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# Mobility of Older Adults in Mexico City: A Mixed Methods Approach

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## Abstract

This dissertation covers the topic of the mobility of older adults in Mexico City using a mixed methods approach. First, I looked at the literature to uncover what is known about elderly mobilities coming from the Global South. Second, I analyzed the 2017 Household Origin Destination Survey to reveal travel behavior patterns and transport mode choice of older adults in Mexico City. Third, I revealed mobility experiences from older adults living in different neighborhoods in Mexico City by conducting twenty two telephone interviews. Lastly, I created joint displays that included both previous results to better understand how the findings from the interviews complement and corroborate the results from the survey. Conclusions included research contributions and limitations, opportunities for future research, and policy recommendations.



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# Mobility of Older Adults in Mexico City: A Mixed Methods Approach

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Jessica Villena Sanchez

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## Abstract

This dissertation covers the topic of the mobility of older adults in Mexico City using a mixed methods approach. First, I looked at the literature to uncover what is known about elderly mobilities coming from the Global South. Second, I analyzed the 2017 Household Origin Destination Survey to reveal travel behavior patterns and transport mode choice of older adults in Mexico City. Third, I revealed mobility experiences from older adults living in different neighborhoods in Mexico City by conducting twenty two telephone interviews. Lastly, I created joint displays that included both previous results to better understand how the findings from the interviews complement and corroborate the results from the survey. Conclusions included research contributions and limitations, opportunities for future research, and policy recommendations.

**Acknowledgements**

I want to acknowledge myself for all the hard work I put into successfully completing my PhD program. I am proud to be a part of the miniscule percentage of Mexican women who have earned a PhD degree from a Higher Education institution in the United States.

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# Chapter One: Introduction, Methods, and Structure of the Dissertation

## What do we know about aging mobilities?

Populations around the world are aging, fertility is declining, and people are living longer, and healthier lives compared to previous generations. According to Rosenbloom (2001), between 1998 and 2025 the world's elderly population will double. For these reasons, geographers and transport researchers are increasingly interested in understanding the aspects that intersect these changing aging trends as aging societies bring long-term challenges to a nation, including urban and transportation planning concerns. The topic of aging mobilities has become more common in the literature, with the majority of papers being published since the beginning of the 2000s (Schwanen and Páez 2010). Some seminal papers include Schwanen and Páez (2010), who called for more research to better understand the changes in aging mobilities over time and accurately address the right of elderly populations to healthy, fulfilling and inclusive lifestyles and a social environment that supports their mobility needs. Rosenbloom (2001) called for policies that take into account the changes in the lifestyle of older people so they can have access to sustainable communities where cars are safer and public transit are effective, safe, and attractive for elderly. Banister and Bowling (2004) center travel as one important element in achieving a desirable quality of life for elderly. Webber et al. (2010) identified the need of a mobility framework that is broad and serves to all older

adults, regardless of their living situation or functional ability. Some of the major themes about aging mobilities found in the transport geography literature include:

- The study of travel patterns and travel mode choice (Kim and Ulfarsson 2004; Hjorthol et al. 2010; Páez et al. 2012; Horner et al. 2015).
- Travel barriers for older adults and the role of the built environment (Dumbaugh 2008; Rosso et al. 2011; Soltani and Shams 2017).
- The mobility challenges of older females (Rosenbloom 2006; Oxley et al. 2010; Nordbakke 2013).
- The importance of automobility and driving cessation (Rosenbloom 2001; Adler and Rottunda 2006; Braitman and Williams 2011; Choi et al. 2012)
- Mobility and active aging (Pettersson and Schmöcker 2010; Zeitler and Buys 2015; Tiraphat et al. 2017; Hsu 2020).
- The multiple incentives for older adults to stay active, including a sense of independence, improvements in their well-being and in their quality of life (Metz 2000; Schwanen and Ziegler 2011; Nordbakke and Schwanen 2014).
- Older adults' perceptions of mobility (Mollenkopf et al. 2011; Ziegler and Schwanen 2011; Goins et al. 2015; Boschmann 2020a).
- The relevance of addressing public policies that take into consideration older adults mobility needs and ameliorate mobility barriers towards more accessible, safe, and affordable transportation systems (Gorman et al. 2019).

**What methods are being used in the literature?**

From a methodological standpoint, much of the literature on mobility of older adults follows either a quantitative or a qualitative approach. The use of descriptive statistics, conducting or analyzing surveys, multivariate analyses, travel behavior models, among others, are common quantitative methods to measure mobility patterns of older adults (Everitt and Gfellner 1996; Tacken et al. 2005; Achuthan et al. 2010). Conversely, the use of qualitative approaches in the literature is less common and overall more recent. The implementation of focus groups, in-person, telephone, or 'go-along' individual interviews to learn about elderly perceptions of mobility, and the creation of travel diaries are common qualitative methods found in empirical studies (Burnett and Lucas 2010; Nordbakke 2013; Green et al. 2014; Adorno et al. 2018).

Studies of mobility of older adults using a mixed methods approach are considerably scarcer. The few studies that have used this research approach suggest that triangulating methods lead to more rich and vivid accounts of mobility behavior (Mollenkopf et al. 2011; Zeitler et al. 2012; Bell et al. 2015; Milton et al. 2015; Meijering and Weitkamp 2016). Indeed, adopting mixed-methods approaches can ultimately result in research that is both theoretically and methodologically innovative, as it helps answer different types of questions and allows for triangulation of results (Schuch and Nilsson 2022).

**Where is this literature coming from?**

Considerable research has been done on mobility of older adults in developed countries; with empirical research generally studying places in Australia (Oxley et al. 2010; Delbosc and Currie 2011; King and Scott-Parker 2017); Canada (Everitt and Gfellner 1996; Mercado and Páez 2009; Mercado et al. 2010; Chudyk et al. 2015); The

United States (Hildebrand 2003; Cao et al. 2010; Boschmann and Brady 2013); and Europe (Siren and Hakamies-Blomqvist 2004; Schmöcker et al. 2008; Hjorthol et al. 2010; Hjorthol 2013; van den Berg et al. 2016).

Aging mobility studies from cities in the Global South are less predominant in the literature, with notable exceptions from studies in Latin America, (Alvarado et al. 2007; Aceves-González et al. 2015); Africa (Odufuwa 2006a; Ipingbemi 2010; Porter et al. 2013; Olawole 2017); and Asia (Pettersson and Schmöcker 2010; Dadashpoor and Rostami 2017; Soltani and Shams 2017). Indeed, more research from the Global South is needed to capture the complex relationships between elderly mobilites, their environment, multigenerational relationships, etc.

**Research contributions**

This research does not assume that the mobility issues that older adults face in the Global North are similar or comparable to the ones that seniors deal with in the Global South. Older adults from different geographic contexts understand and perceive their mobility in different ways, according to their specific cultural, social and economic background. We must take into consideration that different geographic, cultural, demographic, and socioeconomic contexts lead to different local mobility patterns and experiences.

This dissertation adds to the existing aging mobility literature by 1) exploring what we know about elderly mobilities in the Global South 2) analyzing travel behavior patterns and travel mode choice of older adults in Mexico City, as a case study in the Global South, from which we know very little; 3) exploring the lived mobility experiences of older adults living in different neighborhoods of the city to capture

contrasting narratives using a qualitative approach; 4) implementing a mixed methods research design to find results that a more comprehensive and methodologically innovative; and 4) using the mixed methods results to propose transportation policies to ensure older adults' access to safe, comfortable, and accessible travel experiences.

**Methods**

I employed the mixed-methods design proposed by Creswell and Plano (2017) named *explanatory sequential mixed methods design*. This design begins by conducting a quantitative phase and follows up on specific results with a subsequent qualitative phase to help further explain, corroborate, complement or contradict the quantitative results (see figure 1). This approach is suitable for this research because: 1) as Mexico City has over 9 million older adults, it was necessary to determine geographical and statistical parameters to differentiate levels of accessibility to public transport (PT) in different neighborhoods in the city; 2) the quantitative phase uncovers everyday mobility patterns, transport mode choice, and neighborhood accessibility differences that became my primary interests in the qualitative phase; and 3) the qualitative phase provided a more in-depth understanding of elderly self-reported mobility experiences to compare, further explain, complement, or contradict their perceptions with the results obtained from the quantitative phase.

The following five broad research questions (RQ) are thoroughly developed below.

- Literature Review: *RQ1. What do we know about the daily mobilities of older adults in the Global South?* The purpose of this question is to better understand and contextualize what has already been published on this topic and address the relevance of studies coming from the Global South.

- Quantitative phase. It is divided into two separate analyses. *RQ 2. What are the travel behaviors and transport mode choice of older adults in Mexico City, according to the 2017 Household Origin Destination Survey*? This question analyzes older adults' travel behaviors and mode choice and draw conclusions that are statistically representative. *RQ 3 Where are the neighborhoods with higher densities of older adults and statistically different accessibility to (PT) infrastructure?* Results lead to the creation of a neighborhood accessibility index that identifies areas with high densities of older adults and statistically contrasting levels of high and low accessibility to PT.
- Qualitative phase: *RQ 4. What are the lived mobility experiences of older adults living in selected neighborhoods in the city?* To answer this question, purposive sampling informed by the first quantitative phase was conducted. The goal was to conduct one-on-one interviews to learn about contrasting mobility experiences from older adults with different levels of access to PT.
- Mixed Methods phase: *RQ5. How do the qualitative results, based on elderly mobility experiences, corroborate, complement, or contradict the quantitative results?* Integration of methods includes examining the quantitative results closely to isolate findings that might be surprising, contrary to expectations, or unusual and then gathering the qualitative data to explore those specific findings in more depth (Cresswell and Plano Clark, 2017).

