Literature Review

No.17 April 2022

JICA Ogata Sadako Research Institute for Peace and Development

Transport and Equity: Toward Inclusive Transport Development

SDGs 2030 target 11.2 aims at providing "access to safe, affordable, accessible and sustainable transport systems for all, improving road safety, notably by expanding public transport, with special attention to the needs of those in vulnerable situations, women, children, persons with disabilities and older persons" by 2030. This vulnerable population also includes low-income people, especially in the context of developing countries. In developing countries' cities, poverty is likely to be concentrated in the urban periphery far from the CBD (Central Business District) where jobs and other activities are concentrated. Thus, one of the goals of investment in public transport is to reduce these spatial and social inequalities by improving accessibility to jobs and other opportunities for vulnerable populations. This literature review aims to summarize recent empirical evidence on urban transport and equity in developing countries as well as to introduce the theoretical foundations of transport equity so that gaps for further research may be identified. Overall, the existing literature reveals that it is mainly lower-income segments that are likely to be disadvantaged as measured by potential accessibility. Possible factors underlying this transport inequality may include disadvantageous fare structures for lower-income populations and so on, but the mechanism behind this depends on its context in each city. These consequences may relate to the traditional appraisal methodologies for transport projects that highlight economic efficiency. To plan and design more inclusive transport projects, further studies including improving appraisal methodologies focusing more on equity aspects are necessary. In this regard, this literature review identifies research gaps including differing methodological points of view in the transport projects. Filling these gaps would also contribute to planning more inclusive transport projects from a practical point of view.

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[1] I am grateful to Noriaki Nishimiya (Hokkaido University of Education/Oriental Consultants Global), Hirohisa Kawaguchi (Oriental Consultants Global), Yuma Tsumura (Oriental Consultants Global), Naoki Murayama (Oriental Consultants Global), and Yurie Hirabayashi (JICA Sri Lanka Office) for their constructive comments on this literature review. I also thank that members of JICA Transport Knowledge Management Network (KMN) and Urban and Regional Development KMN, especially Yukihiro Koizumi (Transport KMN manager), Keisuke Fukuta (Transport KMN secretariat), and Masato Ashino (Transport KMN secretariat), for setting up a meeting to obtain feedback on the draft of this literature review, and their strong support in other ways.

Table of Contents

1. Introduction

Transport has a variety of economic and social impacts such as alleviation of urban traffic congestion and expanded access to various services, and furthermore contributes to developing the capacity to realize indivual and group potentials as shown in Figure 1 (Japan International Cooperation Agency, 2004). In the context of COVID-19, addressing vulnerabilities in society is focused across all sectors. For the transport sector, the SDGs 2030 target 11.2 aims at providing, by 2030, "access to safe, affordable, accessible and sustainable transport systems for all, improving road safety, notably by expanding public transport, with special attention to the needs of those in vulnerable situations, women, children, persons with disabilities and older persons" (United Nations, 2021). Reflecting the context of developing countries' cities, urban poverty is likely to be concentrated in the urban periphery far from the CBD (Central Business District) where jobs and other activities are accumulated (Oviedo et al., 2019). This leads to longer travel times for vulnerable people such as lower income populations to reach jobs, and thus could contribute to increasing unemployment (Kain, 1992). For other services like educational and health-care facilities, in Africa there is a significant spatial inequality in accessibility to these facilities ("people are accessibility poor") within the peripheral neighborhoods where the poorest residents often settle (World Bank, 2021; AIGA & KARLA, 2021). These vulnerable populations are often captive users of public transport, including the so called "para-transit" or those having to rely on non-motorized travel, and thus their travel expenditure is likely to account for a significant percentage of their income (Van Wee & Geurs, 2011). Furthermore, women have fewer travel opportunities due to the mobility barriers placed on them in accessing and using transport, and this could have a significant negative impact on a country's economic growth potential (NATO et al., 2021). As a result, higher travel expenditures (tangible and/or intangible barriers) and longer travel times could lead to social exclusion among those vulnerable household members.

Thus, one of the goals of investment in public transit such as a Metro, LRT[2], BRT[3], and so on, is to reduce these spatial and social inequalities by improving accessibility to jobs and other opportunities for vulnerable populations. However, equity considerations in transport planning has not usually been sufficient in previous studies, and appraisal methods have also not adequately reflected transport equity issues (Di Ciommo & Shiftan, 2017). In the academic context, research that measures the distribution of accessibility benefits (improvements in accessibility due to public transit development) among different socio-economic groups including vulnerable populations has been relatively limited compared to research on the general impact of public transit systems. Nonetheless, recent research is providing emerging evidence on accessibility for urban vulnerable citizens even in the developing country context.

This literature review is divided into five sections. Following this introduction, section 2 introduces the theoretical foundations of transport equity. Then, section 3 summarizes the overview of recent empirical

