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Review

Transport Poverty in Chinese Cities: A Systematic Literature Review

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Abstract: The widening income gap in post-reform China has given rise to social inequality. Among those, transport poverty and inequality have significantly affected the daily life of low-income groups. While important, this is an under-researched topic in China. This gap in the academic literature is glaring given the country's urbanization rates, sprawling cities and income differentials. Most previous studies have only focused on two aspects of transport poverty—job-housing imbalance and accessibility. A comprehensive understanding of the causes and impacts of transport inequality is currently lacking. Therefore, a systematic review of academic literature based on keywords relevant to transport poverty in China was conducted to provide a more complete assessment of the situation in Chinese cities. In total, 62 relevant studies were identified after close examination of the articles (including titles, abstracts, and full-texts). This set of articles allowed a number of general patterns to be identified. It was found that the most common causes of transport poverty include: a lack of access to private vehicles; uneven access to alternative transport options; inadequate public transport provision; jobs-housing imbalance; and the *hukou* system (a system of household registration which aims to regulate population distribution and rural-to-urban migration). The main impacts of transport poverty include: curtailed mobility and longer travel times; higher household expenditures on travel; reduced access to jobs and essential services; higher household expenditures on travel; and health and environmental issues.

Keywords: China; transport poverty; inequality; systematic review

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1. Introduction

China's impressive economic growth since the 1979 'reform and opening-up' (*gaige kaifang*) policy has led to much higher incomes for its population. However, averages conceal the uneven distribution of wealth under 'capitalism with Chinese characteristics.' While a growing economy has helped lift millions out of poverty, many others find themselves at the bottom of the income ladder with little hope of moving up [1]. From a classless nation in the Maoist era, China has become one of the most unequal countries in the world, with a Gini index of 0.5 [2]. By way of comparison, a GI of 0.4 represents severe income inequality. The higher echelons of society have benefited the most from economic reforms and are poised to become wealthier [3]. By the national standard in 2020, poverty is defined as residents with an annual income lower than RMB 4000 (approximately USD 600) in China.

Inequality presents a major obstacle for economic, social and environmentally sustainable development [4]. The gap between rich and poor is undermining the Chinese idea of 'social harmony' [4]. Inequality has also affected transport—the focus of this paper—notwithstanding vast investments in urban road and rail transport infrastructure since *gaige kaifang* [5].

There have been numerous studies on general transport issues in China [6] but transport inequality among socioeconomically disadvantaged groups is an under-researched topic. More attention to urban transport inequality needs to be paid to developing countries because of its increasing importance, especially in China [7], which has witnessed enormous increases in urban expansion and motorization over recent decades. In most Chinese cities, transportation strategies give priority to the use of private vehicles, while other transport modes, including active and public transportation, have lower priority. The disproportionate investment in transport infrastructure is creating a divide between residents of different socioeconomic backgrounds [7]. The urban poor suffer disproportionately from a limited transport options and disadvantageous housing locations [8]. As a result, widening income gaps in China are increasing social inequalities of low-income workers [7].

Due to the complex urban structure and transport system in China, daily commuting and traveling in China can be affected by many factors including institutional, economic, spatial and individual variables [9]. Ta et al. [9] explain that these factors are interrelated and play a significant role in urban commuting because the spatial mismatch and accessibility issues associated with these factors often lead to longer travel distances and time. However, the detail of how each factor affects transport poverty and how it impacts on social exclusion for low-income Chinese households has yet to be researched. Therefore, to provide a comprehensive understanding on how income impacts transport poverty in China, we conducted a systematic review of studies on transport poverty, set in Chinese cities. We did not merely count the number of studies, but also conducted a qualitative analysis of text to identify key themes found in the literature. We sought to examine both the causes and effects of transport poverty in China's metropolitan areas. Additionally, this study aims to explore the similarities and differences in transport poverty issues between China and the West by comparing the findings with Lucas' transport poverty framework [10].

2. Summary of Findings from the International Literature

The past two decades have witnessed a growing interest in transport-related social inequality issues [10]. These issues have raised concerns about the social exclusion of socioeconomically disadvantaged groups, such as low-income workers. The transport disadvantage dimension goes hand-in-hand with the social disadvantage dimension, and the direct or indirect interactions between them can cause transport poverty, which results in a series of accessibility and mobility issues, and that leads to further social exclusion outcomes [10]. According to Lucas [10], the *transport disadvantage* dimension includes *no car, poor public transport service, high cost of fears, no information* and *fear of crime,* while the *social disadvantage* dimension includes *low-income, no-job, ill-health* and *poor housing.* When these two dimensions interact, transport poverty arises, which causes inaccessibility *to life chances, to goods, to services, to decision-making, to social capital* and *to social networks*. Finally, this inaccessibility leads to further social exclusion.

The definition of transport poverty varies, but Kenyon et al. [11], p. 210 provide a commonly used one, which follows below:

> "*The process by which people are prevented from participating in the economic, political and social life of the community because of reduced accessibility to opportunities, services and social networks, due in whole or part to insufficient mobility in a society and environment built around the assumption of high mobility*."

In the United States (US) and the United Kingdom (UK), transport poverty has become a core theme in transport studies [12–14]. In the UK, a Social Exclusion Unit was established at the national level to study transport-related poverty, inequality and exclusion [10]. Lucas et al. [15] establish four dimensions to assess transport inequality: (1) mobility/accessibility, (2) traffic-related pollution, (3) traffic safety and (4) health.

At the conceptual level, accessibility and mobility are key aspects of transport poverty. Mobility is the ability to move between activity sites, while accessibility is the relative

ease with which people can get to their desired activities. The levels of accessibility and mobility depend on: (1) individual characteristics, such as income, age, gender, race and vehicle ownership; (2) structural factors, such as urban form, transport systems, crime and pollution; (3) national and global economies, including inequality, migration and unemployment; and (4) planning context, including regulations, public participation and power, among others [10].

At the operational level, frequently used measures of transport poverty include commuting times and the proportion of income used for daily trips [16]. Internationally, low-income earners tend to be disadvantaged in terms of transport as they spend a higher percentage of their incomes on transport [17,18]. Transport poverty also results from limited access to transport options. Again, at the international level, it is often the poor who find it harder to access cars due to their lower incomes or formal public transport as the network may not reach poor neighborhoods [17,19,20]. When groups cannot physically access employment, schooling and services, transport poverty compounds social disadvantage and exclusion [21].

Housing costs and job location are other crucial components of transport poverty [22]. In Western cities throughout the 1960s and 1970s, employment opportunities moved from city centers to peripheral 'edge cities' following the residential migration of the middle class. Suburbs had few affordable housing options for low-income workers, which meant that they continued to reside in the declining urban cores. This led to 'spatial mismatch'—an imbalance of jobs and workers [23]. Related to this was an 'automobile mismatch' where low-income groups, who lived farther from suburban employment centers and did not own a car, had to rely on other transport modes, especially public transport, which was often inefficient and unreliable [24]. Beginning in the 1980s, Western cities have experienced several waves of gentrification—the process of upwardly mobile households returning to the inner cities and pushing out poorer groups [25]. Gentrification presents the same problems for transport poverty—except that the direction of the commuting is reversed.

This study aims to determine whether the findings from the international literature apply to Chinese cities. The methodology employed for this systematic review is presented below.