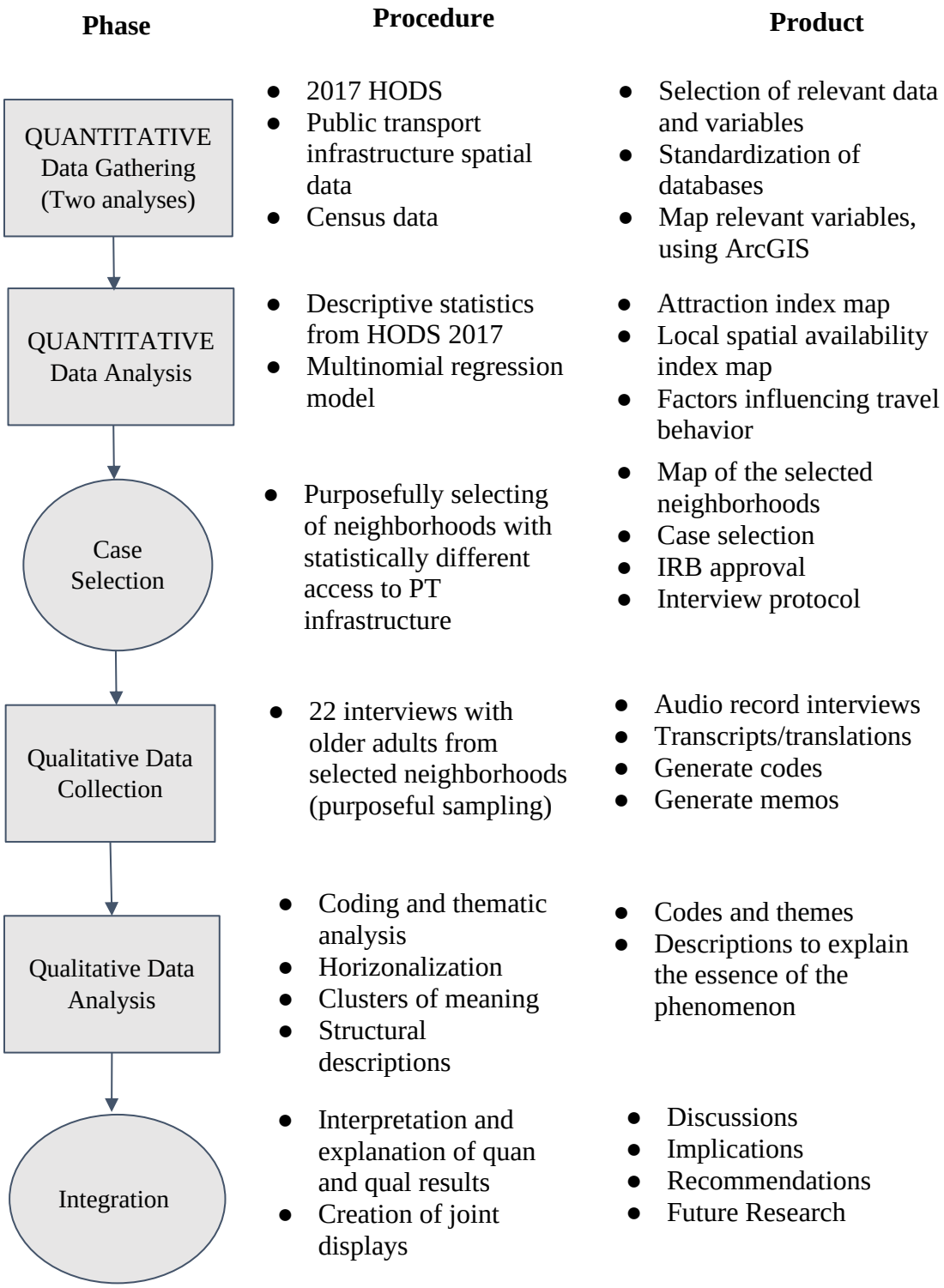


Figure 1. Mixed method procedural diagram

**Mexico City's context and urban form**

Mexico's urban system was first shaped by the Aztec pattern of urbanization, from which two geographic aspects of pre-Columbian settlements stand out. First, the large-population agglomerations adopted a "city-state" model, where commercial and religious components dominated rural communities and other small political-religious localities within their hinterlands. Second, major urban centers were particularly prominent in the central region of Mexico. By 1521, 2.5 million people lived in that region and Mexico City became the capital of the Spanish Empire (Albandoz et al. 2016).

In 1821, after Mexico's independence, new important regional centers emerged, and moderate regional growth was stimulated by foreign investments and the creation of highway and railroad networks, these investments played a crucial role in stimulating urban growth in various cities in the central and north regions of Mexico.

Mexico City's physical geometry has mostly remained unchanged despite a population increase from 185,000 inhabitants at the middle of the nineteenth century to over 3 million by the middle of the twentieth. Throughout this growth, the city retained the same quadrangular design set by Spanish conquistadors in the sixteenth century, and, until the 1950s, the city was largely encompassed by a clearly delimited territory (Canclini and Liffman 2000). The 1960s and 1970s were a transformative time for Mexico City, as the rural decline and the expansion of industrial and commercial opportunities in urban centers led to a rapid expansion of the city. During this decade, the population in the city doubled and the city expanded dramatically in all directions. Currently, Mexico City's population is 9.2 million, and the metropolitan area contains

over 20 million people, which makes it the second largest urban agglomeration in the world, after the Greater Tokyo Area (Heathcott 2019).

In the early 2000s, federal, state and municipal authorities developed a master plan for the metropolitan area which includes the development of metropolitan sub-centers. Since the 1980s, predominant land uses in the central city and first urban ring have shifted towards a service economy. The service jobs agglomeration has displaced residential uses towards the periphery and the central city has shown a decrease in total population. Population and economic census data show that population suburbanization has been accompanied by some local job growth. However, in general terms, there has been a continuing concentration of economic activity in the center. Figure 2 shows Delgado's (1988) urban ring configuration, as presented in Suárez and Delgado (2009, 2190), which I use as a general description of the city as it continues to be appropriate and relevant.

The Aztec origins of the city explain many of the major features of the present-day spatial structure and social segregation. The main routes in and out of the city, later the first metro lines, coincide with the pre-hispanic causeways connecting the island city to the mainland. This pattern of segregation was reinforced by successive investments in roads and other infrastructure systematically favoring the richer half of the city. The socioeconomic segregation would be more severe were it not for the fact that 70% of Mexico City's housing has been informally produced. In general terms, in Mexico City the rich tend to live in the central areas at lower densities, while the poor live on the periphery at high densities (Connolly 2017). According to Yañez-Pagans et al. (2019),

this unplanned urban growth and income inequality have left the poor to endure long and costly travel times to get to their jobs, a circumstance that aggravates social inequalities.

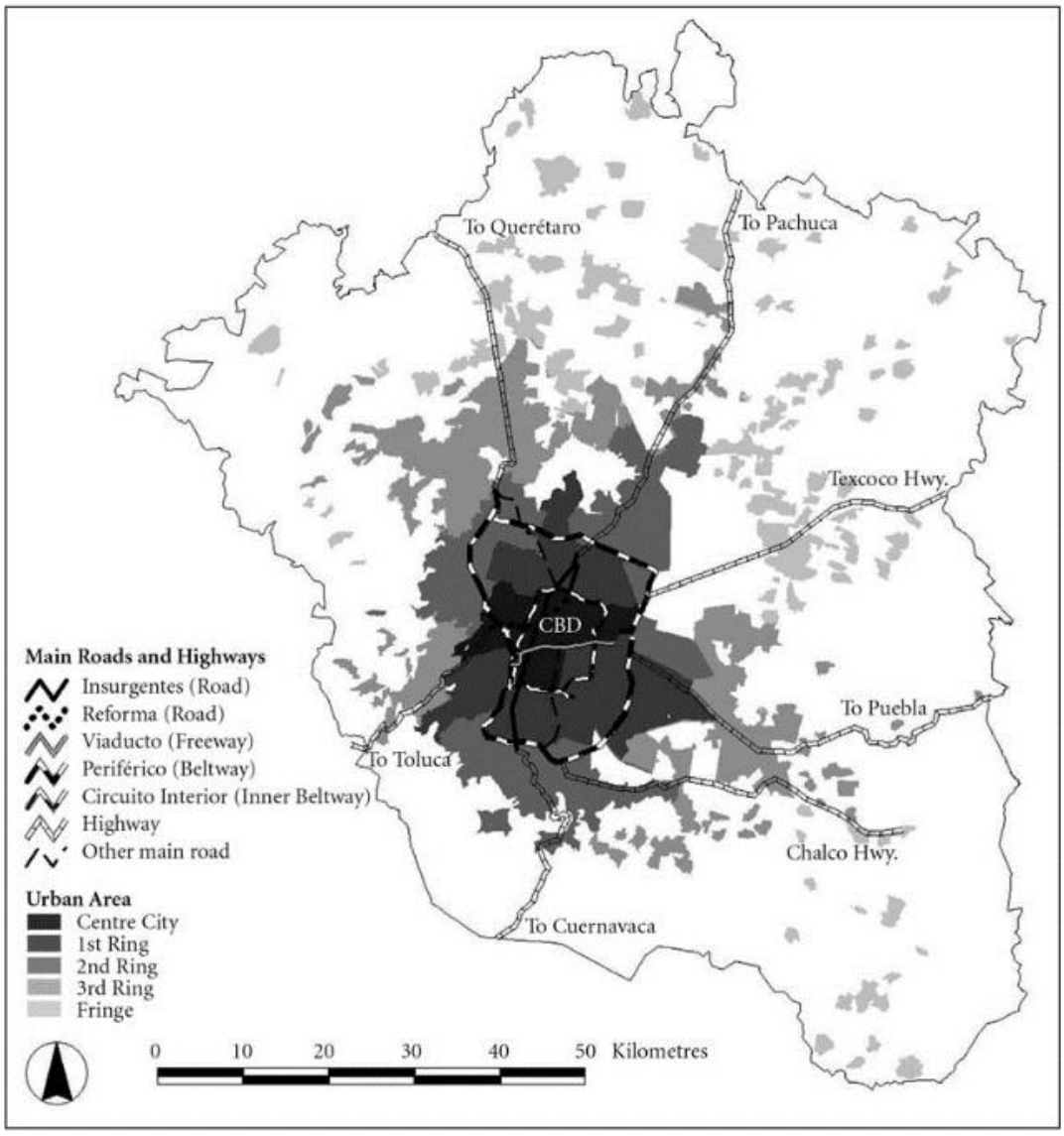


Figure 2. Mexico City: urban ring configuration, main roads and highways (as featured in Suárez and Delgado 2009, 2190)

**Mexico City's transportation system**

Since 2000, the city has undergone relevant transportation projects after many years of virtually no transportation policy. These projects include five Bus Rapid Transit (BRT)

lines, new highway roads, bike sharing systems, suburban rail lines, one new metro line, parking meters in certain areas of the city to avoid informal charging, and the introduction of Uber and other similar platforms (Mejia-Dorantes 2018). According to Leo et al. (2017) the following are the most common transportation modes in Mexico City:

*Vehicles.* Since 2004 the number of vehicles in Mexico City has increased considerably. To this respect, policies have been the plate restriction mechanism imposed in Mexico City's "No Driving Today" or *"Hoy no Circula"* Program, which has actually increased air pollution and increased the hours worked by the huge taxi fleet to replace car trips (Jaitman 2015). Hence there is still room for improvement for the city when it comes to reducing the GHG emissions caused by vehicles. Currently, officials in Mexico City Metropolitan Area are working on programs of road safety and reducing congestion on roads and open spaces for pedestrian and cyclists.