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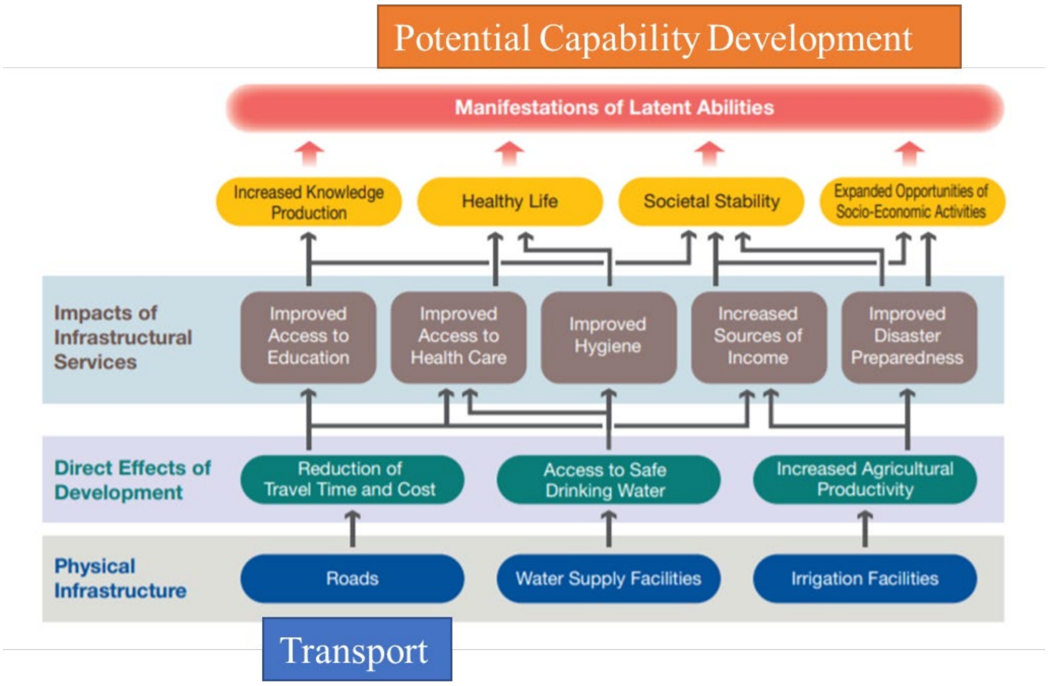
[2] Light Railway Transit.
[3] Bus Rapid Transit.

evidence on urban mass-public transport and equity issues in developing countries, mainly measured by potential accessibility. Based on the previous sections, section 4 identifies gaps for further research, especially from the view point of the methodology of urban transport project appraisal considering equity issues. Lastly, section 5 is the conclusion. This literature review also contributes to the discussion on project design for more inclusive transport projects from the practical point of view for governments and/or international development institutes.



Source: Japan International Cooperation Agency (2004) as modified by the author.

Figure 1: Transport and capability development

2. Theoretical foundation of transport equity

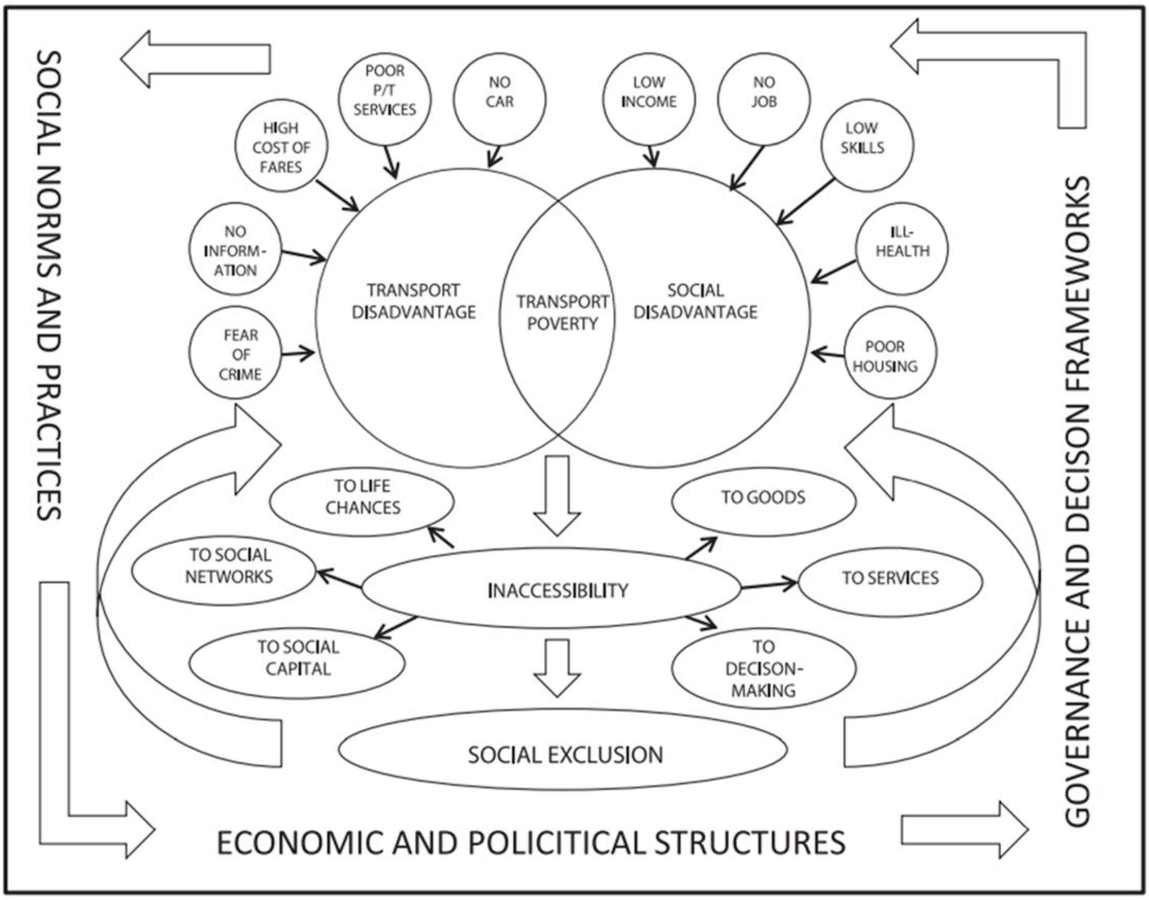
2.1 The theoretical conceptualization progress from transport-related social exclusion to transport inequity