3. Methods

This review is based on the PRISMA method. The articles it contains are sourced from two major databases: ScienceDirect and Scopus. ScienceDirect limited the number of connectors and the use of wildcards for searching, and to maintain the consistency between different databases the final revised string was (income) AND (transport) AND (accessibility OR mobility) AND (China OR Chinese) AND (exclusion OR inequality OR equality). These keywords were considered as main terms when introducing transport poverty issues and could be representative of related issues despite the lack of plural forms, and therefore, the limitation from ScienceDirect would not have a significant effect on the results. The year of the publication was also considered as the first criterion with only results in and after the year 2000 being included. The research was conducted on two multidisciplinary databases: ScienceDirect and Scopus, with 6244 articles extracted initially. Given the fact that transport inequality is only a recently emerging topic among Chinese academics, 6244 was an excessive number of articles for analysis.

To include maximum data, the search terms were applied for all fields: titles, abstracts and full texts. Additionally, the search was not limited to any fixed research field since transport inequality issues can cross multiple disciplines. Another two basic selection criteria were also set at the first stage, which were: publications written in English and publications set in mainland China. The search was conducted on 1 October 2020. The flow of information through the different phases of the systematic review is depicted in a PRISMA flow diagram shown in Figure 1. This maps out the number of records identified, included and excluded, and the reasons for exclusion at four levels, which

includes duplicate, title review, abstract review and full-text review, with a final 62 articles extracted for analysis.

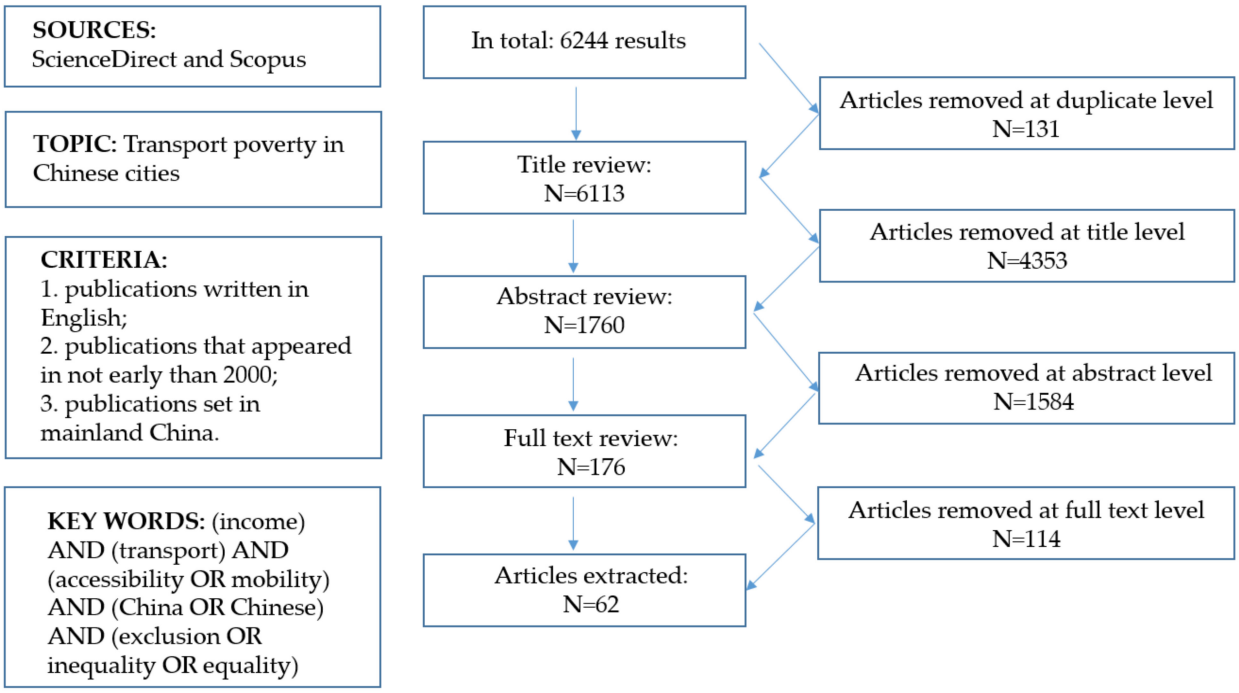

Figure 1. PRISMA flow diagram.

At the initial stage, 6244 records were extracted and exported. From this set, 131 duplicate records were removed resulting in 6113 unique records. These were reviewed based on their titles, and consequently, 4353 records were removed as being irrelevant to the research. The reason for removing such a large portion at this stage was that many records were in unrelated fields such as medicine, which may share some of the key terms, such as 'transport (of disease)' and 'inequality.' Articles that were not set in China were removed as well. Terms such as 'accessibility' and 'spatial mismatch' in the titles were also seen as indicators about whether the articles were related to transport inequality issues. The abstracts of the remaining 1760 records were then reviewed, which resulted in the exclusion of 1584 additional records. The aim of analyzing the abstracts was to further remove articles that were irrelevant to 'transport inequality issues' in 'China.' The majority of the articles were removed after the title and abstract level. This left 176 records for which the full text was reviewed. As some studies did not mention their settings in the titles nor the abstracts, full-text analysis was then needed to determine whether these articles were set in Chinese cities; articles that did not discuss Chinese cities were removed. Although some articles included the term 'income' in the text, the study on which they reported was focused on other factors, such as age and spatial characteristics, rather than specifically on low income. These types of articles were also removed at the full-text level. After this stage, 114 records were excluded, leaving 62 which are shown in Table 1. Of the 62 records, 57 are peer-reviewed journal articles, 2 are conference proceedings and 3 are books/book chapters.

These 62 publications were read and thematically coded. Deductive and inductive analyses were combined. At a higher level of analysis, two a priori themes were applied: (1) 'causes' of transport poverty in Chinese cities; and (2) 'impacts' of transport poverty in Chinese cities.

Two theoretical frameworks, based on previous literature, were modified and applied for categorizing the causes and impacts of transport poverty in China as themes: (1) four influential factors on commuting behavior in China (institutional factors, economic fac-

tors, spatial factors and individual factors) that were identified by Ta et al. [9] to explain the 'causes' of transport poverty; and (2) four dimensions of transport poverty (mobility/accessibility, traffic-related pollution, traffic safety and health) that were identified by Lucas et al. [15] to explain the 'impacts' of transport poverty. Within each theme, frequently recurring keywords were identified to provide a fine-grained analysis. The findings were compared with the framework devised by Lucas [10] to show the differences and similarities between China and the Western in terms of transport poverty issues.

A few methodological limitations should be noted at this point. First, the terms used may not include all the papers of transport disadvantages among Chinese low-income groups. For example, since the terms included 'accessibility' or 'mobility,' other transport poverty related issues, such as health and environment might be neglected. Second, due to the number of results from ScienceDirect and Scopus, no other database was used, which may exclude studies that are relevant to Chinese transport poverty. Third, some of the extracted articles are not entirely focused on transport poverty issues, but because they share some key terms, such as access to private vehicles and mismatch, they were extracted for analysis.

4. Overview of the Selected Papers

The most striking finding is perhaps the lack of China-based literature on the topic. Given the size of China's urban population, 62 publications is minuscule—especially when compared to the hundreds of studies set in the West. Figure 2 provides the publication dates. The number of studies appears to be increasing in recent years, which shows the increasing interest in transport poverty issues among Chinese scholars. However, only a handful of authors are active in this space. For example, 19 of the 62 studies have been authored or co-authored by one researcher (Professor Pengjun Zhao at Peking University). In terms of the methods applied in transport poverty research, Western-based papers have deployed a variety of statistical techniques to measure transport poverty, whereas papers set in China have mostly relied on regression models and job accessibility models.