*Bikes.* The implementation of "Ecobici", the city's bike share system, has become a noticeable strategy that has positioned Mexico City as a sustainable transportation advocate since 2010. Since then, international development experts, non-governmental organizations, middle-class grassroots groups and progressive city officials have been promoting this mode of transportation (Sosa López 2021). According to the Department of Mobility of Mexico City, in 2013, 55,000 users registered Ecobici system with a fleet of 2565 bikes.

*Metro.* This system began in 1969 and is currently the main means of urban transport in Mexico City. This system has the lowest operational costs of any major world metro, and it transports 4.5 million passengers daily, and ridership on its busiest lines approaches 1

million passengers daily. Almost all the lines terminate at the boundary between Mexico City and Mexico State, and these stations there are the busiest in the system (Gilat and Sussman 2003). In 2012, a twelfth line was completed.

*BRT Metrobus system.* It began in 2005, with a fleet of extra-long buses, elevated stations to facilitate boarding, exclusive lanes on the roads and prepaid cards. There were 5 times as many passengers in 2013 as in 2005 as new lines were added to the network, along with complete streets and new pedestrian infrastructure. These investments aligned with a major current transportation trend that has shaped transportation systems in other cities in Latin America.

*The urban bus system (RTP).* It is run by the city government, offering ordinary and express services, which often feed the Metro and Metrobus systems. By 2010, the number of routes had risen to 14, though it fell again to 8, by 2013 as new Metrobus lines were opened. New services were also offered in this period, such as the "Atenea" bus service exclusive for women, which began in 2008 and by 2012 had 100 buses on 50 routes with a fare of only $2 Mexican pesos, where pregnant women, senior citizens and the disabled travel free.

*Electrically fueled transportation.* This network offers trolleybus and light train services and is indirectly run by the city government. Unfortunately for this network, the passenger numbers, and number of lines fell from 2004 to 2013. Although, since 2020, the city has been investing more in new trolleys by adding more units and reinstating previously suspended routes.

In summary, Mexico City as made efforts to include policies such as integrated tariffs or transport subsidies to maximize demand and increase affordability for lower-income

groups. Additionally, while investments in infrastructure for passenger transport have increased recently, the supply of high-quality PT and road infrastructure has not kept pace with the growth in transport demand (Yañez-Pagans et al. 2019). Weak institutions and government omissions have also exacerbated the inefficiency and informality of urban transport systems, including informal "peseros", "combis", and "moto taxis", which will be discussed in subsequent chapters. Therefore, policy priority is to improve transport networks for the poor (Jaitman 2015). Indeed, urban mobility plays an important role in the development of a city. By improving PT service, e.g. revision of tariffs so that mobility is accessible and affordable, reorganizing road space to beneficiate pedestrians and bikers, addressing PT safety concerns, providing efficient services during rush hours to avoid overcrowding, etc. we can modify people's urban mobilities; the places where they choose to live and work; and their ability to use alternative transportation modes besides the personal vehicle (Leo et al. 2017).

**Structure of the dissertation**

The following chapters in this dissertation are stand-alone article papers that have already been published or are intended for publication in peer-reviewed journals.

Chapter Two presents the paper titled "A scoping review of the daily mobilities of older adults in the Global South" co-authored with Dr. E. Eric Boschmann and published in *The Canadian Geographer* as part of a special issue on "The Changing Geographies of Aging" (Villena-Sanchez and Boschmann 2022). I was granted copyright clearance by John Wiley and Sons to include this paper as a chapter of my dissertation (License Number 5297751357551). This paper examines the current state of the literature on the daily mobility patterns of older adults in the Global South to discover what is known and

uncover dominant themes. I used a scoping review approach to search literature in geography and other allied disciplines that primarily focus on elderly daily travel behaviours and related studies. I included 57 papers to review and identified three dominant themes across them: trip mode choice, unmet mobility needs, and socio-economic aspects of mobility. Results show that the elderly in the Global South, in contrast to their peers in the Global North, walk and use PT more frequently than personal vehicles. Some common unmet mobility needs of the elderly in the Global South include safety concerns, gender inequalities, and unequal access to PT. Socio-economic aspects that influence elderly mobilities include employment status, living arrangements, caregiving relationships, and social networks. I conclude that there is a need for more mobility studies that promote the participation of older adults in the Global South and that use longitudinal, qualitative, and/or mixed method approaches. Lastly, transportation policies should address specific elderly needs and avoid "one-size fits all" approaches.

Chapter Three presents the second paper "Daily travel behaviors and transport mode choice of older adults in Mexico City" co-author with Dr. E. Eric Boschmann and Dr. Sara Avila Forcada. This paper was sent to the *Journal of Transport Geography* in February 2022 and is currently recommended to be revised and resubmitted for publication. This paper aims to contribute to the aging mobilities literature in the Global South by uncovering travel behavior patterns and transport mode choice of older adults in Mexico City. My three research objectives are: to describe the socioeconomic characteristics of the elderly population in Mexico City; to explore their travel behaviors; and to examine the relationships of socioeconomic characteristics and older adults' transport mode choice. Results from the 2017 Household Origin-Destination Survey

(HODS 2017) show a complex picture where older adults' everyday mobilities intersect with geographic and socioeconomic characteristics. For example, I discovered equity issues as poorer older adults travel for longer periods of time in comparison to their wealthier peers. In terms of travel mode choice, I found that 40.5% of older adults reported using PT, 32% walking, 26.5% driving, and only 1.2% biking. Also, I learned that when older adults have access to good public transit infrastructure, they use it, regardless of car ownership status. I conclude that future research must focus on designing specific actions towards policies that address older adults' mobility needs and takes into consideration their right to a pleasant transport experience. Lastly, I should continue efforts to improve active transportation modes such as walking and biking, as better walking infrastructure, such as sidewalks and complete street designs, have been shown to improve older adults' mental health and feelings of well-being and social inclusion.

Chapter Four presents a third paper titled "Mobility Perceptions of Older Adults in Mexico City: A Qualitative Study." This paper was co-authored with Dr. E. Eric Boschmann, and it is in preparation to be sent to the *Journal Travel Behaviour and Society.* The objective of this paper is to use a qualitative research methods approach to uncover the mobility perceptions of older adults in Mexico City who live in neighborhoods with drastically different accessibility to PT. The goal is to better understand how different levels of accessibility create different mobility experiences. A phenomenological qualitative framework was used for this research because it seeks to present the varied lived mobility experiences of older adults from selected neighborhoods in Mexico City. Twenty-two semi-structured telephone interviews were conducted with

elderly aged 60 and older. Five dominant themes emerged from the data: 1) different options to commute to work, 2) bad drivers and safety concerns, 3) affordability, connectivity, and exciting new PT investments, 4) mobility changes after the pandemic and adaptation strategies, and 5) recommendations to fix perceived PT challenges. Results confirm similar concerns found in the literature such as lack of accessibility, safety, service reliability, and proper PT infrastructure. This paper add to the literature of older adults' mobility by addressing small-scale mobility differences in selected neighborhoods in Mexico City using a qualitative approach. I uncovered contrasting mobility experiences created by unequal accessibility to PT infrastructure, which resulted in different mobility opportunities and challenges. Future research should take into consideration not only Global North versus Global South mobility differences, but also small-scale differences to uncover locally rooted mobility inequalities that are not visible when studying larger study areas.

Lastly, Chapter Five presents a summary of the findings from each paper and the integration of the methods that examine the quantitative and qualitative results to identify findings that are complementary, contradicting, or innovative in the form of joint displays. Also, I propose recommendations for transportation policies that ensure older adults' access to safe, comfortable, and reliable everyday travel experiences. Finally, I identify limitations of my research and areas of opportunity for future research.

# Chapter Two: A scoping review of the daily mobilities of older adults in the Global South

## Introduction

The daily transportation mobility of older adults is a central theme of research in the geographies of ageing and one that has existed for several decades (Schwanen and Páez 2010). It primarily focuses upon understanding variations, differences, and changes in older adult daily travel behaviours, as measured by trip frequency, trip mode choice, trip purpose, and trip duration or distance (Cui et al. 2017). This literature also explores the relationship of daily mobility to older adults' quality of life (QOL), health, and well-being (Banister and Bowling 2004), as well as perceptions of individual mobility (Boschmann 2020). Most of this research is conducted in cities and countries of the Global North (Mercado et al. 2010; Boschmann and Brady 2013; Chudyk et al. 2015).

However, when considering ageing and mobility in the context of changing geographies of ageing, there is a comparative lack of research focused on older adults' mobility in the Global South (Olawole and Aloba, 2014; Porter et al. 2018; Gorman et al. 2019) where ageing shifts are occurring more rapidly. Current demographic trends show that many countries in the Global South are undergoing faster ageing transitions than those seen in the north (United Nations 2020b). For example, while it took France 115 years to double their proportion of older adults, it will take China only 27 years to reach the same increase. By 2050, there will be 2 billion people in the world aged 60 or older

with 80% of them living in developing countries in the Global South (WHO 2002). Therefore, the purpose of this paper is to provide a review of existing literature from the Global South and to stimulate more research to better understand the nature and context of transportation mobility of older adults across the Global South.

Previous research shows great heterogeneity in older adults' daily mobility and transportation needs depending on their age, gender, socio-economic, and cultural background, etc. (Schwanen and Páez 2010; Porter et al. 2013; Cui et al. 2017). Likewise, ageing societies in the Global South are likely to face mobility challenges that are different from the Global North. A number of these differences inform my review of the literature:

- Older adults' dependency on personal vehicle usage is considerably greater in the Global North in comparison to the Global South, where walking, public transportation, and other modes are more dominant (Rosenbloom 2001; Olawole and Aloba 2014).
- Developed nations benefited from stronger economies allowing them to set up national retirement systems, whereas many developing countries do not have the same opportunity (Kalache and Keller 2000). As a consequence, elderly populations in the Global South are less likely to be retired and more likely to be employed than those in the Global North, resulting in different daily mobility patterns.
- Similarly, the colonial history of many countries in the Global South has left city officials with planning challenges and limited resources to develop transport

infrastructure, especially to accommodate the mobility needs of rapidly growing elderly populations (Ipingbemi 2010).