Transport inequality (sometimes called transport disadvantage or transport poverty) is not a new concept in the transportation literature (Lucas, 2012). For instance, Wachs and Kumagai (1973) suggest that transport is one of the important and decisive factors in social and economic inequality in the US, and Banister and Hall (1981) claim that transport plays an important role in determining social outcomes in the UK context. When transport inequity or disadvantage is considered, it is used as a key to adopt the social exclusion concept (Lucas, 2012). Although numerous definitions of social exclusion exist, there is wide consensus that social exclusion is beyond the concept of poverty, and thus is a multidimensional, multilayered, and dynamic concept of deprivation, involving lack of resources, rights, goods, services, and the inability to participate in the normal relationships and activities available for the majority of the population (Levitas et al., 2007). Lucas (2012) argues that the social exclusion approach is relevant to transport inequality since transport is multidimensional (transport inequity can be seen in both the individual dimension and institutional or structural dimensions within the wider society), relational (transport inequity can be seen in comparison with normal relationships and activities), and dynamic (transport inequity is changeable over time and space). Furthermore, the social exclusion concept focuses on not only the experience of transport disadvantage itself but also on the economic and social outcomes of transport disadvantage (Lucas, 2012). The social exclusion approach acknowledges that it is difficult for vulnerable people to participate fully in society (social disadvantage) due to barriers (Stanley & Lucas, 2008), including a lack of employment, suitable housing, education, health care, and transport (Venter et al., 2018). In this context, transport-related social exclusion[4] emphasizes the relationship between the lack of public transportation (factors lie within the structure of the local area) and age, disability, gender, and race (factors lie within the individual). Figure 2 shows the relationship between transport disadvantage, social disadvantage, and social exclusion. The combination between transport disadvantage and social disadvantage could lead to social exclusion as a result of lower accessibilities to various opportunities.

According to Lucas (2012), the transport-related social exclusion has three perspectives to be addressed by transport and/or urban developments and relevant-policy measures (Grieco, 2006). First are the accessibility perspectives, which include place-based measures (providing transport services in the immediate area where a person lives), social-category based measures (identifying those groups in communities with transport needs), and person-based measures (identifying individual public transport users who have travel needs). Second are the social capital and capability perspectives. These perspectives focus on how transport shapes wider societal values and norms, and reinforces existing social stratification (Urry, 2007). Moreover, these perspectives have three layers; access (the range of available mobility), competence (skills and abilities to appropriate access), and appropriation (how individuals, groups interpret and act upon access and competence as mentioned above) (Kaufmann et al., 2004). The third perspective is time geography. Over the last fifty years, the structural changes in society have led to new inequalities particularly for working women with children (Priya Uteng, 2009). This inequality is time-poverty based exclusion due to tight schedules, multi-tasking, and multi-responsibilities for them

[4] The concept of transport-related social exclusion has also several definitions. For instance, Kenyon et al. (2003, p. 210) defines the concept as "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." On the other hand, Church et al. (2000) note that the concept has seven features contributing to the further exclusion of certain population groups: physical exclusion (vehicle design, lack of disabled facilities or timetable, and so on), geographical exclusion (such as rural areas or urban peripheral areas), exclusion from facilities (the distance from key facilities including shops, schools, healthcare or leisure services), economic exclusion (higher monetary costs of travel to employment or facilities), time-based exclusion (reducing time available for travel due to other demands including household and childcare duties), fear-based exclusion (fears for personal safety on transport services), and space exclusion (security or space management rules preventing certain groups from accessing places such as the first class waiting rooms at stations).

particularly living in the urban periphery (Lucas, 2004). In this case, transport disadvantage may be a self-enforced phenomena rather than an externally-imposed physical isolation and exclusion (Currie et al., 2010). On the basis of these theoretical backgrounds, "accessibility" is a key factor in transport equity analysis (Oviedo et al., 2019), and is explained in the next section.



Source: Lucas (2012)

Figure 2: The relationship between transport disadvantage, social disadvantage, and social exclusion

2.2 Accessibility as a key factor in transport equity analysis

According to Kamruzzaman et al. (2016), four groups of transport disadvantage measures can be observed in relation to accessibility: deprivation-based measures (focus on the levels of deprivation), mobility-based measures (focus on individuals, groups, or areas with decreased mobility options by examining indicators such as car-ownership), accessibility-based measures (focus on the movement opportunities that are available within a certain distance or travel time), and activity-based measures (focus on participation in different activities). Among these, the accessibility-based measures are often used for empirical research in the context of developing countries. Accessibility has diverse definitions.

The well-known definition of Hansen (1959) is based on the potentially available opportunities for an individual and/or groups in a certain location. Other definitions include the available opportunities enabling individuals to participate in particular activities when considering activity-based travel (Dong et al., 2006) or the capacity of a location to be reached from different locations through transport (Dalvi & Martin, 1976). According to Geurs and Wee (2004), the four main components in accessibility are: (1) land-use which refers to the quantity, quality and distribution in space of opportunities including jobs, shops, healthcare, and social recreational facilities; (2) transport which means the features of the transport system; (3) time, which reflects time constraints including the availability of opportunities during the day and the time available for such opportunities; and (4) individuals, which reflects the needs, abilities and opportunities influencing their levels of access to transport. The combinations among these four components produces differentiated levels of accessibility by mode, location, social groups, and activity (Geurs & Wee, 2004). The focus on the different components of accessibility leads to various indicators and methodologies for its measurement, however, the dominant approaches are infrastructure-based measures, location-based measures, and individual-based measures (Wee et al., 2013). A major example of measurement of transport accessibilities to opportunities is accessibility to employment. Three dynamic relationships between jobs, housing and transport are: the distance between housing and jobs, the availability of transport and its cost, and the availability of disposable income to pay for it (Titheridge et al., 2014).

