost every new residential project (Deng, 2017). Persons in gated communities were able to take a walk and breathe fresh air during the pandemic in fenced places without worrying about being infected (Atkinson and Flint, 2004; Church et al., 2000; Deng, 2017). In the suburbs, the number of gated communities is fewer, and many people choose to gather in villages. This does not mean, however, that people in rural areas were in a more dangerous situation as the countryside in Huzhou has is a relatively low population, which is not conducive to the spread of the virus. Second, people are familiar with each other, enabling them to quickly recognise strangers and take actions such as temperature measurement and health code checking. Those in the villages also have more green space, which provides higher levels of

satisfaction and improves physical activity and well-being (Benton et al., 2018; Bowler et al., 2010; Lee and Maheswaran, 2010).

> *'Non-residents such as couriers would be stopped by the security guard if they wanted to enter the community'.*
>
> *(Interviewee 10, female, 21/06/2020)*

> *'It was very easy to recognise people from other places as I know everyone in this village. Any outsider must take the temperature test and show the health code. Those who have visited dangerous areas, such as Wuhan and Wenzhou, needed to be quarantined'.*
>
> *(Interviewee 30, male, 13/06/2020)*

In addition, travel routes in the last 14 days affected the degree of exclusion people received. Those who visited areas with many confirmed cases might be stigmatised or alienated by others. Even if the majority of these people might be healthy, they were labelled as a 'risk group' due to geographical reasons (Peng, 2020). The panic about the disease might turn into alienation or even hostility towards this group, which might continue for some time after quarantine.

5.4 Governance During the Pandemic

Containment measures conducted by the Huzhou government could be divided into two categories. The first aims to curb the spread of COVID-19 and decrease its threat to public health by encouraging driving, mandating masks and other methods. The second is 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 took 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 strived to reduce the possibility of infection when outdoor activity is inevitable. For instance, driving was encouraged instead of public transport. Third, the price and the sale of medical supplies such as surgical masks were monitored by the Huzhou government to ensure sufficient medical supply during the pandemic. Fourth, people who were infected could be treated for free. Various policies and guidance built trust in the government and the confidence to overcome the pandemic, leading to the full engagement of citizens in the prevention and control of the pandemic (Department of Health, 2007).

> *'We set up roadblocks on major traffic roads. People were not allowed to leave Huzhou without special reasons.'*
>
> *(Interviewee 4, male, 27/06/2020)*

After the pandemic, the Huzhou government took actions to stimulate consumption to restore economic growth. From the corporate perspective, the Huzhou government encouraged recruitment and development of enterprises by reducing or exempting rents for three months and decreasing loan interest rates, and granted subsidies for companies that produce pandemic prevention materials and (China Daily, 2020). For example, catering and tourism enterprises at certain scales could receive a one-off subsidy which equals to 3% and 2% of the taxable business income they declared in 2019 respectively (Nanxunfabu, 2020). Furthermore, the revenue of the transport sectors is rising with the increase in travel demand and the restart of highway tolls. From the perspective of the individual, the government cooperated with Alipay, and various merchants have issued consumer vouchers of different denominations to encourage consumption. Some vulnerable groups, including orphans, the elderly, the disabled and the poor, were able to receive financial support. However, not everyone in these groups has been given enough support. For instance, small-scale companies in catering and tourism industries, the unemployed and informal workers cannot receive subsidies. Such disadvantages illustrate that the development of welfare and laws to reduce social exclusion in Huzhou still requires improvement.

In addition to physical health and economic aspects, citizens' mental health and subjective well-being also play an essential role in social cohesion, though these elements have not yet attracted enough attention. During the pandemic, the Huzhou government has not taken effective measures to prevent the stigma of some groups such as international students, which may cause social exclusion and inequity. Moreover, other negative feelings due to the pandemic have not been correctly recognised and seriously addressed. The income gap among residents in Huzhou is not as large as that in big cities, which may explain why the local government has insufficient awareness of social inequity.