- Elderly populations in the Global South are more likely to live in multigenerational households (United Nations 2020b), which can impact elderly travel opportunities, as they may rely more on family members to conduct everyday travels than elderly in the Global North (Pettersson and Schmöcker 2010).
- While perceptions of public transportation tend to be more favourable in the Global North, public transit in some regions of the Global South may be viewed as inadequate, informal, or unregulated (Odufuwa 2006).

Given that "no full picture has emerged of the travel and transport needs and patterns of the elderly in the Global South" (Soltani et al. 2018, 110), this scoping review examines the current state of the literature to discover what is known about the daily mobility patterns of older adults in the Global South. In the remainder of this paper, I searched the literatures in geography and allied disciplines that primarily focus on elderly daily travel behaviours and related studies. I then developed exclusion and inclusion criteria and included 57 papers to review. From those papers, I identified eight key categories and summarized three emerging themes: trip mode choice, unmet mobility needs, and socio-economic aspects intersecting elderly mobilities. I end by discussing major gaps in the literature and offer recommendations for future research.

## Materials and Methods

For this literature review I used a scoping review approach to summarize and disseminate research findings to identify research gaps and to make recommendations for future

research (Peters et al. 2020). It is an appropriate approach because: a) this body of literature has not yet been comprehensively reviewed; b) studies in this literature employ a diverse range of research methods; and c) I aim to systematically map the literature available on this topic and identify key concepts, predominant themes, and gaps in the literature. My goal was to review the research literature of older adults and mobility that comes from outside the realms of Australia, New Zealand, the United States, Canada, and Western and Northern Europe, regions which have dominated the literature. I did not make direct country to country comparisons but sought to synthesize all the research that is emerging from the Global South. I followed the five stages of the scoping review framework proposed by Arksey and O'Malley (2005):

Stage 1. Identifying the research question. To understand what is known from the existing literature, I began with the following broad research question: What does the existing literature say about daily transportation mobility of older adults in the Global South?

Stage 2. Identifying relevant studies. I conducted a search of academic papers and books in six different electronic databases: Web of Science, Academic Search Complete, Agricultural & Environmental Science Collection (ProQuest), Medline, PsycINFO, and Google Scholar. The search terms used are as follows: ((“older adults” OR aging OR ageing OR elder* OR retired OR senior*)) AND ((mobility OR transportation OR “active ageing” OR travel)) AND ((“Global South” OR “developing world” OR “developing countries” OR “South America” OR “Latin America” OR Africa OR Asia)). No time limits were set. I retrieved and organized all papers using the software Zotero.

Stage 3. Study selection. The initial search resulted in 200 potentially relevant papers. To ensure consistency, I developed inclusion and exclusion criteria based on research question. Inclusion parameters included: a) title/abstract focused on elderly mobilities; b) title/abstract mentioned transportation; and c) empirical studies researched a place in the Global South. I determined which countries belong to the Global South (Dados and Connell 2012) by adopting the classification method of the United Nations (2020a). Exclusion parameters included: a) the use of the word "mobility" did not explicitly refer to transportation mobility; or b) "mobility" referred to the capacity of movement inside a household. After reading all 200 titles and abstracts, I selected 120 papers that met the study criteria. In the second round of the selection process, I read all 120 papers to further refine inclusion in my scoping review. I kept 93 and excluded 27 that did not focus sufficiently on the inclusion criteria. In the third round of the process, I classified these 93 papers into key categories and decided to add one exclusion criterion to exclude papers that, despite mentioning older adults' mobilities, did not have a central focus upon those mobilities. I ended up with 57 papers in this review.

Stage 4. Charting the data. "Charting" refers to the technique of synthesizing and interpreting data by sorting material according to key issues and themes. To organize the data, I created a spreadsheet with columns for charting the following data: name of the paper, journal, year of publication, key words, study area, objectives/key themes, dataset, methodology, main conclusions/results, aspects unique to the Global South, inclusion/exclusion, and category. The papers in this review come from the following regions and countries: Asia (China, including Hong Kong and Taiwan, South Korea, Thailand, Malaysia, and Philippines); Africa (Nigeria, Ghana, and Zambia); Latin

America and the Caribbean (Mexico, Brazil, Colombia, Chile, Argentina, and several Caribbean countries studied within a single article); and the Middle East (Iran and Pakistan.)

Stage 5. Collating, summarizing, and reporting the results. I read the final collection of papers and populated the spreadsheet outlined above. Across several meetings my coauthor and myself discussed findings from individual papers and identified emerging themes. The final 57 papers included in this review were mostly published within the last decade (2010-2020), with only one paper published in 1996 and two in 2006. Figure 3 shows the frequency of these papers by year of publication.

**Results**

The papers included in this review are mostly empirical studies, with a few literature reviews and policy focused papers. Initially, I identified eight broad key categories among the papers: the role of the built environment, multigenerational relationships, travel/mobility perceptions, walkability, travel behaviours, active ageing, age-friendly cities, and pertinent policies.

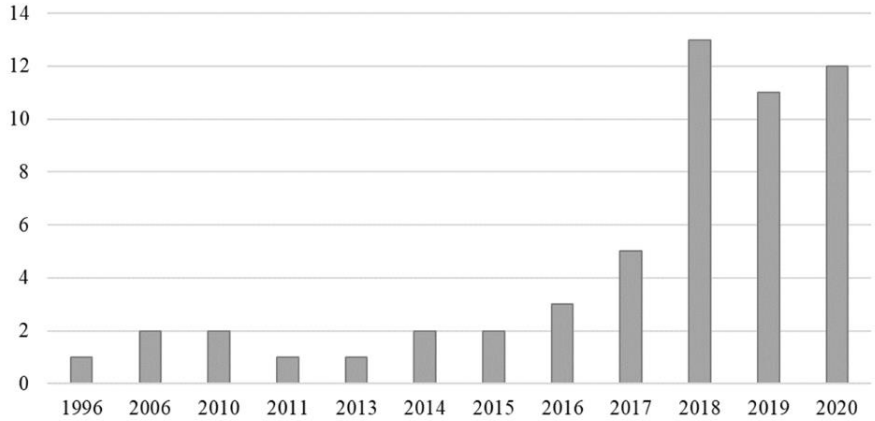


Figure 3. Papers included by year of publication (1996–2020)

After further discussion and consideration of these categories, I narrowed these to three dominant themes across the 57 papers: trip mode choice, unmet mobility needs, and socio-economic aspects of mobility. To better understand the implications of this body of literature, I turned these into secondary research questions:

- What modes of transportation do elderly choose or use?
- What are major unmet mobility needs among the elderly, and what solutions are proposed in the literature?
- What socio-economic aspects influence elderly mobility patterns?

Likewise, several subthemes emerged that helped organize and make sense of the key findings in the literature, as illustrated in Figure 4. The following section presents a narrative of this literature based upon these categories, themes, subthemes, and secondary research questions.

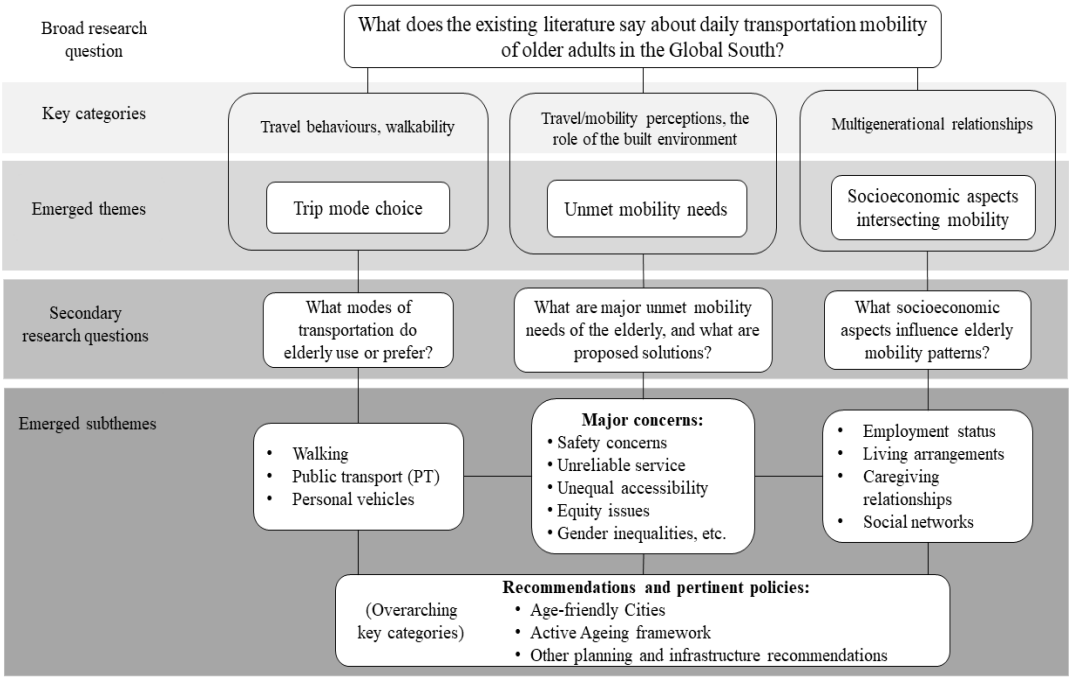


Figure 4. Key categories, themes, and subthemes found in the literature

### Trip Mode Choice

***Walking.*** Walking as a mode of transportation is prevalent and common for elderly in the Global South. For example, a study conducted in Iran argues that older females are more likely to choose walking than older men, as are the elderly who do not own a car or cannot drive. Similarly, researchers found the opportunity for walking for elderly increases in areas with a high mixture of land uses, high intersection density, and low car parking space (Lotfi and Koohsari 2011; Hatamzadeh and Hosseinzadeh 2020). Walking is also associated with older adults' employment status. One study in Wenling, China shows that elderly who do not work and have more free time are more likely to walk (Ren et al. 2018). In studies conducted in Latin America and Malaysia, elderly cohorts were found to walk more than younger ones (Mohd et al. 2019; Ferrari et al. 2020). Moreover, Adeel et al. (2017) found that Pakistani elderly men take frequent walking trips to nearby social and religious places. Similarly, Olawole (2017) described walking as the primary mode of travel for older Nigerians attending religious centres or visiting relatives.