The most important approach to the analysis of transport equity is to identify the distribution of accessibility between different social groups and geographical areas (Lucas et al., 2015), since traditional transport policies generally overlook distribution effects and how transports affect the travel capacity of different groups of population in urban areas (Guzman et al., 2017). On the other hand, another approach is analyzing accessibility equity, which means providing equitable transport for all the inhabitants of cities (van Wee & Handy, 2016). Furthermore, equity in transport has two definitions; first is horizontal equity requiring transport benefits to be allocated equally to groups or individuals (Litman, 2018). The horizontal equity approach is usually suitable for mass-transit that is aiming to maximize the number of transported people in an efficient way (Delbosc & Currie, 2011). The second is vertical equity, implying that disadvantaged groups or individuals must be identified in transport development policies to improve their current condition (Litman, 2018). Major examples of the existing empirical literature on transport and equity can be found in the evaluation of particular transport projects or the whole transport system in a city by addressing equity issues (Lucas et al., 2015). Moreover, the recent literature includes the use of Lorenz curves and Gini-indexes for assessing transport (vertical) equity, which is a suitable approach to policy-related topics such as tariff subsidies (Guimarães et al., 2020). A typical method to evaluate accessibility is measuring potential accessibility as shown in equation (1).

$$A_i^m = \sum_j O_j \exp(-\beta_i^m C_{ij}^m) \quad (1)$$

$$where\ C_{ij}^m = t_{ij}^m + {c_{ij}^m}/{VOT}$$

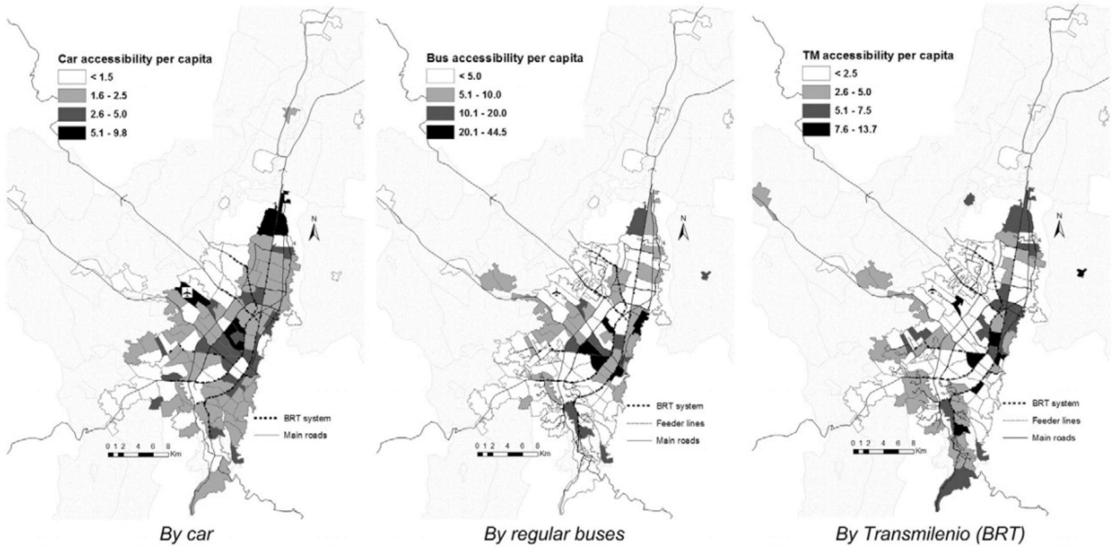
In equation (1), A_i^m is the potential accessibility of the zone i to the transport mode m, O_j is the opportunities available at the destination (workplace, school, etc), C_{ij}^m represents the generalized transport cost between zones i and j, and β_i^m is a calibration parameter of zone i transport mode m. Also, in the equation (1), t_{ij}^m is the travel time on transport mode m between i and j, c_{ij}^m is the monetary cost of transport mode m between i and j, and VOT is the average time of value in the study area, respectively.

3. Existing empirical research on transport equity in the context of urban transport projects in developing countries

This section summarizes existing empirical research on urban transport equity in the context of developing countries, focusing on empirical studies (quantitative studies) that provide evidence using mainly the accessibility approach as well as the methodology used in urban transport project evaluation of equity issues.

3.1 Empirical evidence on transport equity in the context of urban transport projects in developing countries

The typical empirical research on transport equity in developing countries analyzes the equity in accessibility to employment and education across different geographical settings provided by transport systems. Guzman et al. (2017) explore the equity level of accessibility to employment and education in Bogota, the capital-city of Colombia, using data from 2011. In their study of horizontal accessibility across the Bogota city-region, they found that this is unevenly distributed and higher in the central-area rather than in the urban periphery across different transport modes including Car, Bus, and BRT (See Figure 3).