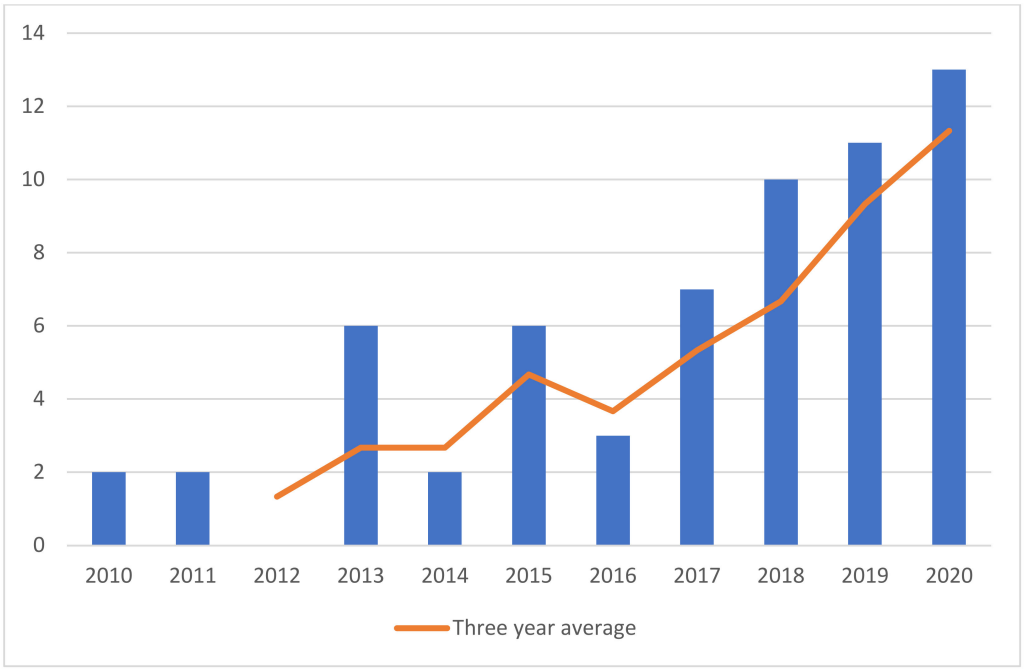

Figure 2. Publications by year.

Beijing dominates the literature, being the setting for 23 of the 62 studies. This may be because owing to its population size, Beijing is facing some of the most severe transport challenges in China. Additionally, the complex socioeconomic characteristics of Beijing's

residents and the considerable income disparity may be factors in explaining Beijing's prevalence in the literature. Another reason may be that many prestigious, research-active universities and institutes are located in Beijing. However, even here, researchers are more likely to investigate better-funded areas of transport policy (e.g., technology or infrastructure) rather than issues related to the mobility and accessibility of the urban poor. However, no studies to date have examined the influence on transport poverty of the 'new mobility' paradigm—represented in China by Didi Chuxing, a ride-hailing service.

Beyond Beijing, other first-tier cities—Shanghai, Guangzhou, Shenzhen and Nanjing are also represented in research studies on transport poverty. Meanwhile—as is often the case in the transport literature [26]—medium and small-sized cities (which in China still comprise millions of residents) are largely neglected. While various types of inequality (income-based, gender-based and age-based) are common across China, transport poverty is in large part a result of context. Therefore, we conclude that studies to date are not reflective of all Chinese cities.

Figure 3 shows the overview of the findings. It was found that the most common 'causes' of transport poverty include: a lack of access to private vehicles; uneven access to alternative transport options; inadequate public transport provision; jobs-housing imbalance; and the *hukou* system. The main impacts of transport poverty include: curtailed mobility and longer travel times; higher household expenditures on travel; reduced access to jobs and essential services; higher household expenditures on travel; and health and environmental issues. The main findings are discussed in detail below.

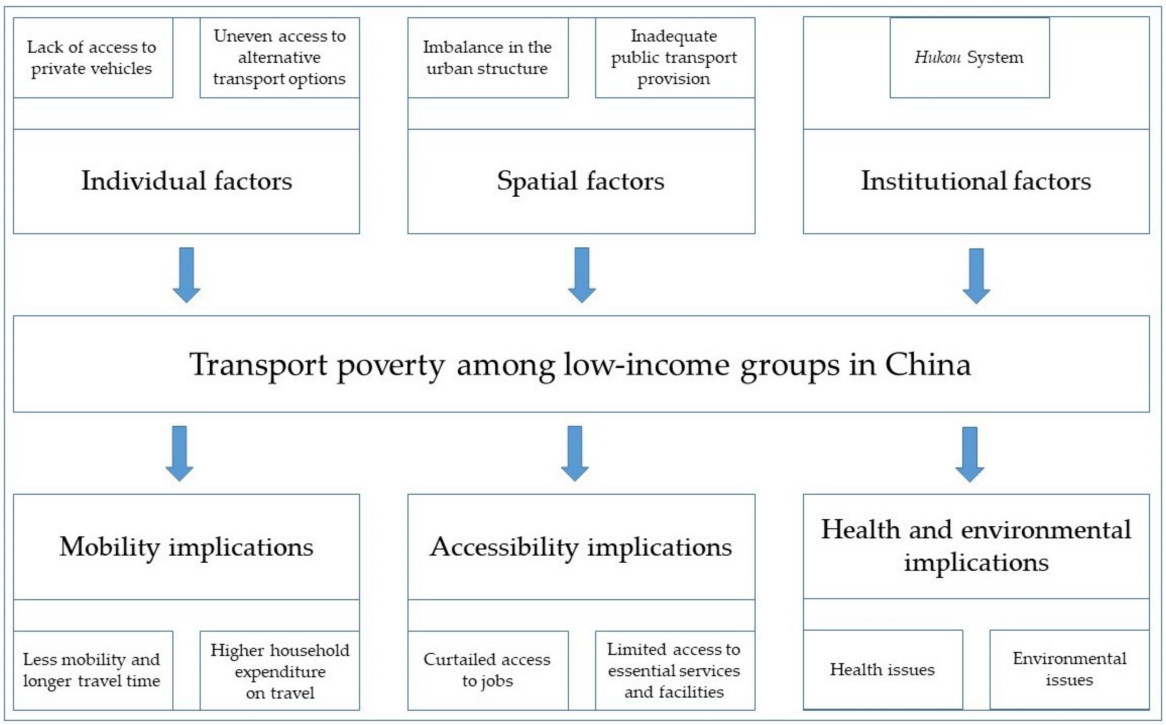

Figure 3. An overview of the main findings.

5. Causes of Transport Poverty in Chinese Cities

Most publications in our dataset focused on the reasons why low-income groups in Chinese cities were suffering from transport poverty, disadvantage and exclusion. Common 'causes' included: a lack of access to private vehicles; uneven access to alternative transport options; inadequate public transport provision, job-housing imbalance and *hukou* system, all of which fall into three of the four factors (spatial factors, institutional factors and individual factors) identified by Ta et al. [9], with economic factors barely discussed in any of the studies. Therefore, this section will discuss the causes by categorizing them into

individual, spatial and institutional factors. An overview of the studies addressing the causes of transport poverty in Chinese cities is shown in Table 2.

5.1. Individual Factors

5.1.1. Lack of Access to Private Vehicles

The lack of access to private vehicles (cars in particular) due to low incomes is underscored in most studies as the driver of transport poverty and disadvantage. Numerous studies showed that high-income commuters were more likely to own and use private automobiles, whereas low-income groups were less likely to own cars and therefore could not easily move around [7,16,27–39]. Longitudinal studies also suggested that as a result of gradually increasing household incomes, there was a rapid growth in car use among high-income groups, which led to an increasing gap in car ownership between the rich and poor [29,40]. However, increases in income for those in low-income groups were often also accompanied by car purchases to a certain extent [41]. A close relationship between income and leisure car trips was also identified [42]. Another study showed that there might be a threshold where the use of private vehicles decreased with increasing income level, and that might be caused by considerably shorter distance to employment for high income residents and non-motorized modes were prioritized [43].