Neighbourhood design is a commonly mentioned in the literature as a characteristic that influences elderly walking behaviours. For example, several studies argue that green spaces, parks, and recreational facilities are crucial to increase older adults' likelihood of walking and can provide suitable space for other physical and social activities (Huang et al. 2018; Garcia-Valdez et al. 2019; Zang et al. 2019). Additionally, older adults' proximity to open and green spaces is linked to fewer depressive symptoms and improved mental health (Lam et al. 2020). Similarly, higher ratings of self-rated health

among older adults were associated with higher walkability and higher satisfaction of transportation options (Wong, Yu, et al. 2017).

***Public transport (PT).*** The literature shows great variation in older adults' usage of PT in the Global South. For example, less than 4% of elderly in Malacca, Malaysia use PT (Mohd et al. 2019), whereas in Hong Kong, nearly 90% of the total population uses PT and bus travel represents the highest percentage of daily travel for older adults (Szeto et al. 2017). Additionally, the use of PT differs depending on socio-economic status, age, and gender. For example, middle-class elderly in São Paolo are more likely to choose PT compared to walking, and elderly women are more likely to choose PT in comparison to younger women (Mação Bernal et al. 2019). In contrast, older adults in Nigeria and Manila do not use PT as much as younger cohorts (Pettersson and Schmöcker 2010; Olawole 2017). Regardless of the different degrees of use, research shows that good access to PT helps older adults navigate considerable distances, despite their limited mobility. Therefore, addressing the needs of elderly passengers is of particular concern for public transport service providers, especially for those with disabilities or mobility impairments (Szeto et al. 2017). Despite this great variation in public transport usage, it is generally a more dominant trip mode for older adults in the Global South than in the Global North.

***Bicycle.*** Very little has been written about older adults' usage of bicycles. I only found one study on older adults' usage of bicycles in the Global South (Useche et al. 2019). The authors conclude that elderly in Colombia and Argentina do not cycle nearly as much as younger cohorts, but when they do, they present the lowest rate of cycling accidents and report positive mental health outcomes.

***Personal vehicles.*** Car ownership and usage is generally lower in the Global South than in the Global North (Odufuwa 2006; Olawole 2017; Zhao and Yu 2020). For example, the overall vehicle ownership per person in Hong Kong in 2016 was 0.07, much lower than 0.79 in the United States or 0.74 in Australia (Lu et al. 2018). In London, 37% of elderly shopping trips are made by car, compared to only 6% in Manila (Pettersson and Schmöcker 2010). In another study, Ren et al. (2018) found in their travel survey that older adults and individuals with disabilities in Wenling, China walk; ride bicycles, e-bicycles, or motorcycles; or take buses significantly more frequently than they travel by car.

However, some studies showed that cars are preferred for certain trip purposes, such as attending healthcare facilities, and that vehicles are more frequently used by working older males of higher income (Choo et al. 2016; Li et al. 2018; Ahmad et al. 2019). Additionally, a study in Santiago de Chile found that the tendency to associate status with the car tends to increase with age (Lira and Páez 2021). Lastly, car usage has been found to be negatively associated with walking (Hatamzadeh and Hosseinzadeh 2020) and positively associated with higher trip frequency (He et al. 2018).

**Unmet Mobility Needs**

Since older adults in the Global South are generally more reliant on PT, a considerable number of papers addressed PT-related unmet mobility needs. This subsection reviews several major concerns found in the literature as well as general policy recommendations.

***Major concerns.*** Studies focused on older adults' perceptions and attitudes towards usage of PT revealed numerous concerns in Guadalajara, Mexico (Aceves-González et al.

2015, 2016); Tunja, Colombia (Márquez et al. 2019); and Lahore, Pakistan (Al-Rashid et al. 2020). In particular, Aceves-González et al. (2015, 2016) identified several concerns for older adults who use buses in an informal transport system: impatient and unfriendly bus drivers, buses not designed for the needs of older adults, crowding, and long walking distances to bus stations. These concerns impacted elderlys' actual and perceived safety, perception of transport usability, and comfort levels. Similarly, concerning aspects that limit older adults' mobility in African studies include irregular PT services, low accessibility to transportation infrastructure, difficulty getting on and off buses, high fare costs, and unfriendly behaviour of PT operators (Odufuwa 2006). Results from a study in Pakistan show that concerns related to frequent negative perceptions about PT include sentiments of fatigue, poor staff behaviour, and poor accessibility for disabled older adults (Ahmad et al. 2019). Porter (2018) identifies fear of harassment and crime (especially amongst older females), low transport availability, low affordability, and ease of use as mobility constraints for African older adults. Additionally, a study in India found that that speeding of buses and sudden accelerations made it very difficult for older adults to use them (Munshi et al. 2018).

A study in Wenling, China reported that wheelchair access is available only in a few stations, and access to reserved seating on buses and metro is limited, especially during peak hours (Ren et al. 2018). Another study in rural China found that factors limiting travel opportunities for older adults in non-urban areas include less economic resources, long distances between villages and transport stops, and lower car ownership (Zhao and Yu 2020).

Closs et al. (2010) explored the perceptions of elders in six Caribbean countries and found large disparities in access to PT. For example, in this region there is little to no access to special transport tailored to older adults and people with disabilities, forcing older adults to use public or private transport services, which are not always available and can be expensive. Moreover, in countries such as Barbados, Jamaica, and Trinidad and Tobago, even though PT is free of charge for senior citizens, bus routes and times are not always scheduled for trips to and from health clinics. In Latin America, social inequality, associated with unplanned urban growth, aggravates living conditions, and limits the adaptation capacities of the elderly, negatively affecting their QOL. For example, one study shows that in most Latin American cities, such as Santiago de Chile, elderly PT needs constitute an element of social exclusion (Garcia-Valdez et al. 2019).

***Pertinent policies and recommendations to improve mobility challenges.*** Numerous papers reviewed existing ageing policies or made policy recommendations with the goal of improving older adults' mobility. One major initiative, the World Health Organization's (WHO) Active Ageing policy framework (WHO 2002), provides action plans that promote healthy and active ageing. This policy framework is composed of eight broad "determinants" (economic, health and social services, social, physical environment, personal, behavioural, culture, and gender) as good predictors of how well individuals and populations age. The physical environment determinant is relevant to the mobility of older adults as it brings attention to the inclusion of accessible and affordable public transportation services in rural and urban areas so that older adults can participate in family and community events and reduce mobility barriers.

In the context of the Global South, several studies address active ageing in relation to elderly mobility challenges. Hsu et al. (2019) assessed equity and active ageing determinants among older Taiwanese and found significant active ageing disparities in gender, education, and living areas. The authors suggest that ageing policies should be more gender-focused to eliminate gender disparities; that socio-economic inequalities should be addressed by social policies; and that geographic disparities should be reduced by investing in rural areas and increasing community involvement in urban areas. In another study, Hsu (2020) examined the association between active ageing and age-friendliness across cities in Taiwan to identify their effects on well-being and life satisfaction. Hsu concluded that convenient and accessible PT for older Taiwanese should be a priority for age-friendly cities as an accessible physical environment is correlated to an increase in their well-being and social participation, therefore benefiting active ageing.

Active ageing is difficult to achieve for older people living in developing countries where access to PT is compromised and rapid urban regeneration undermines older people's attachment to their community, negatively impacting their sense of place. Therefore, while walkable neighbourhoods are important, policy makers also need to understand the social, cultural, and political context in which older urban populations live, in order to provide opportunities for social networking, engagement opportunities, and different forms of neighbourhood participation (Woolrych et al. 2020).

The WHO also established the Age-Friendly Cities (AFC) program to encourage policies and services that better enable older persons to actively age in their urban communities. It contains eight age-friendly city domains: community and health care, transportation, housing, social participation, outdoor spaces and buildings, respect

and social inclusion, civic participation and employment, and communication and information (WHO 2007). Some empirical studies have explored the effectiveness of the transportation domain on the livelihood of older adults in developing regions. For example, Tiraphat et al. (2017) found a significant relationship between higher QOL measures among older adults and AFC transportation metrics of service accessibility, walking/biking infrastructure, and reduced traffic hazards in Thailand. In terms of satisfaction with local transportation in the AFC framework, two studies in Hong Kong (Chui et al. 2019) and Taiwan (Liu et al. 2018) noted preferences for infrastructure that better supports lower physical agility, adequate seating and weather protection at stations, and improved service provision for needs of older adults.

Besides these WHO frameworks, other infrastructure recommendations raised in the literature included: investment in infrastructure for pedestrians, such as clear zebra crossings and proper sidewalks (Olawole 2017); improvement of transport ventilation and cleanliness; introducing low-floor buses; including mounting equipment for wheelchair access; investing in audible and visual signals to stop a bus and equipment that clearly display routes and destinations (Esmailpour et al. 2020); establishing senior-center-based shuttle buses, prepaid taxi services, or specially coordinated bus/rail service to medical facilities (Szeto et al. 2017); providing more direct public transport services by reducing costs associated with interchanges; improving transfer experiences (Yang 2018); providing appropriate training to public transit drivers in order to enhance their awareness of driving behavior and attitude; evaluating the performance of the drivers (Wong, Szeto, et al. 2017); and designing a partition between females and males inside buses to provide comfort and a sense of security (Malik et al. 2020).

Other planning suggestions include promoting mixed land uses to ensure higher accessibility for elderly populations to help promote an active lifestyle (Adeel et al. 2017); promoting socially inclusive policies that encourage a safe traveling environment and a comprehensive female-friendly transport system to improve elderly women's mobility (Ahmad et al. 2019); and advocating for PT that provides the service, reliability, and safety needed by older adults (Aceves-González et al. 2016). Al-Rashid et al. (2020) call for policies that seek to develop more positive attitudes and associations towards PT in an effort to increase usage.

Lastly, one major policy problem is the lack of political participation of older adults, which may explain the lack of attention paid to the needs of this disadvantaged population group and their consequent inability to influence decision making on mobility policies (Gorman et al. 2019). It has been suggested that employing more mixed-method studies would be helpful, as these approaches are likely to uncover social issues, especially if the starting point is community engagement research involving older people as part of the research process and not just as subjects (Porter et al. 2018). Indeed, collaborations with local elderly communities in research has proven crucial to the implementation of inclusive transport infrastructure policies (Kuneida and Roberts 2006).