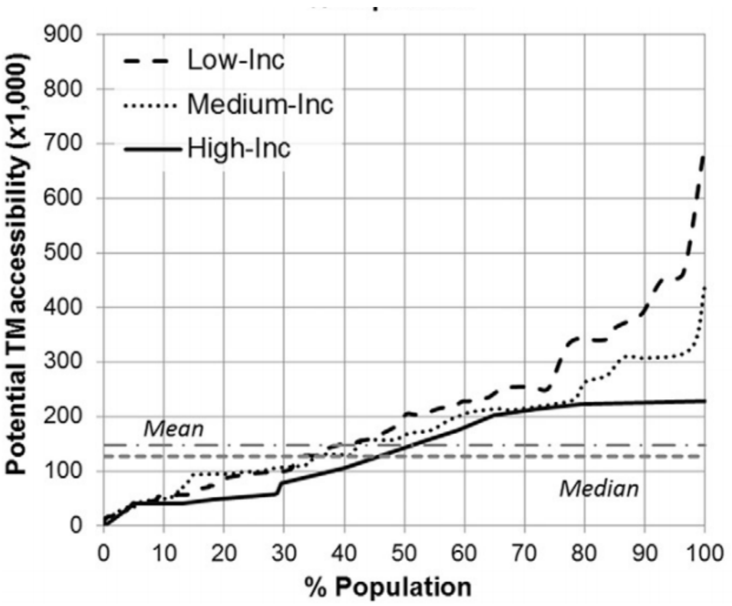


Source : Guzman et al. (2017).

Figure 3: Potential accessibility per capita in Bogota

On the other hand, in respect of vertical equity across different income groups they also found different trends according to transport modes. While access to cars is evenly distributed in high-income segments of the population, it is unevenly distributed in low and medium-income segments (about 70 % of the population of these two-income groups experience higher car accessibility). By contrast, the higher accessibility allowed by buses and the BRT is concentrated in small numbers of the low and middle-income groups only (e.g. about 20 % of low and medium income groups experience significantly higher accessibility to BRT, see Figure 4). Overall, the low-income population is significantly disadvantaged in terms of accessibility to bus and BRT compared to wealthier groups (Guzman et al., 2017). Furthermore, Guzman et al. (2018) updates the analysis on accessibility to jobs in Bogota with data from 2015 after a new public transport system had been gradually implemented. The result shows that this improvement in public transport still fails to improve accessibility especially for low-income residents; rather it reinforces the accessibility gaps between rich and poor.

Guimarães et al. (2020) study the case of accessibility to jobs in Medellin in Colombia under a vertical equity approach and reveal that better accessibility is distributed to higher income groups rather than low-income groups, even though higher income groups are not meant to be the beneficiaries of subsidy policies. As an example of the research on measuring accessibility change by a specific public transport project, Oviedo et al. (2019) examines the contribution of BRT in Lima, Peru on the accessibility to employment with difference-in-difference method. The result shows the positive effects of BRT on accessibility is only for higher-income areas. More specifically, in the higher socioeconomic area within the BRT surrounding zone, accessibility increased due to the BRT. In contrast, in the lower socioeconomic area within the BRT surrounding zone, accessibility decreased due to the BRT (Oviedo et al., 2019). Oviedo et al. (2019) discuss three possible factors underlying this transport inequality. First, the fare structure of the newly developed BRT brought an increase in total travel costs for public-transit users, which limits lower-income population travel and reinforces social exclusion. Second, the BRT network serves the highest transport demand area according to traditional transport planning principles. Thus, the BRT may contribute to the consolidation of the connectivity within already higher-value areas in the city, rather than strengthening the travel pattern between the urban peripheral and the city center. Third, middle or higher income populations might live closer to the BRT, and thus the connectivity benefit due to the BRT development for lower-income population may be limited. In addition, Oviedo and Guzman (2020) explore the equity of accessibility among different socio-economic groups for non-commuting (not mandatory) travel such as healthcare services, shopping, leisure, or meeting friends in Bogota. They found that on average, low-and-middle income areas have higher accessibility than high-income areas in both public and private transport (Oviedo & Guzman, 2020). This result (transport equity for non-mandatory trips such as leisure) is in contrast with the result of Oviedo et al. (2019) (transport equity for mandatory trips such as for employment and education). According to Oviedo and Guzman (2020), the possible underlying reasons for this contrast are the different travel mechanisms for non-mandatory trips between higher and lower-income groups. More specifically, while higher-income groups make longer non-mandatory trips than lower-income groups by car or other transport modes, lower-income groups make shorter non-mandatory travel via walking and cycling.



Source: Guzman et al. (2017).

Figure 4: Accessibility to work/study by BRT and income group in Bogota

The remainder of the empirical research on transport equity has studied various outcomes of transport provision among different socio-economic groups. One area is the research exploring the causal relationships between urban transport investment and the employment outcomes among different genders. According to Martinez et al. (2018), the BRT in Lima, Peru brought large improvements in employment and earnings per hour among women, but not for men. Seki and Yamada (2020) suggest that proximity to the Delhi Metro in India shows an increased trend in the female work participation ratio, but in contrast, it is ambiguous for the male work participation ratio. Furthermore, Bautista-Hernández (2021) analyses the difference on commute time for different transport mode (car or transit) and educational background (college or non-college) in Mexico City, and shows that transit users in lower socioeconomic categories tend to experience longer commute times. In contrast, commuting time for car users shows limited differences according to socioeconomic level. Falavigna and Hernandez (2016) analyze the public transport affordability among different income groups in Cordoba, Argentina and Montevideo, Uruguay. They calculate the observed affordability index based on the expenditure for observed public transport trips in total income. They also calculate the potential affordability index considering middle class groups as a benchmark since the observed affordability index may not represent non-performed trips due to the financial constraints on the poorest groups. The result shows that the differences between the observed affordability index and the potential affordability index for lowest income groups are 44.1% in Cordoba, and 40.5% in Montevideo, respectively. This implies significant financial burden is an obstacle to accessibility for lower-income groups.