While incomes have increased for all groups in China, the cost of purchasing a car is still too high for the poor. A study in Nanjing found that between 2008 and 2011, car ownership had decreased among low-income workers, and the gap in private car use between the rich and poor had increased for both commuting and leisure travel [44]. Public transport could be generally less favored by the urban wealthy due to the inconvenience associated with bus and train ridership, and because of the low symbolic value of public transport vis-à-vis cars [45].

The lack of access to car-based travel also produces transport poverty among children from low-income households. Children from high-income families were more likely to travel to school by car than public transport, whereas children from low-income families tended to walk [46,47]. Children from higher income families sometimes did walk too—especially if mothers were in charge of the school run (cars were more often used by fathers or paid chauffeurs) [47]. While walking was positive in terms of physical activity, it exposed children to adverse weather, which could be problematic during Beijing's cold winters and hot summers, and to accident risk [46].

The situation of internal migrants is more complex. Car ownership and use was lower among younger migrants (aged under 31) even when their incomes were high [35]. This was because people in this cohort tended to rent rather than own their homes and they were under pressure to retain some of their income to support their families left behind in rural areas [35].

Car ownership has increased significantly among Chinese high- and middle-income households, which not only brings social inequality but also negative environmental impacts. The emission from private vehicles is a major contributor to the air pollution in China, and Xu and Lin [48] point out cars have affected more in the eastern region, where car ownership is higher than in the other areas. Air pollution has posed high costs on Chinese residents, especially on levels of health and productivity [49]. Increasing car ownership in Chinese cities is harmful for both social and environmental sustainability.

5.1.2. Uneven Access to Alternative Transport Options

Public transport and non-motorized travel are the main modes for low-income workers in general [50]. However, one research suggested that beyond private cars, low-income people found it difficult to gain access to other transport options, whereas high- and middle-income groups had a suite of options available to them [44]. Furthermore, to save travel costs, some low-income households were less likely to choose public transport compared to high-income residents [51]. To the extent that the poor had access to private vehicles at all, these tended to be motorcycles rather than cars—especially in rural areas [52]. Motorcycles

were prohibited in some historic inner-city zones, such as Guangzhou [53]. While this was positive in terms of reducing air and noise pollution and increasing traffic safety, it also disadvantaged the poor and increases transport poverty [53]. Such tradeoffs are typical in transport planning where conflicting agendas tend to characterize the sustainability paradigm [54].

Even a relatively cheap mode such as cycling—which was once a fixture of the Chinese urban landscape [6]—appears to be more available to the wealthy than to the poor. Low-income workers showed little participation in the public bicycle sharing program due to its complexity and high cost of registration [55]. The same results were also found in a dockless bike share study, which revealed that dockless bikeshare was less popular among low-income groups [56].

5.2. Spatial Factors

5.2.1. Imbalances in the Urban Structure

Urban gentrification has a range of distinct effects on different socioeconomic groups [57]. Gentrification refers to urban development processes where new businesses relocate to areas with improved residential or commercial property, often bringing in middle-class or wealthier residents. This can have substantial impacts on the spatial distribution of different socioeconomic groups and exacerbate social inequality for disadvantaged groups, such as the urban poor [57]. Two types of imbalances appear to exacerbate transport poverty in Chinese cities: jobs-housing mismatch and transport-land use mismatch. In terms of transport-land use mismatch more broadly, a study set in Guangzhou found that residents in subsidized rental housing (i.e., poorer residents) had to travel longer distances to shopping venues [58]. However, this aspect has not been extensively studied, whereas more is known about the jobs-housing mismatch.

Wang et al. [59] explained that, since property prices were soaring in city centers, lower income workers were pushed to the suburban areas where there was a lack of amenities for the residents. Some middle-income workers were also moving to newly built satellite towns with good public transport to escape overcrowded housing in inner cities [41]. As many tended to retain their urban job, commuting distances increased, but the upside was improved housing quality [41]. Higher mixed land use, due to its effect on housing rent, was another factor that can make the low-income residents leave the community and experience disadvantages to access a range of services [51]. All of these trends result in a mismatch in the location of jobs and housing that affect lower income workers disproportionally [8,58,60]. Where household incomes decrease, commuting times increase as a consequence—and vice versa [61]. Lower-income earners are particularly sensitive to the travel distances between home and work, as these affect the household transport budget. Compared to their counterparts, low-income residents also had less ability to adjust their housing location to reduce commuting times [62]. However, the tolerance of longer travel time to jobs had limits, even for low-income workers [63].

Affordable housing is one of the major housing types, and large-scale affordable housing communities are occupied by low-income workers. However, these communities are typically located on the urban fringe. The poor location leads to low accessibility levels for low-income workers [9,31,64–68]. This may exacerbate transport disadvantage because few public housing residents can afford a car to substitute for inadequate public transport services [68]. Compounding the problem is the fact that many of the industries employing the poor tended to be concentrated in the inner cities [69]. Therefore, unlike communities facilitated with adequate services that are normally occupied by the rich, the uneven distribution of public transport and other services of the location for affordable housing leads to social segregation of low-income workers [28].

5.2.2. Inadequate Public Transport Provision

Over the last decade, a significant portion of China's national expenditure has funded urban public transport infrastructure [6]. Unfortunately, public transport provision remains inadequate due to rapid urbanization. It has been difficult for public and private providers to meet the travel demands of a growing urban population. Poor land use planning compounds this problem, particularly in major cities. A study in Beijing showed that, low-income workers were forced to move to public housing located in the outer suburbs that were served by low-quality public transport, which had created a commuting barrier [8,31]. The imbalance of investment between highway and public transport was another factor that exacerbated the commuting barrier between high- and low-income commuters [28]. With more investment in highway construction, high-income residents tended to benefit more due to their high level of car ownership [28]. This situation is also found in other developing countries, such as Latin America, where public transport is unevenly distributed [69].

5.3. Institutional Factors

Hukou System

Institutional factors, including the *hukou* and *danwei* housing system—*danwei* were work-live units created by state-owned enterprises—have a significant impact on job-housing relationships and further affect workers' commuting time [70,71]. *Hukou*, a factor unique to China, is an official registration record or local residence permit, which rural-urban migrants need to obtain when settling in a new city to get access to all levels of local services, and it is highly associated with low-skilled and low-income migrants. The *hukou* system plays a significant role in low-income migrant mobility [72]. Those migrants without *hukou* tend to suffer more from longer commuting times and lower accessibility to employment and other services in general [71,73–75]. One reason given by Zhao and Howden-Chapman [72] was that some social housing, which was typically built within the proximity of major transport hubs to improve access to public transport for low-income workers, was exclusive to local *hukou* holders. Migrant workers without *hukou* also faced the dilemma of choosing between poor living conditions close to their employment or low accessibility of living in the suburb with better housing [70,75–78]. The basement was one of the informal housing types for avoiding the burden of commuting [76]. Although these types of housing options did not require local *hukou*, they still created social issues, which tended to result in social exclusion [76]. This social segregation could be explained by the fact that low-income migrants tended to limit their social interaction to only those from the same hometown [79]. On the other hand, high-income migrant workers were less sensitive to commuting burdens and preferred to live in the suburbs where the environment was better [70].