**Socio-Economic Aspects Intersecting Elderly Mobility**

Across these papers, I found recurrent mention of several socio-economic aspects as factors that intersect older adults' mobility opportunities, including employment, living arrangements, caregiving relationships, and social networks.

***Employment.*** The proportion of older adults in the Global South that need to work differs significantly from proportions in developed countries (Olawole 2017). Poverty

and deficient pension systems force older adults in the Global South to remain employed to support themselves and their families. A study in Hong Kong found that work is the dominant trip purpose for older men aged 60–69, despite the country's retirement age falling in that same age range (Szeto et al. 2017). In rural China, 57.3% of the participants in a study reported to work an average of 7.1 hours per day (Zhang and Qiu 2020). In contrast, Rajkumar and Kumar (1996) posited that a vast number of elderly in the Global South are capable of working, but frequently lack the opportunities to do so. Unemployed elderly have fewer employment opportunities than unemployed youth, therefore they are more likely to become marginalized.

***Living arrangements.*** Household composition influences many aspects of an older adult's life, including their mobility patterns, and can modify caring relationships and family members' ability to provide intergenerational support. Older adults living alone are more likely to experience feelings of loneliness and have less frequent interpersonal interactions (Knodel and Chayovan 2008). A bigger proportion of older adults in the Global South live with family members, in contrast to older adults in the Global North. A study in Manila reported that only 1% of older adults live alone, whereas in London the percentage is 36% (Pettersson and Schmöcker 2010).

Different household compositions result in different travel behaviours. For example, He et al. (2018) found that a larger household size is associated with more and longer mandatory trips during the early morning (before AM peak), and fewer and shorter discretionary trips particularly in the second half of the day. Elderly females who live with elementary school-aged children tend to walk frequently (Hatamzadeh and Hosseinzadeh 2020). Similarly, Manoj and Verma (2017) found that the number of

school-aged children in a household strongly predicts the amount of time older adults will allocate to out-of-home activities. When it comes to trips to a healthcare facility, family accompaniment has a negative effect on walking and public transportation, and a positive effect on use of taxis and cars (Li et al. 2018).

***Caregiving relationships***. Older adults often require care from their family members. Hanrahan (2018) explains how Ghanaian's culture emphasizes the importance of caring for family members and how intergenerational relationships create expectations of everyday support for women. Intergenerational care responsibilities mostly impact Ghanaian women's mobility because they are considered primary caregivers. In fact, women's socially constructed mobility requires them to fulfil these care responsibilities. Similarly, a study in Nanjing, China, found that even when living with elderly parents is negatively related to QOL, families continue to give great emphasis to family ties and care for one's parents and elderly family members, in an effort to follow Confucian cultural traditions (Feng et al. 2018).

However, older adults also provide care to children and grandchildren. A study in China found that elderly people usually drop off and pick up grandchildren to reduce the burden on their parents (Zhou et al. 2020). A study in rural Tanzania (Porter et al. 2018) found that older people have a role as caregivers of young children whose parents died or work in town. Moreover, many older people in Africa take care of people living in poor settings with HIV and AIDS, especially where there is limited access to anti-retroviral therapy. Likewise, Porter et al.'s. (2013) research on the mobility of older adults in Kibaha district Tanzania showed that the elderly travel mostly to visit family or attend social events and pedestrian travel dominates, even for journeys between villages. Porter

et al. 2013 found that the relationality between older people and their children and grandchildren is strongly displayed in their mobilities since mobility patterns of diverse age-groups are often intimately bound together, as older people care for grandchildren.

***Social networks.*** A study by Wignall et al. (2019) acknowledges that mobility is central to older people's social lives, as participants in this research stated that activities such as traveling within and between cities, attending church, and visiting relatives and friends represent an integral part in their lives. Nearly all the participants reported using buses, taxies, cars, or walking to maintain their social relationships with family and friends. Similarly, a study conducted in South Korea (Lee and Choi 2020) demonstrates that older adults' mobility and social participation have a positive effect on life satisfaction. The authors suggest developing more community-based initiatives to support social participation of South Korean older adults, who tend to participate less than those in other countries as their immature pension system forces them to work longer. Along the same lines, Wu and Tseng (2018) found in their study that community-based social support networks can reduce social isolation, provide emotional support, and increase independence among the elderly, therefore enhancing their well-being.

## Discussion and Conclusion

The purpose of this scoping review was to uncover the dominant themes within the existing literature of older adults and daily mobility in the Global South. This is particularly important given the changing geographies of ageing and the rapid growth of older adult populations across the world. I found the existing body of literature to be small and fairly recent—with most sources published since 2010, and especially since

2016—and spread across diverse geographic regions. From these papers, three dominant themes emerged, which I translated into secondary research questions.

In terms of what modes of transport elderly choose or use, I found walking, public transportation, and personal vehicles to be most important, depending on the study context. This is a key difference from the findings in the Global North literature, where car-dependency dominates older adults' mobility (Cui et al. 2017). Given the lack of national travel survey datasets, particularly in low- and middle-income countries (Gorman et al. 2019), these trip mode choice studies were based on small-scale surveys. Access to national surveys would provide broader understandings of older adult travel behaviours and important variations. Also, only one study in this review focused on older adults' usage of bicycles. This is an area that could be explored further, especially where strong and growing bicycle cultures exist, such as Asia. Future research should consider that factors such as safety perceptions, transport infrastructure, health and environment, and comfort levels contribute to older adults' unfavourable attitudes towards cycling (Acharjee and Sarkar 2021), and that older adults who bike are more likely to choose e-bikes (Cheng et al. 2019).

I found the major unmet mobility needs of the elderly to be broadly similar to those found in the Global North literature, including: safety concerns, inaccessible transport, service unreliability, negative attitudes of public transport, and age and gender inequities. However, many of the underlying problems and proposed solutions point to some fundamental differences.

In instances where informal transport systems are dominant, their unregulated and competition-driven capitalist nature disincentivizes transport operators them to provide

service to meet the transportation mobility needs of older adults (Aceves-González et al. 2015, 2016). For solutions such as inclusive transport infrastructures, including pedestrian mainstreaming, there is a large disconnect between the existing legal frameworks and the actual lived mobility experiences of older adults (Kuneida and Roberts 2006). The global planning models from the WHO to promote health ageing and age-friendly cities are useful starting points but have limited uptake in the Global South due to lack of political incentive or economic resources, the mismatch of one-size-fits-all approaches, or the confluence of other pressing local demands (e.g., rapidly growing young populations, poverty alleviation) (McQuaid et al. 2020). To better address the problems of unmet mobility needs, many argue that older adults have been excluded from decision making and the research process and call for the use of more qualitative, mixed-methods and participatory research methods to enable the examination of these issues at a grassroots level (Kuneida and Roberts 2006; Porter et al. 2018; Gorman et al. 2019).

Regarding the socio-economic aspects that influence elderly mobility, there are three sub-themes that appear to manifest in contrast to the existing Global North literature. First, a few Global South studies articulated the important role of mobility in maintaining social networks and a sense of autonomy, and the subsequent impacts of these on QOL and health and well-being (Rajkumar and Kumar 1996; Aceves-González et al. 2015), but this is otherwise absent from this literature. Second, in some instances there are high levels of old-age employment in the Global South, creating transportation mobility demands that are different than those for retired persons. This contrasts with the dominance of retirement status within Global North literatures. And third, the "intergenerational intersectionality of older adult mobility" (Porter et al. 2018, 84)

suggests that mobility is socially produced through intergenerational households. In more traditional household structures, the mobility of older adults intersects with other family members, whereby younger members may be more mobile out of the home and older members become domestic anchors. Central to these relational mobilities are bi-directional caregiving relationships of providing and receiving care. Though this traditional household structure is more dominant outside of advanced economies, there are many older adults in the Global South that do not have such family support and the resulting intergenerational exchange (Gorman et al. 2019). Future research might consider the "household responsibility hypothesis" (Silveira Neto et al. 2015) to study differences in household responsibilities between older females and males in terms of how those responsibilities intersect their everyday mobilities.

There are a few noted limitations in this scoping review. First, the database search parameters and inclusion/exclusion criteria likely overlooked some relevant papers. I assume there is a larger body of existing research that is not catalogued in the mainstream databases and/or not published in English or Spanish. Therefore, this scoping review does not claim to be exhaustive. Second, the broader use of the geographic realm "Global South" was intended to explore ageing and mobility research beyond the advanced economies of Northern and Western Europe, Canada, the United States, and Australia where a vast majority of the existing literature is situated. This delineation subsequently included cities and countries that represent a wide range of economic and urban development levels. As such, given the small number of studies reviewed (n=57), representing very diverse geographic contexts, it is difficult if not unwise to suggest generalizable conclusions from the literature.

In conclusion, I concur with the findings of others (Porter et al. 2018; Gorman et al. 2019)—that there is a shortage of research on older adults and transportation mobility from outside the Global North. My primary recommendation for future research, therefore, is two-fold. First, expanding the body of research literature should happen with new empirical studies, as well as deeper explorations of existing studies outside of mainstream databases. Second, as new research emerges from the Global South, it is essential to recognize the heterogeneity across the regions and to understand the geographically specific contextual nature of older adult mobility, the nuances between places, and differences within localities (Gorman et al. 2019). This will support locally specific theoretical development and contextually relevant policy recommendations to improve the daily mobilities of older adults.

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# Chapter Three: Daily Travel Behaviors and Transport Mode Choice of Older Adults in Mexico City

## Introduction

Increased life expectancy and decreasing fertility trends are changing the age structure of populations worldwide. According to the United Nations (2020), the global percentage of people aged 65 and older will increase from 9.3% in 2020 to 16% by 2050. In particular, Latin America and the Caribbean is one of the fastest aging geographic regions in the Global South, where fertility started to fall in the last half of the 20$^{th}$ century (Wong and Palloni 2009). In Mexico, projections show that by 2050 the birth and mortality rates will converge and continue to influence a fast aging process (Zamorano et al. 2012; Angel et al. 2016)

From the many dynamics aging cities face, transport geographers have shown interest in better understanding the mobility of this growing aging population by proposing different theories related to aging and quality of life (Metz 2000; Banister and Bowling 2004); wellbeing (Ziegler and Schwanen 2011; Nordbakke and Schwanen 2014); the cycle of life (Webber et al. 2010); elderly mobility perceptions (Goins et al. 2015); loneliness and the role of the built environment (van den Berg et al. 2016; Lyu and Forsyth 2022); aging in car dependent societies (Harrison and Ragland 2003; Cui et al. 2017; Ang et al. 2019); aging societies' impact in transportation policy (Gorman et al. 2019); transport-related social exclusion (Lucas 2012); and differences between the

elderly societies from the Global North and the Global South (Pettersson and Schmöcker 2010).