Table 1 summarizes the empirical evidence on urban transport equity in developing country cities where urban poverty is relatively concentrated in the urban periphery. Overall, the existing literature reveals that lower-income segments are the main ones likely to be disadvantaged. Underlying components of this unequal transport accessibility vary according to the context of projects, transport systems, or socio-economic structure of each city. For example, in the case of Lima, Oviedo et al. (2019) discuss possible factors underlying the transport inequality including a disadvantageous fare structure on the newly developed BRT for lower-income populations, The BRT network serving highest transport demand areas, the uneven connectivity benefit of BRT due to different living areas according to different socio-economic groups (middle or higher income populations might live closer to the BRT). Those negative consequences for social equity are similarily observed in other cities (Bocarejo et al., 2016; Guzman et al., 2017; Linovski et al., 2018; Venter et al., 2018). Geographically speaking, the existing studies mainly analyze cities in Latin-American countries. This is due to the fact that Latin American cities are highly unequal ones, and transport is one of the causes of such structural imbalance (Vecchio et al., 2020).

Table 1: Summary of empirical evidence on urban transport equity in the developing countries

Literature	Location	Targeted transport	Indicators	Results
Guzman et al (2017)	Bogota	Car, Bus, and BRT	Potential accessibility to employment and education	Low-income population is significantly disadvantaged
Guzman et al. (2018)	Bogota	Upgrade public transport (BRT and Bus)	(Traditional) Accessibility to employment	Public transport improvement still fails to improve accessibility especially for low-income residents
Guimarães et al. (2020)	Medellin	Whole transport system	Potential accessibility to employment	Better accessibility is distributed to higher income groups rather than low-income groups
Oviedo et al. (2019)	Lima	BRT	Potential accessibility to employment with the difference-in-difference method	The positive effects of BRT on accessibility only for higher-income areas is observed
Oviedo and Guzman (2020)	Bogota	Car and Public transport	Potential accessibility to non-commuting travel	Low-and-middle income areas have higher accessibility to both public and private transport
Martinez et al. (2018)	Lima	BRT	Employment and earnings with the difference-in-difference method	Large improvements in employment and earnings among women are observed
Seki and Yamada (2020)	Delhi	Metro	Work participation ratio with the difference-in-difference method	An increasing trend in the female work participation ratio is observed

Bautista-Hernández (2021)	Mexico City	Car and public-transit	Differences in commuting time according to the educational background	Transit users in lower socioeconomic categories tend to experience longer commuting time
Falavigna and Hernandez (2016)	Cordoba and Montevideo	Public transport	Observed affordability index (public transport expenditure in total income and the potential affordability index)	Differences between the observed affordability index and the potential affordability index for lowest income groups are significant

Source: The Author.

3.2 Methodological research for project evaluation considering equity

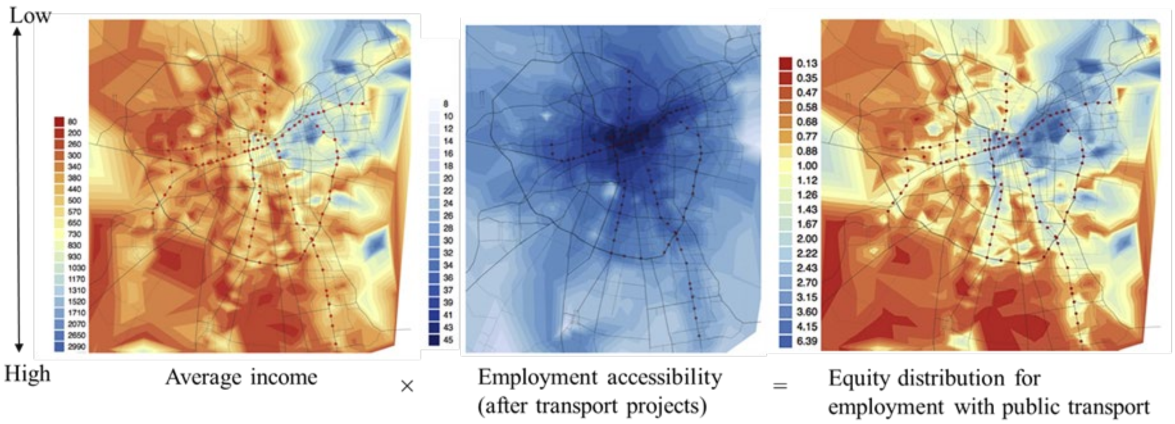
Traditional appraisal methodologies for transport projects are based on economic efficiency, often represented by savings in travel time (Niehaus et al., 2016). This method is usually called Cost Benefit Analysis (CBA) and is the widely accepted standard in transport project. However, CBA usually does not evaluate the welfare gains or losses of specific groups or people due to transport projects[5], and thus is limited when considering equity aspects in transport projects evaluation (Nahmias-Biran & Shiftan, 2019). Moreover, CBA could bring an optimism bias favoring higher-income groups, and thus the public transport projects, which primarily benefits higher income groups, are more likely to be selected as priority projects (Nahmias-Biran & Shiftan, 2019). In this context, Niehaus et al. (2016) propose an index to evaluate equitable accessibility impacts by transport projects parallel to traditional CBA. This index multiplies income inequality and potential accessibility, which illustrates accessibility gaps and their distribution in the city. They propose two indexes of equitable accessibility contribution by public transport projects as shown in equation (3) and (4). Figure 5 is an example of the indexes as used in a public transport project in Santiago, Chile.