The COVID-19 crisis presents enormous challenges, but also opportunities. It has offered a chance to pause urban life and consider the limitations of the ways in which society has been run over the past few decades (Chatterton, 2020). The first half of 2020 have witnessed a series of measures taken by the Huzhou government to reduce the negative impacts of COVID-19 and provide financial assistance to vulnerable groups. One area that has received scant government attention, however, is the mental toll taken by the pandemic, particularly on disadvantaged groups. Therefore, there is still a long way to go in promoting social cohesion as well as subjective well-being.

6. Conclusions

6.1 Summary

This study discusses how COVID-19 affected travel behaviour in Huzhou and has shown which groups are more vulnerable from travel restrictions, economic losses and other effects of the pandemic, resulting in social inequity. Policies taken by the Huzhou government during and post pandemic are critically reviewed. Finally, responses to three objectives and contributions as well as policy implications of this study are given in conclusions.

6.2 Responses to Research Objectives

6.2.1. Objective 1

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 citizens, except for people in essential occupations such as policemen and doctors, minimised travel. Most travel was undertaken for the purposes of shopping, and the number of trips undertaken for other aims, such as commuting or leisure tours, was greatly reduced. Moreover, public transport became the least popular mode of transport, as both confined spaces and crowding increase the risk of transmission (Krishnan, 2020; Liu et al., 2020). Additionally, some protective measures, including wearing surgical masks, showing health codes and taking temperature assessments became mandatory when entering public spaces or using public facilities, decreasing the convenience of travel.

The pandemic in Huzhou has brought under control since April. The demands, purposes and mode of transport choices for travel have gradually returned to pre-crisis levels. Unlike the transport changes above, the requirements for protective measures remain unchanged after the pandemic, and it is unclear how long these requirements will last.

6.2.2. Objective 2

Travel restrictions during the pandemic could cause and exaggerate social inequity. People may suffer unfairness because of personal and spatial heterogeneity. Students, people with lower incomes and those working in tourism, catering, informal businesses and transport-related sectors are more vulnerable to disruptions to their education and careers, economic loss, poor physical health, negative emotions and decreased well-being (Julius et al., 2020; NAACP, 2020; WEF, 2020). Moreover, many studies illustrate that green spaces help improve levels of physical activity and well-being (Benton et al., 2018; Bowler et al., 2010; Lee and Maheswaran, 2010). This is consistent with the finding that groups living in communities with large size and sufficient green spaces express more satisfaction.

6.2.3. Objective 3

During the pandemic, the Huzhou government implemented various policies to prevent the transmission of COVID-19. The most influential policy was to issue 'travel passes' to limit the number of trips taken by every household, which cut off the transmission pathway directly. Other methods, such as encouraging driving rather than public transport, were also conducted to reduce infection risks during the journey. Additionally, the government regulated the sale and price of medical supplies, which reduced the impacts and shortened the duration of the epidemic.

After the pandemic, local governments have loosened travel restrictions and taken actions to promote consumption and economy. Some vulnerable individuals and groups have received financial support from the government, but this is insufficient to eliminate the social injustice caused and exacerbated by the pandemic. In addition to material unfairness, the inequity in the spiritual aspect also requires more attention.

6.3 Contributions and Policy Implications

This study fills a research gap by examining the relationship between transport and health during and

after the COVID-19 crisis in China, whereas the existing studies emphasise links before the pandemic. This research investigates previously unexamined aspects of the pandemic, such as the effects of long-term lockdowns on physical and mental health. The findings confirm perspectives in previous literature that participation in activities plays a significant role in persons' subjective well-being (Archer et al., 2013; De Vos et al., 2013). Some of this study's findings, however, are inconsistent with those of earlier research. For instance, people living in rural areas are more likely to be excluded from social life and less involved in activities due to insufficient transport services in general (Brown, 2008; Church et al., 2000; Feng, 2011). But the heterogeneity of urban and rural areas is not obvious during the pandemic.