The role of older adults' access to PT is recurrently mentioned in the literature, for example, Musselwhite (2015) argues that provision of good quality bus services are vital to health and wellbeing for older people. Cui et al. (2017) suggest that unreliable and poor PT services and a lack of pedestrian infrastructure are key barriers for elderly to use PT. Lyu and Forsyth (2022) found that older adults feel less lonely when they have access to affordable and convenient PT services. van den Berg et al. (2016) found positive effects of PT accessibility on social satisfaction as PT provides a space where social interactions can occur. Lucas (2012) explains that transport-related exclusion refers to the interactions between individual factors such as age, gender, disability, and race; local area factors, including lack of access or availability to PT; and national and global economy factors. In this context, the poorest populations tend to experience transport disadvantages and have less access to PT.

In the context of Mexico City, previous research suggests that transport-related inequalities, particularly related to PT, represent a current reality that needs to be further studied. For example, Guerra (2017) found that poor households in Mexico City are the least able to reduce PT expenditures without reducing travel, whereas wealthier households are located in the most accessible neighborhoods. Similarly, Bautista-Hernández (2020) mentioned that Mexico City's PT infrastructure decreases as we go from the center to the periphery which disproportionally affects low income populations. Bautista-Hernández (2021) analyzed the 2017 Household Origin-Destination Survey

(HODS 2017) and found that increasing age, lower categories of socioeconomic class and low educational attainment were associated with the use of PT and non-motorized travel. Moreover, Flores-Espinosa (2018) claims that the most deprived areas of PT services in Mexico City coincide with the areas of highest marginalization, mainly located on the outskirts of the city. These transport-related inequalities are even more relevant to address as previous studies have shown PT as one of the most prevalent mode choices in Mexico City, according to Suárez et al. (2016) 80% of trips in the city are made by PT.

Lucas (2012) calls for the need to address transport-related exclusion problems in the Global South to uncover different geographical and social contexts and for different society groups. To respond to this call, I present a research that seeks to uncover the travel patterns and transport mode choice of older adults in Mexico City, as a growing sector of the population whose travel behaviors have not been studied before. In fact, the study by Navarrete-Reyes et al. (2017) appears to be the only one that examines the everyday mobilities of elderly in Mexico City. However, their study only focuses upon perceptions of transportation deficiencies among older adults, aged 70 or older (N=228), who attended a specific tertiary care hospital in Mexico City. Their results examine mobility obstacles identified by participants. Their research sets a precedent and highlights the importance of further understanding mobility patterns of older adults. However, it also presents several limitations e.g., a small sample size, inability to extrapolate results to all older adults in Mexico City, little information gathered about transport mode choice, and bias regarding participant selection since they were all outpatients of the same hospital.

My paper adds to the aging mobilities literature in the Global South by uncovering travel behavior patterns that are representative of all older adults residing in Mexico City. Additionally, I construct a multinomial logit model to predict older adults' transport mode choice. This paper has the following research objectives: to describe the socioeconomic characteristics of the elderly populations in the city; analyze their travel behaviors and examine the relationship between socioeconomic characteristics and transport mode choice; and finally uncover transport-related inequalities faced by older adults in the city.

## Methods and data

**Descriptive statistics from the HODS 2017**. The 2017 HODS was administered by Instituto Nacional de Estadística y Geografía, INEGI (National Institute of Statistics and Geography) and is publicly available (INEGI, 2017). This survey captures data on trip characteristics, modes of transportation, household composition, and socioeconomic variables. It includes responses from 66,625 households located in 194 origin-destination (O-D) districts that comprise MCMA, 86 in Mexico City, 108 in Mexico State, and 1 in Hidalgo State. *O-D districts* are defined as territorial units of statistical representativeness of the collected data on population, housing, and trips. They are composed of conglomerates of primary sampling units with the same number of households and total population. The unit of analysis is the *trip*, which refers to the movement of a traveler from an origin to a destination and using one mode of transportation. The survey includes weighted values to calculate estimates representative of MCMA. Figure 5 shows the O-D districts conforming MCMA and identifies in yellow the study area conformed by 86 O-

D districts in Mexico City. According to the 2020 census (INEGI 2021), there are 9,209,944 inhabitants in Mexico City, from this total, 16% are 60 or older.

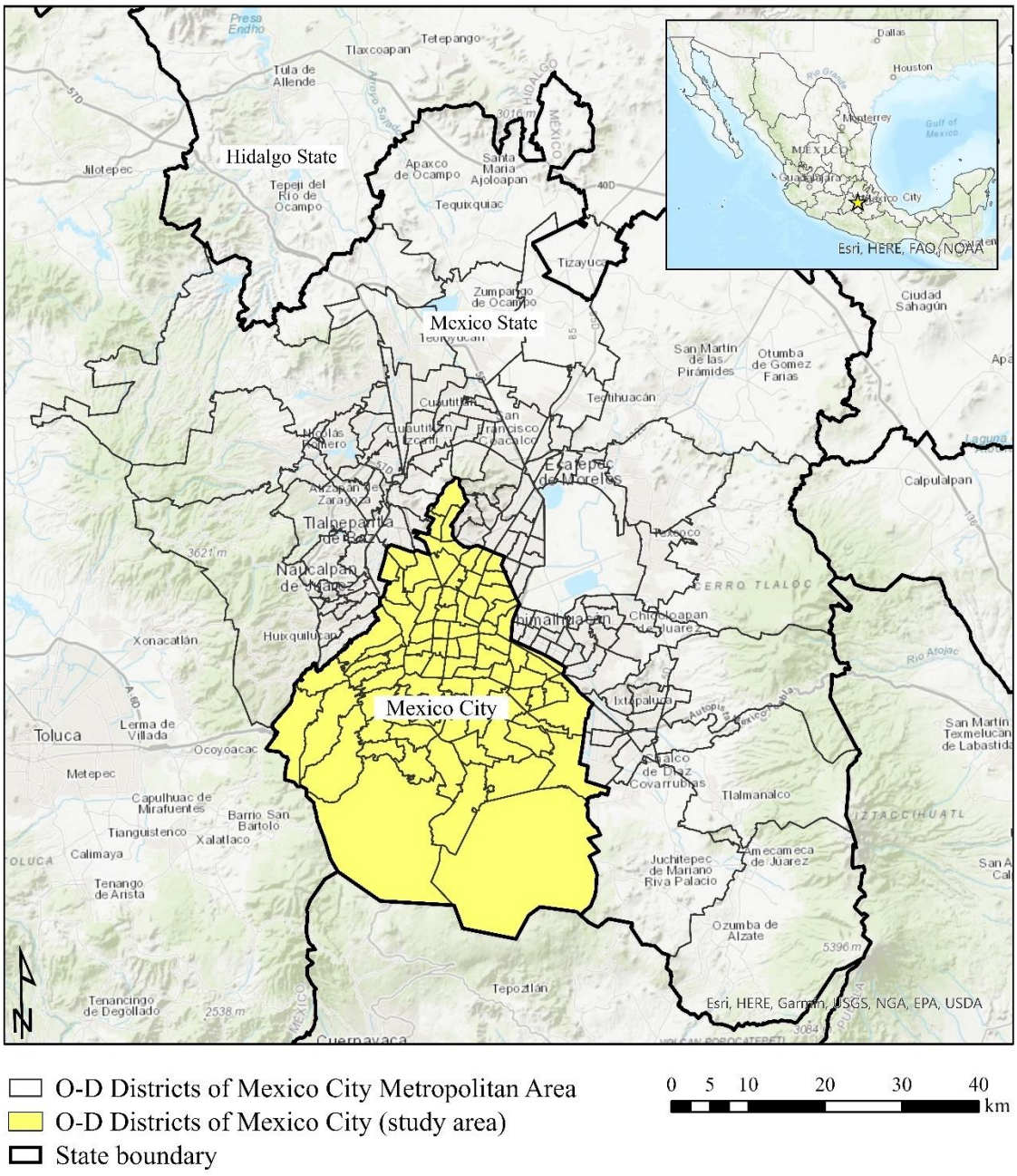


Figure 5. Study area

I used a subset of this survey by selecting the trips that originated in one of the 86 districts in Mexico City and were conducted by a person aged 60 or older. This sample contained 10,349 older adults who conducted 35,047 trips. Later, I multiplied these values by the weighted factors to obtain the estimate for the study area. The weighted scheme extrapolates responses of 1,099,665 older adults with a residence in Mexico City that conducted 3,743,839 trips and is representative of all older adults who reside in Mexico City. I ran all descriptive and inferential statistics using R and Stata and generated thematic maps in ArcGIS Pro.

**Local spatial availability index (LSAI).** This index ranks census tracts by level of access to public transit infrastructure. This measure is relevant in the context of Mexico City as 40.5% of elderly in the study area report conducting trips by using some form of public transit. The index is constructed by considering the transit stops from four major public transit modes: subway, BRT, trolley, and buses and determining a spatial service area for each one of them, namely a 200 m buffer for buses and trolley; 800 m for the subway; and 400 m for the BRT (El-Geneidy et al. 2006). Afterwards, I performed a spatial join to count the number of buffers that intersect every census tract in the study area. A factor of "2" was added to the subway count, because of its large connectivity. The higher the index value, the more public transit stops elderly living in that census tract can access.

**Attraction index (AI).** To illustrate which districts receive the most trips and which generate the most trips, I calculated two different indexes using the dataset. First, the *attraction index* was calculated by dividing the total number of trips attracted by a district

by the total number of trips generated by that same district. The *trip generation index* is obtained by dividing the total number of trips generated in a district by the total number of trips attracted by that same district. This index reflects the attractiveness of a specific district. A high value represents a high amount of older adults traveling towards a specific district in comparison to the total number of older adults who travel from this district towards another one.