$$Proposed\ index\ (1)\ of\ equitable\ accessibility\ contribution = \sum_{\mathrm{SEG}}^{n} \frac{\text{Potential accessibility } (after\ projects)_{SEG}}{Baseline\ potential\ accessibility_{SEG}} \quad (3)$$

[5] Theoretically, the welfare gains or losses of specific groups or individuals can be evaluated using the benefit incidence table approach. However, as an accepted standard, this evaluation is normally conducted in an aggregated manner (not for specific groups or people) due to the technical difficulties in carrying it out.

$$\textit{Proposed index (2) of equitable accessibility contribution}$$

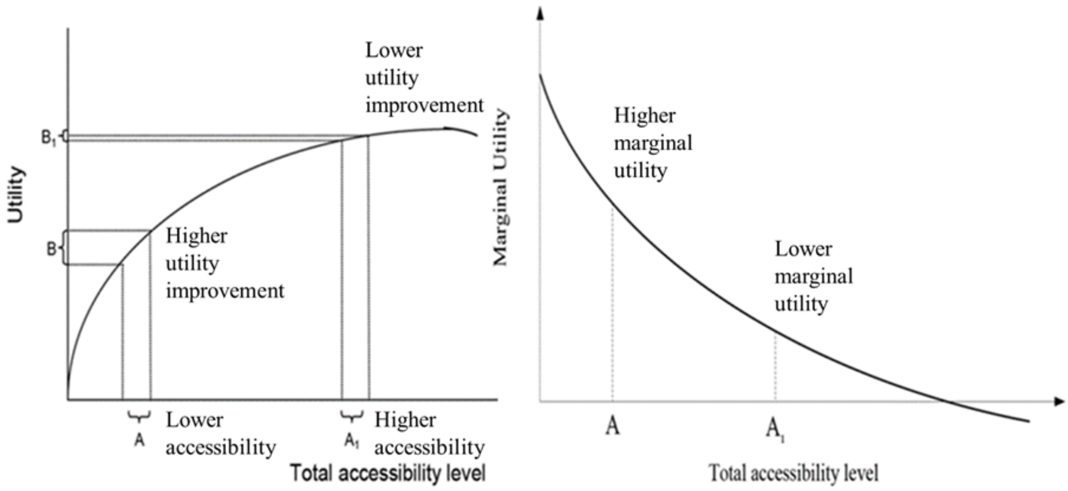
$$= \frac{\sum_{\substack{Lower\\income\\SEG}} \text{Potential accessibility } (after\ projects)_{Lower\ income\ SEG} * \text{Househologs income}_{\text{Lower income SEG}}}{\sum_{\substack{Higher\\income\\SEG}} \text{Potential accessibility } (after\ projects)_{Higher\ income\ SEG} * Househologs\ income_{Higher\ Income\ SEG}} \quad (4)$$



Source: Niehaus et al. (2016)

Figure 5: Image of the index to evaluate equitable accessibility with the public transport project in Santiago, Chile

Nahmias-Biran and Shiftan (2019) also propose that "Value of Capability gains" (VOC) to evaluate both efficiency and equity in the CBA. The VOC measure is based on the widely-known capability approach argued by Sen (1985). Since VOC focuses on individual level outcomes, the activity-based models are employed to assess individual traveler capabilities under different transport improvement conditions. Martens (2011) also argues the capability gains according to different levels of accessibility from the theoretical point of view. As shown in Figure 6, persons with initially lower levels of accessibility (vulnerable people including lower income groups) will gain more additional utility than persons with initial higher level of accessibility (Martens, 2011). In other words, persons with initial lower levels of accessibility will have higher marginal utility. Monetizing the sum of all utility gains due to the transport projects can be VOC. Nahmias-Biran and Shiftan (2019) build a theoretical framework for the appraisal of transport projects incorporating equity aspects with the capability concept, however they also point out that their framework is still in the conceptual stage, thus further research is needed for its practical use.



Source: Martens (2011).

Figure 6: Capability gains of persons with different level of accessibility

4. Identifying gaps for further research

Based on the review of existing research in the previous sections, this section explains the gaps for further research. The gaps identified here are based on the author's preferences, especially focusing on the international development practitioner's need to promote the planning and implementation of further inclusive transport projects.

Baseline study for transport equity without possible selection biases

In terms of transport project design and/or appraisal, a focus is the change of accessibility benefits among different population groups within a city. This will be usually the comparative analysis of equity distribution with the intervention of proposed transport projects and the baseline. However, some existing studies investigate the accessibility equity by targeting a city where the mass-public transport already exists. For instance, Guzman et al (2017), Guzman et al. (2018), and Oviedo and Guzman (2020) investigate the accessibility equity after the completion of Bogota or Lima city's BRT systems. No studies investigate the accessibility equity during the time before the completion of the BRT. Given that a mass-transit system might be more likely to be developed in area where a relatively higher-income population resides to secure enough ridership for the financial sustainability of the mass-transit, these studies may involve selection bias. Thus, conducting baseline studies for transport equity (before the introduction of a mass-transit system) without selection bias is necessary to more accurately grasp the equity distribution changes resulting from a transport project.

The operational framework for project design, monitoring, and evaluations with equity consideration considering the developing country context

Some existing research proposes methodology and indicators that consider transport equity (Niehaus et al., 2016: Nahmias-Biran & Shiftan, 2019). However, these are not yet widely accepted as standard due to some limitations. Further studies aiming to overcome the limitation in proposing alternative indicators or methodology, are required. These efforts could contribute to building the operational (practical) framework for project design, monitoring, and evaluation with equity consideration. It is also noted that these frameworks should reflect the context of cities in developing countries (lack of data, and so on), and thus are expected to be as simple and practical as possible.