This study focuses on impacts of COVID-19 in small Chinese cities, whereas the existing literature places more emphasis on the influences of COVID-19 on cities with large populations (Cheng, 2020; Gouk, 2020; Lau et al., 2020). Besides, social inequity and exclusion due to transport and individuals' heterogeneity in megacities such as Beijing, Melbourne and London, have been widely discussed (Cao and Hickman, 2019; Currie et al., 2009; Zhao et al., 2020). However, such unfairness in small cities resulting from these factors is easy to be ignored. The findings show that social inequity has not yet received adequate attention in Huzhou – a state of affairs that must be improved.

The outbreak provided a break in urban life and a new perspective, demonstrating that economic assistance to vulnerable groups and the increase of public participation are conducive to maintaining social cohesion. Policymakers should value these goals whilst recognising the limitations in 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 running frequency, building and upgrading infrastructure and introducing new modes of transport such as light rail. Moreover, it is also beneficial to introduce active transport such as shared bicycles, as it increases fitness and well-being (Andersen et al., 2000; Martin et al., 2014).

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Appendices

Appendix 1: Semi-Structured Interview Question List

Numbers	Questions	Objectives
1	Could you please describe the differences in your travel behaviour before and after the pandemic?	1,2
2	What types of transport do you often use and why?	1,2
3	Did you change the frequency of using public transport during and post the pandemic compared to the past?	1
4	What are the impacts of the pandemic on your work, study, and entertainment?	1,2
5	Did the pandemic bring you economic losses?	1,2
6	Did the pandemic affect your well-being?	1,2
7	What policies did the Huzhou government adopt during and after the pandemic?	3
8	Did the Huzhou government provide subsidies during and after the pandemic?	3
9	Could you please describe the most impressive thing you encountered during the pandemic?	1,2,3

Appendix 2: Risks Assessment Form

RISK ASSESSMENT FORM

FIELD / LOCATION WORK

The Approved Code of Practice - Management of Fieldwork should be referred to when completing this form

http://www.ucl.ac.uk/estates/safetynet/guidance/fieldwork/acop.pdf

DEPARTMENT/SECTION **BARTLETT SCHOOL OF PLANNING**

LOCATION(S) **HUZHOU, CHINA**

PERSONS COVERED BY THE RISK ASSESSMENT **YILIN YANG**

BRIEF DESCRIPTION OF FIELDWORK: Telephone interviews will be conducted.

Consider, in turn, each hazard (white on black). If **NO** hazard exists select **NO** and move to next hazard section.

If a hazard does exist select **YES** and assess the risks that could arise from that hazard in the risk assessment box.

Where risks are identified that are not adequately controlled they must be brought to the attention of your Departmental Management who should put temporary control measures in place or stop the work. Detail such risks in the final section.

ENVIRONMENT	**The environment always represents a safety hazard. Use space below to identify and assess any risks associated with this hazard**
e.g. location, climate, terrain, neighbourhood, in outside organizations, pollution, animals.	Examples of risk: adverse weather, illness, hypothermia, assault, getting lost. Is the risk high / medium / low? Low

CONTROL MEASURES	**Indicate which procedures are in place to control the identified risk**
☒	work abroad incorporates Foreign Office advice
☒	participants have been trained and given all necessary information
☐	only accredited centres are used for rural field work

☐	participants will wear appropriate clothing and footwear for the specified environment
☐	trained leaders accompany the trip
☐	refuge is available
☐	work in outside organisations is subject to their having satisfactory H&S procedures in place
☐	OTHER CONTROL MEASURES: please specify any other control measures you have implemented

EMERGENCIES	**Where emergencies may arise use space below to identify and assess any risks**
e.g. fire, accidents	Examples of risk: loss of property, loss of life