6. Impacts of Transport Poverty in Chinese Cities

Several research publications focus on the impacts of transport poverty among low-income commuters. The research suggests the following major impacts: less mobility and longer travel times; curtailed access to jobs and essential services; higher household expenditures on travel; and lower quality of life and health issues. Therefore, our main themes of impacts are modified as mobility, accessibility, health and environment, based on the dimensions illustrated by Lucas et al. [15]. A summary of the studies addressing the impacts of transport poverty in Chinese cities is represented in Table 3.

6.1. Mobility

6.1.1. Less Mobility and Longer Travel Times

Commuting time is a key measure of transport poverty. Longer commuting times are one of the most significant impacts of transport poverty, particularly for low-income groups in China [7,38,43,61,71,72]. Low-income residents also had restrained mobility [79], which could lead to rigid space–time constraints [80]. A study also argued that, due to lower car ownership rates, middle-income workers, who lived in the Chinese suburbs

might also carry a greater commuting time burden [16]. Although low-income commuters tended to make fewer and shorter trips, their average trip duration was still longer than higher income commuters [27], which was due to imbalances in the urban structure [58]. Family income could also have an impact on university student mobility, where students from high income families tended to travel more frequently and longer distances to access different services [81]. Chen et al. [82] addressed the impact of travel time uncertainty on socioeconomically disadvantaged groups, which could also exacerbate accessibility inequality.

Unlike Western cities, particularly the U.S., where many wealthy families live in the suburbs, the wealthy aspire to live in the urban core in China. As transport infrastructure tended to be inadequate in poorer suburbs, residents had to pay more, in terms of time, for transport [68,77]. Zhao and Li [36] suggested that this was also true from non-work travel. When considering relocating, high- and middle-income groups sought to improve their housing conditions, whereas low-income groups sought to minimize their commuting time [41].

While these are the general trends, in a complex country like China there are exceptions. For example, a study set in the historic zone of Guangzhou found that higher income individuals tended to spend more time traveling due to longer travel distances, whereas low-income workers had a lower travel times [53]. This could be explained by lower income workers seeking jobs closer to their homes due to limited mobility options. While shorter travel times were an advantage, a problem still remained because transport availability constrained employment options for the poor [53].

However, a study in Beijing found that medium-income workers enjoyed the shortest travel times [71]. This group tended to avoid the spatial mismatch problem by choosing to live in lower quality, but more affordable housing within the urban perimeter. Given the choice between shorter commutes and better housing, middle-income workers tended to choose the former. Higher income commuters, by contrast, were less compromising in terms of housing quality, whereas lower income commuters were more sensitive to housing costs [71].

6.1.2. Higher Household Expenditures on Travel

Longer commuting distances mean that low-income groups may have to spend a larger portion of their income on transport. Distance-based public transport fares (recently applied in Beijing and other cities) are regressive as they penalize lower income workers who live in outer suburban areas. By contrast, flat fares cross-subsidized commuters—wealthy riders traveling shorter distances paid the same fare as poor riders taking longer trips [83]. For the very poor, any public transport fare could be unaffordable—although metro ticket prices in Chinese cities might appear low by Western standards [68].

6.2. Accessibility

6.2.1. Curtailed Access to Jobs

Accessibility is a crucial component of transport poverty as noted by Lucas et al. [15] and others [11,13,14]. Several studies showed low-income commuters in Chinese cities suffered from a jobs-housing imbalance and struggled to access employment [38,53,84]. Employment accessibility by public transport, upon which low-income workers were dependent, was much poorer than that by private vehicles, and the distribution of public transport services were unequal for the poor [85].

Migrant workers—especially 'second class citizens' without local *hukou*—were particularly vulnerable and tended to have less access to employment opportunities [73,74]. However, the development of new industrial centers and informal housing constructed around them could be beneficial for low-income migrants as it meant less travel time [78]. A study of Guangzhou's new satellite towns showed that due to the rapid industrialization and urbanization, jobs and housing were moving outwards [86]. New towns were forming township and village enterprises that were developing affordable housing for industrial

plant workers. To reduce travel times migrant workers employed in new industrial estates were starting to move into this housing [86]. In a sense, this signifies a return to the *danwei* arrangements of the Maoist era.

6.2.2. Limited Access to Essential Services and Facilities

Apart from jobs, accessibility to essential goods and services is also a problem for lower income people [27,38,66,67,84,87–90]. These services include health services, education, shopping and physical activity facilities. Longer travel times for these services may result in low satisfaction levels [66,89]. Among these services, poor access to medical facilities had a substantial impact on low-income households [37,39,90].

Children in low-income families are also transport disadvantaged as they have poor access to schools and other educational opportunities, in part because urban sprawl has led to longer travel distances for children. As education resources are unevenly distributed across urban areas, poorer children may be stuck in underfunded public schools close to their homes. In a society that greatly values educational achievement, this perpetuates a downward spiral of social exclusion [46].

Social inequality is also found in park accessibility in Chinese cities. Studies suggested that low-income groups tended to be excluded from using parks due to their disadvantaged locations [91–93]. Parks in low-income areas were not prevalent, and thus residents of these areas must rely on walking and substandard public transit to access parks [91–93]. However, a different result was found in a study of urban park access in Beijing [94], which showed a weak association between socioeconomic conditions and park access. That could be explained by the substantial funding from the government to ensure that park planning meeting the needs of residents from all socioeconomic backgrounds.

6.3. Health and Environmental Issues

While the wealthy can travel safely, comfortably and conveniently in their private cars [41] the conditions for the poor are considerably worse [27]. Zhou et al. [58] found that commuters from subsidized low-income rental housing relied heavily on cheaper transport modes, such as buses, while commuters from commercial and private-leased housing were more frequent users of the metro and private vehicles. As a result, the poor struggled to meet their daily travel needs, which could result in a lower quality of life [35].

Wang et al. [59] examined the link between density, lifestyle and being overweight among middle-aged and older adults in China. The results showed that adults living in densely populated areas had a higher risk of being overweight due to their inactive lifestyle. Similar results were found for residents that owned cars. Both of these factors were associated with household income levels since wealthy people tended to live in densely populated neighborhoods and had a high levels of car ownership, which made them more vulnerable to health risks from being overweight [59]. Weng et al. [95] examined the health benefits of walkable communities and showed that highly walkable neighborhoods tended to be located in city centers where the urban wealthy live.

Environmental pollution has become a key concern in urban China, with the transport sector being a major contributor. One study addressed the issue of exposure to pollution by comparing the ability of low- and high-income groups to switch travel modes based on weather conditions [96]. The results showed low-income workers were less likely to switch from cycling to motorized modes due to their limited financial resources, which would lead to more exposure to pollution. Meanwhile, the restrained access to medical services and parks, noted above, can exacerbate the health of low-income residents.

Table 1. List of publications included in the review.