The impact of transport-related technological development on equity

The existing literature studies the relationships between the traditional transport modes (mass-transit, bus, private car, and so on) and equity issues. However, as Lucas (2019) argues, transport innovations including autonomous vehicles, robotic deliveries, shared mobility and mobility as a service (MaaS) may affect the future equity of mobility and accessibility. Currently, there are both optimistic (technologies will allow more people to have new access) and pessimistic (concentration of transport advantage amongst higher-income residents) views (Lucas, 2019). Hence, the impact of transport-related technological development on equity in the context of developing countries is also one of the future research areas of importance.

Causal relationships and inequitable transport accessibility

The existing literature analyzes transport equity and illustrates how accessibility benefits are distributed evenly or unevenly. However, the causal relationships between a particular transport investment and observable transport inequity are rarely investigated. As Takada et al. (2021) in their study of the causal impacts of rural rode development on household income in Cambodia show, the analysis of causal relationships on inequitable transport accessibility is necessary.

Guiding principles to balance between efficiency (profitability) and equity (inclusiveness) for transport projects appraisal

When-to decision making for project design on urban mass-transit investment, balancing efficiency (profitability) and equity (inclusiveness), is critical. However, in the context of a mass-transit system, this balance is a delicate issue because the mass-transits (especially railway or metro) are capital-intensive public goods. Haider and Badami (2004) argue that the fares required for profitable public transit might reduce the accessibility of low-income households due to the gap between public transit fare and affordable fare for lower-income residents. Prioritizing equity too much may not compensate for the unprofitability of a mass-transit system, and thus might be a risk for the financial sustainability of a system in the future. Some guiding principles on how to balance efficiency (profitability) and equity (inclusiveness) are necessary for project design of urban-mass transit systems. Since decision-making on how to balance between efficiency and equity in proposed projects is dependent on the local-context of each city these guiding principles are likely to include multi-criteria variables rather than single and universal ones.

5. Conclusions

The SDGs 2030 target 11.2 aims, by 2030, to provide "access to safe, affordable, accessible and sustainable transport systems for all, improving road safety, notably by expanding public transport, with special attention to the needs of those in vulnerable situations, women, children, persons with disabilities and older persons". This vulnerable population also includes low-income populations, especially in the context of developing countries. In developing country cities, poverty is likely to be concentrated in the urban periphery far from the CBD (Central Business District) where jobs and other activities are concentrated. Thus, one of the goals of investments in public transit is to reduce these spatial and social inequalities by improving accessibility to jobs and other opportunities for vulnerable populations. The literature review in this paper summarizes the recent empirical evidence on urban transport and equity in developing countries as well as introducing a theoretical foundation for transport equity to identify gaps for further research. Overall, the existing literature reveals that it is mainly the lower-income segments of a population that are likely to be disadvantaged as measured by potential accessibility. The mechanism for this depends on the context in each city, but possible factors underlying transport inequality may include disadvantageous fare structures for lower-income populations, the public transport network serving the highest transport demand area, or an uneven connectivity benefit from public transport due to different living areas and socio-economic groups. These consequences may relate to the traditional appraisal methodologies for transport projects that highlight economic efficiency, often represented by travel time saving. To plan and design more inclusive transport projects, further studies including improving appraisal methodologies are necessary. In this regard, the identified research gaps are baseline studies for transport equity without possible selection bias, the nature of operational frameworks for project design, monitoring, evaluations that include equity considerations, the impact of transport-related technological development on equity, other causal relationships affecting inequitable access to transport, and guiding principles for achieving a balance between efficiency (profitability) and equity (inclusiveness) for transport project appraisal. Filling in these gaps would also contribute to the ability to plan more inclusive transport projects from the practical point of view.

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要約

SDGs2030 のターゲット 11.2 は、「2030 年までに、脆弱な立場にある人々、女性、子ども、障害者、および高齢者のニーズに特に配慮し、公共交通機関の拡大などを通じた交通の安全性改善により、すべての人々に、安全かつ安価で容易に利用できる、持続可能な輸送システムへのアクセスを提供する。」であり、開発途上国の文脈では低所得者層も脆弱層に含まれる。開発途上国の都市においては、中心市街地から離れた周縁部に貧困層の居住が集中する傾向があり、公共交通投資の目的の一つは、脆弱層のアクセシビリティを向上させることで、空間的・社会的な不平等を緩和することにある。本開発協力文献レビューは、開発途上国の都市を対象とした交通と平等性に関する先行研究（定量的な実証研究）をレビューしている。先行研究では、ポテンシャル・アクセシビリティ等の指標を用いて、中南米地域の都市を中心に開発途上国の都市の交通と平等性に関し分析を行い、概して低所得者層等の脆弱層が不利な状況に置かれているとの結果が出ている。この背景として、都市ごとのコンテクストによるものの、想定される理由として、新規に整備される公共交通の運賃体系によっては低所得者層の交通費用がかえって増加する場合もあること等の可能性が考えられる。今後、より包摂的な交通プロジェクトを計画・実行していくためには、平等性をより加味した交通プロジェクトの計画や評価の枠組みの検討が必要であり、いくつかの先行研究では、交通平等性を踏まえた交通プロジェクトの評価指標や評価手法の提案を行っているが、実務での活用を見据えた更なる研究の蓄積を進め、包摂的な交通プロジェクトがさらに推進されることが期待される。