CONTROL MEASURES	**Indicate which procedures are in place to control the identified risk**
☐	participants have registered with LOCATE at http://www.fco.gov.uk/en/travel-and-living-abroad/
☐	fire fighting equipment is carried on the trip and participants know how to use it
☒	contact numbers for emergency services are known to all participants
☒	participants have means of contacting emergency services
☒	participants have been trained and given all necessary information
☐	a plan for rescue has been formulated, all parties understand the procedure
☐	the plan for rescue /emergency has a reciprocal element
☐	OTHER CONTROL MEASURES: please specify any other control measures you have implemented

EQUIPMENT	**Is equipment used?**	**NO**	**If 'No' move to next hazard** **If 'Yes' use space below to identify and assess any risks**
e.g. clothing, outboard motors.	Examples of risk: inappropriate, failure, insufficient training to use or repair, injury. Is the risk high / medium / low?		

CONTROL MEASURES	**Indicate which procedures are in place to control the identified risk**

☐	the departmental written Arrangement for equipment is followed
☐	participants have been provided with any necessary equipment appropriate for the work
☐	all equipment has been inspected, before issue, by a competent person
☐	all users have been advised of correct use
☐	special equipment is only issued to persons trained in its use by a competent person
☐	OTHER CONTROL MEASURES: please specify any other control measures you have implemented

LONE WORKING	**Is lone working a possibility?**	**YES**	**If 'No' move to next hazard** **If 'Yes' use space below to identify and assess any risks**
e.g. alone or in isolation *lone interviews.*	Examples of risk: difficult to summon help. Is the risk high / medium / low?		

Lone interviews, low risk

CONTROL MEASURES	**Indicate which procedures are in place to control the identified risk**
☐	the departmental written Arrangement for lone/out of hours working for field work is followed
☐	lone or isolated working is not allowed
☒	location, route and expected time of return of lone workers is logged daily before work commences
☒	all workers have the means of raising an alarm in the event of an emergency, e.g. phone, flare, whistle
☒	all workers are fully familiar with emergency procedures
☐	OTHER CONTROL MEASURES: please specify any other control measures you have implemented

ILL HEALTH	**The possibility of ill health always represents a safety hazard. Use space below to identify and assess any risks associated with this Hazard.**
e.g. accident, illness, personal attack, special personal considerations or vulnerabilities.	Examples of risk: injury, asthma, allergies. Is the risk high / medium / low? Low

CONTROL MEASURES	Indicate which procedures are in place to control the identified risk
☐	an appropriate number of trained first-aiders and first aid kits are present on the field trip
☐	all participants have had the necessary inoculations/ carry appropriate prophylactics
☒	participants have been advised of the physical demands of the trip and are deemed to be physically suited
☐	participants have been adequate advice on harmful plants, animals and substances they may encounter
☐	participants who require medication have advised the leader of this and carry sufficient medication for their needs
☐	OTHER CONTROL MEASURES: please specify any other control measures you have implemented:

TRANSPORT	Will transport be required	NO	X	Move to next hazard
		YES		Use space below to identify and assess any risks
e.g. hired vehicles	Examples of risk: accidents arising from lack of maintenance, suitability or training Is the risk high / medium / low?			

CONTROL MEASURES	Indicate which procedures are in place to control the identified risk
☐	only public transport will be used
☐	the vehicle will be hired from a reputable supplier
☐	transport must be properly maintained in compliance with relevant national regulations
☐	drivers comply with UCL Policy on Drivers http://www.ucl.ac.uk/hr/docs/college_drivers.php
☐	drivers have been trained and hold the appropriate licence
☐	there will be more than one driver to prevent driver/operator fatigue, and there will be adequate rest periods
☐	sufficient spare parts carried to meet foreseeable emergencies
☐	OTHER CONTROL MEASURES: please specify any other control measures you have implemented:

DEALING WITH THE PUBLIC	Will people be dealing with public	NO	If 'No' move to next hazard If 'Yes' use space below to identify and assess any risks
e.g. interviews, observing	Examples of risk: personal attack, causing offence, being misinterpreted. Is the risk high / medium /		

	low?