Author(s), Year	Keywords	Journal	Research Methods
Zhao and Howden-Chapman, 2010 [72]	* social inequalities, mobility, hukou system, job accessibility, Commuting costs, Beijing	International Development Planning Review	regression analyses, ordinary least squares
Zhao and Lü, 2010 [62]	job accessibility, commuting time, institutionalist approach, housing reform, Beijing	Journal of Transport Geography	institutionalist approach, in-depth analysis
Liu and Wang, 2011 [63]	spatial mismatch, job accessibility, commuting time, Beijing	Acta Geographica Sinica	job-accessibility index, regression analysis, survey
Zhao et al., 2011 [61]	jobs-housing balance, commuting time, housing reform transformation, Beijing	Journal of Transport Geography	zone-based aggregate method, disaggregated method
Cheng et al., 2013 [27]	urban low-income, travel behavior, two-step clustering, policy recommendations	[Conference proceedings]	two-step clustering analysis
Lau, 2013 [53]	sustainable transport planning, access to employment, development variables, social exclusion, a historic inner city, policy suggestions	Habitat International	questionnaire survey
Lau and Chiu, 2013 [86]	dual-track suburbanization, institutional policies, migrant workers, township and village enterprises, urban village, co-location process	Cities	questionnaire survey, in-depth interviews
Yu and Cai, 2013 [76]	migrants, housing, rented basement, Beijing	Habitat International	case study
Zhao, 2013 [28]	social segregation, urban sprawl, spatial planning, Beijing	Tijdschrift voor economische en sociale geografie	index of dissimilarity, index of residential exposure
Zhou et al., 2013 [58]	* spatial mismatch, jobs-housing relocation, low-income housing, Guangzhou	Urban Studies	spatial mismatch hypothesis
Feng et al., 2014 [42]	mode choice, China, multivariate analysis, urban structure	Tijdschrift voor economische en sociale geografie	multi-logistic regression models
Zhao, 2014 [29]	urban mobility, car use, consumer society, aging society, China	Journal of Transport Geography	multiple travel surveys, in-depth analysis
Dai, Zhou and Ye, 2015 [43]	middle-class, commuting mode, commuting time and distance, job-housing balance, Guangzhou	Chinese Geography Science	multilevel logistic regression method

Table 1. *Cont.*

Author(s), Year	Keywords	Journal	Research Methods
Han et al., 2015 [64]	jobs-housing relationship; job accessibility; spatial mismatch; population density; employment density; Beijing Metropolitan Area	Chinese Geography Science	job accessibility model
Li and Zhao, 2015 [46]	school children, modal split, social inclusion, hukou system, education policy	Journal of Transport Geography	logit and nested-logit models
Wang et al., 2015 [91]	park planning, accessibility, cross-cultural analysis, community survey, Australia, China	Habitat International	park accessibility model, neighbourhood-level surveys
Zhang and Man, 2015 [31]	accessibility, jobs-housing mismatch, urban metro, affordable housing, Beijing	Urban Rail Transit	OD matrix, job accessibility model
Zhao, 2015 [8]	transport inequity, commuting time, spatial constraints, self-determined actions, Beijing	Environment and Planning A	regression models
Karki and Tao, 2016 [55]	public bicycle-sharing program, zero-carbon transportation policy, bicycle rental system, non-motorized transport, healthy transportation alternative	Habitat International	questionnaire survey, in-depth interviews
Zhan et al., 2016 [81]	university students, trip frequency, mode choice, hierarchical tree-based regression	Transport Policy	hierarchical tree-based regression model
Zhao and Li, 2016 [16]	Beijing, growing cities, spatial planning, transport inequality	International Journal of Sustainable Transportation	semi-log-multinomial linear regression analysis
Aizezi et al., 2017 [52]	travel mode, socio-demographic characteristic, multinomial logit model, rural, urban	[Conference proceedings]	multinomial logit model
Feng et al., 2017 [44]	travel behaviour, transformation, built environment, urban China, Nanjing	Transport Policy	multivariate analyses
Jiang et al., 2017 [33]	car ownership, car use, built environment, street form, double-hurdle model	Transportation Research Part D	multinomial logistic regression, double hurdle model
Li and Liu, 2017 [73]	land use, mobility, job accessibility, hukou, Guangzhou	Cities	job accessibility model

Table 1. *Cont.*

Author(s), Year	Keywords	Journal	Research Methods
Ta et al., 2017 [9]	jobs-housing relationship, commuting pattern, danwei, government intervention, Chinese city	Transportation Research Part D	in-depth analysis
Xu et al., 2017 [92]	geographic access, open spaces, transport modes, social justice, hierarchical regression	Journal of Transport Geography	hierarchical regression
Xiao et al., 2017 [93]	social equity, environmental justice, marginalised groups, park access, Shanghai	Landscape and Urban Planning	local indicators of spatial association, Mann–Whitney U test
Gao et al., 2018 [65]	low-to-moderate-income group, transit smart card data, housing affordability, residential spatial distribution, residential relocation	Computers, Environment and Urban Systems	public transit smart card data
Guo et al., 2018 [35]	mode choice, internal migration, China, correlated random-parameters, logit	Computers, Environment and Urban Systems	correlated random parameters logit models
Li and Zhao, 2018 [79]	mobility, social network, migrant worker, mobile phone, Beijing	European Transport Research Review	one-to-one in-depth interviews
Liu et al., 2018 [60]	* residential housing policy, car ownership, trip chaining, China	Transportation Research Part D	binary logit probability, ordered Probit model
Liu et al., 2018 [47]	parental chauffeurs, escort-space, travel mode choice, child, nearby enrollment policy	Transport Policy	multinomial logit model
Tu et al., 2018 [94]	urban parks, urban greenspace, park access, neighborhood socioeconomic conditions, environmental justice	Sustainability	Pearson correlation
Xiao et al., 2018 [87]	transportation disadvantage, transportation opportunity, social indicators, social inequalities, principle component analysis	Social Indicators Research	spatial regression
Zhang et al., 2018 [77]	commuting burden, transport inequality, jobs-housing relationship, institutional constraints	Journal of Transport Geography	regression analysis, qualitative interviews
Zhao et al., 2018 [96]	cycling, air pollution, psychological perceptions, environment, Beijing	Transportation Research Part D	binary logistic model, multinomial logistic model
Zhao and Zhang, 2018 [41]	travel behaviour, car use, travel mode, commuting distance. life events, China	Journal of Transport Geography	structural equation model

Table 1. *Cont.*

Author(s), Year	Keywords	Journal	Research Methods
Bi et al., 2019 [74]	employment outcome, housing segmentation, enclave effects, migrant workers, spatial mismatch, Yunnan province, China	Habitat International	econometric model
Cao and Hickman, 2019 [84]	transport, social equity, travel equity, the capabilities approach, Beijing	Transport Policy	F-test, multinomial logistic regression
Chen and Yeh, 2019 [75]	* accessibility inequality, geographic distribution, low-income groups, three-step floating catchment area, China	Annals of the American Association of Geographers	3SFCA approach, quantile/share ratio
Li et al., 2019 [7]	commuting time, social equity, transportation equity; China; commuting paradox	Sustainability	multi-level order logistic regression
Wang et al., 2019 [59]	population density, sedentary lifestyle, overweight, neighbourhood, China	Health and Quality of Life Outcomes	multilevel regression
Weng et al., 2019 [95]	walkability, walk score, 15-Min walkable neighborhoods, social equality, healthy communities, China	Journal of Transport & Health	walk score metric
Yu et al., 2019 [51]	public transit, built environment, urban villages, urban regeneration, transport planning	Sustainability	multinomial logistic regression model
Zeng et al., 2019 [66]	relative accessibility deprivation, affordable housing communities, Nanjing, services, spatial patterns of access	Cities	geographical analysis
Zhao and Bai, 2019 [40]	car ownership, mobility, transport inequality, longitudinal data, forced car ownership, China	Journal of Transport Geography	longitudinal data analysis
Zhao and Li, 2019 [36]	travel satisfaction, discrepancy, rail transport, expectation, Beijing	Journal of Transport Geography	questionnaire survey, descriptive analyses
Zhao and Zhang, 2019 [83]	social equity, metro fare, fare structure, transport disadvantage, just pricing, Beijing	Journal of Transport Geography	multivariate models
Cao and Hickman, 2020 [88]	* transport, travel behaviour, social equity, mobility, the capabilities approach, Beijing	[Book chapter]	F-test