CONTROL MEASURES	Indicate which procedures are in place to control the identified risk
☐	all participants are trained in interviewing techniques
☐	interviews are contracted out to a third party
☐	advice and support from local groups has been sought
☐	participants do not wear clothes that might cause offence or attract unwanted attention
☐	interviews are conducted at neutral locations or where neither party could be at risk
☐	OTHER CONTROL MEASURES: please specify any other control measures you have implemented

WORKING ON OR NEAR WATER	**Will people work on or near water?**	**NO**	**If 'No' move to next hazard** **If 'Yes' use space below to identify and assess any risks**
e.g. rivers, marshland, sea.	Examples of risk: drowning, malaria, hepatitis A, parasites. Is the risk high / medium / low?		

CONTROL MEASURES	Indicate which procedures are in place to control the identified risk
☐	lone working on or near water will not be allowed
☐	coastguard information is understood; all work takes place outside those times when tides could prove a threat
☐	all participants are competent swimmers
☐	participants always wear adequate protective equipment, e.g. buoyancy aids, wellingtons
☐	boat is operated by a competent person
☐	all boats are equipped with an alternative means of propulsion e.g. oars
☐	participants have received any appropriate inoculations
☐	OTHER CONTROL MEASURES: please specify any other control measures you have implemented:

MANUAL HANDLING (MH)	Do MH activities take place?	NO	If 'No' move to next hazard If 'Yes' use space below to identify and assess any risks
e.g. lifting, carrying, moving large or heavy equipment, physical unsuitability for the task.	Examples of risk: strain, cuts, broken bones. Is the risk high / medium / low?		

CONTROL MEASURES	Indicate which procedures are in place to control the identified risk
☐	the departmental written Arrangement for MH is followed
☐	the supervisor has attended a MH risk assessment course
☐	all tasks are within reasonable limits, persons physically unsuited to the MH task are prohibited from such activities
☐	all persons performing MH tasks are adequately trained
☐	equipment components will be assembled on site
☐	any MH task outside the competence of staff will be done by contractors
☐	OTHER CONTROL MEASURES: please specify any other control measures you have implemented:

SUBSTANCES	Will participants work with substances	NO	If 'No' move to next hazard If 'Yes' use space below to identify and assess any risks
e.g. plants, chemical, biohazard, waste	Examples of risk: ill health - poisoning, infection, illness, burns, cuts. Is the risk high / medium / low?		

CONTROL MEASURES	Indicate which procedures are in place to control the identified risk
☐	the departmental written Arrangements for dealing with hazardous substances and waste are followed
☐	all participants are given information, training and protective equipment for hazardous substances they may encounter

☐	participants who have allergies have advised the leader of this and carry sufficient medication for their needs
☐	waste is disposed of in a responsible manner
☐	suitable containers are provided for hazardous waste
☐	OTHER CONTROL MEASURES: please specify any other control measures you have implemented:

OTHER HAZARDS	**Have you identified any other hazards?**	**NO**	**If 'No' move to next section** **If 'Yes' use space below to identify and assess any risks**
i.e. any other hazards must be noted and assessed here.	Hazard: Risk: is the risk		

CONTROL MEASURES	**Give details of control measures in place to control the identified risks**

Have you identified any risks that are not adequately controlled?	**NO**	☒	**Move to Declaration**
	YES	☐	**Use space below to identify the risk and what action was taken**

Is this project subject to the UCL requirements on the ethics of Non-NHS Human Research? NO

If yes, please state your Project ID Number

For more information, please refer to: http://ethics.grad.ucl.ac.uk/

DECLARATION	The work will be reassessed whenever there is a significant change and at least annually. Those participating in the work have read the assessment.

Select the appropriate statement:

☒ I the undersigned have assessed the activity and associated risks and declare that there is no significant residual risk

☐ I the undersigned have assessed the activity and associated risks and declare that the risk will be controlled by the method(s) listed above

NAME OF SUPERVISOR Mengqiu Cao

SIGNATURE OF SUPERVISOR Mengqiu Cao

DATE 08/05/2020

FIELDWORK **5** May 2010