Table 1. *Cont.*

Author(s), Year	Keywords	Journal	Research Methods
Chen et al., 2020 [56]	dockless bike share, active transportation, cycling, travel behavior, travel attitudes	Sustainability	binary logistic regression
Chen and Yeh, 2020 [80]	accessibility, housing, inequality, neighbourhood, time geography, transport	Urban studies	space–time prism model
Du et al., 2020 [37]	urban elderly, healthcare travel characteristic, core area, suburb, mode choice, influential factors	Sustainable Cities and Society	multinomial logistic model
Lau, 2020 [38]	Self-organisation, travel behaviours, social exclusion, deprived urban neighbourhoods, China	[Book]	N/A
Liu et al., 2020 [70]	transport inequality, transport policy and governance, institutional constraints, commuting burden, jobs-housing relationship, Tianjin	Research in Transportation Business & Management	multiple linear regression
Liu et al., 2020 [90]	physical activity facilities, physical activity, point of interest (POI), home neighborhood, work neighborhood, China	International Journal of Health Geographics	regression models
Tao et al., 2020 [85]	job accessibility, public transport, multi-modal, 2SFCA competition, Shenzhen	Land Use Policy	Multi-modal 2SFCA
Wang et al., 2020 [67]	low-income, activity space, accessibility, social exclusion, China	Cities	ANOVA tests
Wu et al., 2020 [39]	* accessibility, medical facilities, transport modes, Guangzhou,	Complexity	3SFCA modes
Zhao, 2020 [71]	* urban transport inequality, transition china, social inequality, commuting	[Book chapter]	Case study
Zhao and Cao, 2020 [78]	transport inequity, long commuting, migrants, geographically weighted regression (GWR), megacity, Shanghai	Transport Policy	geographically weighted regression
Zhao et al., 2020 [89]	healthcare services, inequality, spatial accessibility, COVID-19 pandemic, megacities, China	Health and Place	2SFCA model

* An asterisk identifies where the keywords were added by the authors of this article, since no keywords were included in the original papers.

Table 2. A summary of extracted studies addressing different dimensions of the causes.

Causes	Studies
Access to private vehicles	Cheng et al., 2013 [27]; Zhao, 2013 [28]; Feng et al., 2014 [42]; Zhao, 2014 [29]; Li and Zhao, 2015 [46]; Wang and Liu, 2015 [30]; Zhang and Man, 2015 [31]; Dai et al., 2016 [43]; Linn et al., 2016 [32]; Zhao and Li, 2016 [16]; Feng et al., 2017 [44]; Jiang et al., 2017 [33]; Wei and Pan, 2017 [34]; Guo et al., 2018 [35]; Liu et al., 2018 [47]; Zhao and Zhang, 2018 [41]; Li et al., 2019 [7]; Zhao and Bai, 2019 [40]; Zhao and Li, 2019 [36]; Du et al., 2020 [37]; Lau, 2020 [39]; Wu et al., 2020 [39]
Alternative transport options	Lau, 2013 [53]; Karki and Tao, 2016 [55]; Aizezi et al., 2017 [52]; Feng et al., 2017 [44]; Yu et al., 2019 [51]; Chen et al. 2020 [56]
Urban structure	Zhao and Lü, 2010 [62]; Liu and Wang, 2011 [63]; Zhao et al., 2011 [61]; Zhao, 2013 [28]; Zhou et al. 2013 [58]; Han et al., 2015 [64]; Zhang and Man, 2015 [31]; Zhao, 2015 [8]; Ta et al., 2017 [9]; Liu et al., 2018 [60]; Gao et al., 2018 [65]; Zhao and Zhang, 2018 [41]; Wang et al., 2019 [59]; Yu et al., 2019 [51]; Zeng et al., 2019 [66]; Wang et al., 2020 [67]
Public transport provision	Zhao, 2013 [28]; Zhang and Man, 2015 [31]; Zhao, 2015 [8]
***Hukou* system**	Zhao and Howden-Chapman, 2010 [72]; Yu and Cai, 2013 [76]; Li and Liu, 2017 [73]; Li and Zhao, 2018 [79]; Zhang et al., 2018 [77]; Bi et al., 2019 [74]; Chen and Yeh, 2019 [75]; Liu et al. 2020 [70]; Zhao, 2020 [71]

Table 3. A summary of extracted studies addressing different dimensions of the impacts.

Impacts	Studies
Mobility and travel time	Zhao and Howden-Chapman, 2010 [72]; Zhao et al., 2011 [61]; Zhou et al., 2013 [58]; Cheng et al., 2013 [27]; Lau, 2013 [53]; Dai et al., 2016 [43]; Zhan et al., 2016 [81]; Zhao and Li, 2016 [16]; Li and Zhao, 2018 [79]; Zhang et al., 2018 [77]; Zhao and Zhang, 2018 [41]; Chen et al., 2019 [56]; Li et al., 2019 [7]; Zhao and Li, 2019 [36]; Zhao and Zhang, 2019 [83]; Chen and Yeh, 2020 [80]; Lau, 2020 [38]; Zhao, 2020 [71]
Household expenditure on travel	Zhao and Zhang, 2019 [83]
Curtailed access to jobs	Liu and Wang, 2011 [63]; Lau, 2013 [53]; Lau and Chiu, 2013 [86]; Li and Liu 2017 [73]; Bi et al. 2019 [74]; Cao and Hickman, 2019 [84]; Lau, 2020 [38]; Tao et al., 2020 [85]; Zhao and Cao, 2020 [78]
Access to essential services and facilities	Cheng et al. 2013 [27]; Li and Zhao, 2015 [46]; Wang et al., 2015 [91]; Xu et al., 2017 [92]; Xiao et al., 2017 [93]; Tu et al., 2018 [94]; Xiao et al., 2018 [87]; Cao and Hickman, 2019 [84]; Zeng et al., 2019 [66]; Cao and Hickman, 2020 [88]; Du et al. 2020 [37]; Lau, 2020 [38]; Liu et al., 2020 [89]; Wang et al., 2020 [67]; Wu et al., 2020 [39]; Zhao et al., 2020 [90]
Health and environment issues	Zhou et al., 2013 [58]; Cheng et al., 2013 [27]; Guo et al., 2018 [35]; Wang et al., 2019 [59]; Weng et al., 2019 [95]; Zhao et al., 2018 [96]

7. Discussion and Conclusions

The income gap between China's rich and poor has widened substantially over the past decade, and low-income workers are experiencing more transport advantage in urban areas. Our research suggests that transport poverty is an under-researched topic, and the gap in the academic literature is glaring given the country's urbanization rates, sprawling cities and income inequalities, especially compared to studies conducted in the West. The reason for the nationwide gap may be that transport poverty is a relatively new issue in China. Problems such as income gaps, the position of women in society, an aging population and urban sprawl have yet to be associated with transport poverty and inequality. Although Chinese cities have spent significant amounts of money to improve transport infrastructure, these investments are framed as benefiting everyone equally. Awareness of group-specific benefits and disadvantages seems to be lacking. The presence of social inequality, disadvantage and exclusion are not impacts of urban development that

a communist nation would openly want to measure or admitted. The lack of research on transport poverty can also simply be due to the in conducting extensive field observations.

The analysis provided in this paper is based on a review of 62 publications, most of them set in first-tier Chinese cities. Based on these studies, we were able to discern the main causes and impacts of transport poverty among low-income residents in Chinese cities. Common causes can be categorized into individual, spatial and institutional factors, which include: a lack of access to private vehicles; uneven access to alternative transport options and inadequate public transport provision; jobs-housing imbalance; and the *hukou* system. Meanwhile, the main impacts of transport poverty, categorized into mobility, accessibility and health are: restrained mobility and longer travel times; higher household expenditures on travel; curtailed access to jobs and essential services; higher household expenditures on travel; and health and environmental issues.

Based on the number of articles that focused on each theme, respectively, some causes and impacts were discussed more than others. Lack of private vehicles among low-income groups was the most frequently discussed cause since it plays a significant role in determining transport poverty in China. This is in line with the findings from many studies conducted in the West [97–100]. Considering that the car industry is still booming in China, this issue might even affect the low-income workers even further. Car ownership has increased rapidly in the last two decades in China. However, compared to the US, the current motorization in China is only the same as the level of the US in the 1920s, which shows the great gap between Chinese and other developed countries' motorization, and therefore, many have suggested the trend of motorization in China will continue despite the policies imposed by national and local government to restrain the use of private vehicles [101]. Beyond their functional purposes, cars have also become a social status for Chinese car users [102]. Since income level is considerably related to car ownership, the income inequality in China may result in an increasing car ownership gap between the rich and the poor [40]. As an important factor related to transport poverty, the lack of private vehicles among low-income workers can directly lead to a range of social exclusions [10]. Due to their retrained mobility for using slower transport alternatives and longer distance, low-income residents may find it difficult to access jobs, shopping and other leisure activities [10].

The institutional factor, the *hukou* system, plays a significant role in transport inequality in Chinese cities, which is a unique feature that can exacerbate transport disadvantages for low-income migrant workers in China. The *hukou* system excludes migrants from affordable housing and other services, and the isolation can create a social barrier and affect those low-income migrant workers' daily commuting and other aspects of their life. On the other hand, studies set in developed countries seem to focus on immigrants from foreign countries and their personal preferences or cultural differences on travel demand [103]. In some post-communist countries in Europe, rural migrants, women in particular, find in difficult to adjust their travel patterns to a new urban life [104]. A spatial mismatch exists in both China and Western countries. The job-housing imbalance has been considered the most important determinant of transport advantage for low-income residents in western countries [105]. However, job decentralization has been considered one of the main reasons that contribute to spatial mismatch in the West [106], while in China, it is mainly caused by the rapid gentrification in the urban centers, along with rapid urban sprawl [8]. As a result, low-income residents are moving out into the suburbs where the housing price is lower but away from employment, which results in a job-housing imbalance for the urban poor.

In terms of the impacts, the majority of the studies focused on accessibility and mobility. This finding is similar to studies in developed countries since accessibility and mobility are the main dimensions of transport poverty impacts [15]. Since the low-income workers tend to live in the suburbs and the transport options are limited, they may have to experience longer travel time to access employment and services or facilities [67]. For instance, low-income residents may have less access to medical services due to their disadvantaged locations [39]. Therefore, the urban poor may face social exclusion, which

can also affect their general well-being and life opportunities [67]. However, the number of studies that were conducted in small cities or regional areas is still scarce and considering the population and income levels in these areas, transport poverty might be more severe and need to be addressed. Therefore, a multidimensional and multilayered framework of transport poverty has yet to be created for Chinese cities due to the characteristics of urban China and the unique institutional factors.

Environmental factors appear to be significant in transport poverty. Due to a disadvantaged housing location and longer commuting times, low-income groups tend to experience more health issues. They are more exposed to air and noise pollution than wealthier groups [15]. However, this environmental justice aspect has been rarely investigated in Chinese cities, notwithstanding the fact that here, air pollution has reached a critical stage. The question of whether socioeconomically disadvantaged groups are more vulnerable to pollution exposure due to transport inequality is yet to be addressed. However, existing research has established that daily commuting is a main contributor to air pollution as motorized transport is favored in China [107]. Conversely, transport-related pollution is damaging and has been shown to have adverse health impacts on Chinese commuters overall [107]. Moreover, it may impede further economic growth [108]. Although the Chinese government has implemented a number of policies to tackle this issue, more actions are still required. In comparison with the framework provided by Lucas [10], this systematic review only focused on low-income from the social disadvantage dimension, and the associated transport disadvantages of *no car*, *poor public transport services* and *high costs.* It is worth noting that *information and crime* were seldom mentioned in the 62 studies. In terms of accessibility, this review has explained life chances, goods and services, but no articles were found that related to *social-networks*, *social capital* or *decision-making*. Western countries take social capital as a significant component that is associated with transport poverty to address social exclusion, while this aspect is rarely found in studies conducted in Chinese studies. Lucas [10] points out inaccessibility to social network and social capital can be a consequence of transport poverty. Frei et al. [109] argues due to its flexibility, high-income residents with private vehicles are less restricted to physical location, and hence have a stronger social network. This is in accordance with a study in Swiss cities, which shows disadvantaged groups with lower mobility have lower access to social capital [110]. When our findings are overlaid to the Lucas framework, a partial match emerges. This suggests that future research needs to be done to tackle these under-discussed topics, especially social aspects that are caused by transport poverty. Additionally, since this study is only related to income levels, studies on the transport inequalities experienced by women and the elderly need a comprehensive review—especially given China's context of (re)emerging gender inequalities [111] and an aging society [112].

Low-income groups may not only be experiencing a range of transport poverty issues but are also associated with a high level of transport vulnerability [113]. The concept of transport vulnerability goes hand in hand with transport resilience, which refers to the transport system's ability to adapt when exposed to threats and risks. The risks can range from natural disasters, such as flooding, to social or economic impacts. These risks can create transport-related uncertainties and insecurities among the urban poor, which, in the long term, could have negative impact on the low-income groups due to their lack of strategic solutions [114]. Friend and Moench [114] also point out, due to the housing location of low-income groups, the longer travel time to jobs and essentials can leave them more exposed to these threats and risks.

Transport inequality issues exist in China but are often neglected in transport planning policy. To improve transport equality in China, the first step is to recognize, at a social and policy level, that transport poverty is now a reality affecting millions of people. It cannot be alleviated through small-scale community responses and will require a concerted whole of government effort. Interventions will need to focus on both urban transport and land use. First, transport policies should focus on promoting and adding transport alternatives options for residents. As the most essential transport mode, public transport should be

accessible and convenient, especially for those who live in disadvantaged communities. The development of the public transport system must be prioritized in major Chinese cities, and the government could provide a range of incentives for the vulnerable groups. Bike sharing, as the feeder to major public transport hubs, should also be conveniently located for the low-income groups, and the urban poor should be encouraged to use shared bikes. Second, the supply of affordable/public housing should realize affordable housing is not only about low-cost but also livability. Since affordable housing is seemingly located on the urban fringes and often lack accessibility and sufficient amenity, the residents are facing limited access to jobs and essential services. Therefore, when developing affordable housing, policymakers should take location into consideration and ensure affordable housing is not built in the least desirable neighborhoods. Other basic infrastructure and amenities should also meet low-income groups' needs so that these residents would not be socially excluded from transport and other essential services. More importantly, affordable housing should be open to migrants without local *hukou* to ensure their needs can be met. In addition, mix land use development may be effective for improving accessibility for low-income residents by providing job opportunities and services locally. Third, Zhao and Bai [40] emphasize the importance of transport policies on reducing car ownership, such as congestion fees and license auctions, and that can help mitigate transport-related inequality issues caused by car ownership. However, there is also a chance that these policies can contribute to greater inequality since these policies may not affect car ownership among wealthy households but limit socioeconomically disadvantaged workers' chances to own private vehicles instead. As a result, households, who may have a greater need for cars, such as families with children, cannot benefit from the policy. Therefore, policymakers should consider contextual constraints and implement measures to reduce car usage. However, in order to address a 'cure,' the root cause of transport poverty—socioeconomic inequality—will need to be addressed.

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