**Multinomial logistic model.** Mode choice models are useful in transportation studies because they analyze how individuals move and what their mobility patterns are, an issue fundamentally relevant for proper planning of a transportation system (Muro-Rodríguez et al. 2017). My mode choice analysis aims to identify variables that affect commuter choices and determine the probability of choosing one from a set of different options. I include socioeconomic factors such as income, retirement status, household composition etc. as these are unequally distributed in the study area and therefore relevant to address on mode choice decisions. I assume that the unobserved portion of utility is independent and identically distributed, therefore, I calculated a logit model and a utility given by:

$$V_{nj} = V(x_{nj}, s_n) \forall j$$

$$v_{nj} = \alpha_1 + \alpha_{2j} length + \alpha_3 purpose + \alpha_4 day\ of\ the\ week + \beta_1 sex + \beta_2 age + \beta_3 retirement\ status + \beta_4 socioeconomic\ status + \beta_5\ number\ of\ vehicles\ + \beta_6\ number\ of\ people\ in\ the\ household + \beta_7\ LSAI + \beta_8\ AI$$

***Variables included in the model***

*Mode choice.* The dependent variable is the mode that an older adult (*n*) chooses for trip *j*. Sometimes a trip requires different transportation modes. For multimodal trips, I

assigned the dominant mode of transportation to each trip. That is, the mode that takes most of the length of the trip.

*Socioeconomic variables.* These are given by the descriptive statistics calculated using the HODS 2017. I created a dummy=1 when the trip occurs during the weekday and 0 otherwise. The variable sex is 1= older male and 0 = older women. The age is given in years. Retirement is a dummy =1 if the commuter is retired. The HODS 2017 provides a socioeconomic variable given by 1= low income status, 2= medium low, 3= medium high and 4= high income level. I also include the number of vehicles and the number of people living in the household.

*Trip's length*. As the survey also provides the length of the trip in minutes, I built a proxy for distance in the following way: first I selected trips within the same district, and I calculated the average time. Then I use the city average speed of 12 km/hr, which I obtained by including all transport modes, excluding walking, to calculate the distance traveled during this time and get a variable that gives an approximate distance traveled.

Table 1. Trip purpose categories

| **Purpose** | **Group** |
|---|---|
| Work | Go to a workplace |
| Care | Go shopping, or go pick up someone |
| Socialize | Go visit someone, or go to church |
| Responsibilities | Run and errand, go to a doctor's appointment |
| Other | Other |

I created a dummy variable for each alternative leaving other out of the equation to avoid multicollinearity

*Trip purpose.* This variable was also provided by the HODS 2017 and was categorized into five different groups to facilitate the calculation of the regression model.

Table 1 shows the classification given by grouping purposes encompassing similar sentiments.

## Results and discussion

To address the first research question, I describe socioeconomic characteristics of older adults in Mexico City to better understand their demographic profile and later analyze how these variables influence their everyday mobility patterns.

### Sociodemographic context of older adults in Mexico City

***Age and gender.*** Approximately 60% of the elderly in the study area is aged 60 to 69. Older women represent 54.4% of the sample and older males 45.6%. The mean age of the sample is 68.7 years for both genders. Table 2 shows the total number of older adults included in this sample by age group and gender.

***Employment status.*** In the sample, 41.3% of older adults reported having a job. From this percentage, 25.8% are older males and 15.5% older females. Table 6 presents the percentage of elderly working population by gender and age group. Percentages of working older adults are higher for older males and decrease with age. These results are contextualized with findings from Angel et al. (2016) and Aguila et al. (2012) who estimate that half of all Mexican workers are employed in the informal sector, where low-wage, low-income workers employed as part-time or seasonal work, therefore giving very few older adults access to pensions. The high percentage of employment differs from a study in Seoul, South Korea, where only 10.2% of the elderly surveyed reported having a full-time or part-time job (Choo et al. 2016).

Table 2. Total older adults and employment status by age group and gender

| Age group | Older males | % Older males | | Older females | % Older females | |
|---|---|---|---|---|---|---|
| | | Working | Not working | | Working | Not working |
| 60 - 64 | 175,823 | 76.7 | 23.3 | 204,774 | 41.6 | 58.4 |
| 65 - 69 | 129,265 | 61.5 | 38.5 | 154,566 | 29.3 | 70.7 |
| 70 - 74 | 94,472 | 44.0 | 56.0 | 106,749 | 22.4 | 77.6 |
| 75 - 79 | 52,773 | 35.9 | 64.1 | 69,651 | 13.9 | 86.1 |
| 80 - 84 | 30,567 | 20.9 | 79.1 | 41,002 | 13.3 | 86.7 |
| 85 - 89 | 13,459 | 14.2 | 85.8 | 15,901 | 6.6 | 93.4 |
| 90 + | 4,625 | 9.1 | 90.9 | 6,038 | 0.0 | 100 |

Footnote: each row per gender is equal to 100%

***Education level.*** Results from the sample showed that 5.4% of older adults reported not having any education, 67.6% completed a K-12 education, and 26.8% earned a degree in higher education (figure 6). On average, older adults in the sample completed 9.5 years of school. In contrast to 11.5 years of school completed by adults 15 and older (INEGI, 2020).

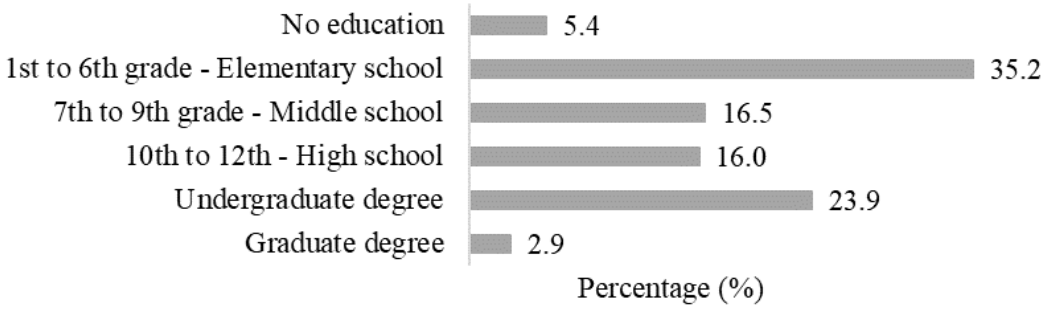


Figure 6. Percentage of older adults per education level

***Socioeconomic status***. INEGI included a socioeconomic status variable in the HODS 2017 defined by four categories: low, medium low, medium high, and high. These categories were calculated considering 34 different indicators from the INEGI 2010

Household Census. These indicators were used to determine the socioeconomic status of each individual surveyed. In the study area, 0.1% of older adults present a low socioeconomic status, 33% medium-low, 47.9% medium-high, and 19% high. According to data from 2001, 20% of the population in Mexico lived in poverty and this rate increased almost to 30% among older adults aged 65 and more (Aguila et al. 2012). Therefore, older adults in Mexico continue to be vulnerable to poverty.

***Retirement status***. Results indicate that only 30.5% of older adults report being retired and receiving a monthly pension. It is higher among males (55.4%) than females (44.6%). Receiving a pension varies depending on age group, for example only 18% of older adults aged 60 to 64 reported being pensioned, whereas this percentage increases to 46.2% for older adults aged 85 to 89. Actually, the Mexican pension system continues to show quite a low coverage among populations 65 and older (Antón 2012), therefore intergenerational family transfers represent a major source of income for low-income, older Mexicans (Angel et al. 2016). Furthermore, forecasts predict that the pension system will reduce its coverage and by 2051 the percentage of males without a pension will rise from 38 % to 59% (Colín 2019)

***Household composition***. Only 13.1% of the elderly in the study area reported living by themselves. 61.8% reported living in a household with 2 to 4 more individuals; 23% live with 5 to 8 more, and 2.2 with 8 or more. These results show the prevalence of multigenerational households in the study area and differ from living situations found in the literature coming from the Global North, where elderly living by themselves is more common (United Nations 2020)

***Car ownership.*** The study area includes 838,977 households. From these households, 53.9% older adults report owning zero vehicles (cars or trucks), 35.3% own 1, and 10.8% own 2 or more. The low percentages of car ownership concur with other studies from the Global South see (Odufuwa 2006; Pettersson and Schmöcker 2010; Ren et al. 2018; Ahmad et al. 2019). Variations occur depending on socioeconomic status. For example, 89.6% of low socioeconomic status older adults do not own a vehicle compared to 25.5% for older adults from a high socioeconomic status. The percentage of older adults who own two or more vehicles increases as their socioeconomic status increases.

**Travel behaviors of older adults in Mexico City**

This section describes older adults' travel behaviors related to trip purposes, trip origins and destinations, trips by geographic destination, trip durations, and preferred transportation mode.

***Trip generation.*** 3,743,839 trips originated in Mexico City and were made by 1,099,665 older adults. Fifty seven percent of these trips were made during the week and 43% on a Saturday. On average, older adults made 3.9 trips across the two days of the survey. These results are comparable to findings in the Philippines (Pettersson and Schmöcker 2010) and Seoul (Choo et al. 2016). Among weekday trips, 53.2% were made by older females and 46.8% by older males. Similarly, 53.7% of weekend trips were made by older females and 46.3% by older males. These percentages are different from other studies where older males conducted more trips on average than older females (Hu et al. 2013; Ahmad et al. 2019).

***Trip purpose.*** Table 3 shows the total number of trips made in the week and the weekend by trip purpose. The percentage of trips purposes changes depending on the day of the week. Picking up someone, running an errand, going to the doctor, and going to work are trips generally conducted during the week while going to socialize and going to church are more likely to occur during the weekend. These results are comparable to the ones reported by Choo et al. (2016) who found that the most common trip purposes for elderly in Seoul were: personal business, work, and leisure/recreational/social trips. Similarly, Soltani et al. (2018) found that the main trip purposes of elderly in Shiraz, Iran were: shopping, work, personal business, and medical/dental.

Table 3. Percentage of trips by purpose

| Trip purpose | % Total trips |
|---|---|
| Go home | 46.9 |
| Go shopping | 18.8 |
| Go to work | 13.2 |
| To go socialize/recreation | 10.8 |
| Go to the doctor | 3.6 |
| Go pick up someone | 3.0 |
| Go run an errand | 1.5 |
| To go to church | 0.9 |
| Go to school/study | 0.4 |

***Trip origins.*** 48.3% of the trips in the study site started in participants' own households; 23.9% in a retail store, market, or shopping mall; and 26.6% in a different public space, including an office, community center, restaurant, etc. Also, 68% of older adults who reported starting a trip in an office during the week were older males, this percentage increases to 71% on the weekend. This concurs with other studies that found older females less likely to make trips to work (Choo et al. 2016). In comparison, 62% of

older adults who reported starting a trip in a retail store, market, or shopping mall during the week were older females, this percentage changes to 60% during the weekend.

***Trips by geographic destination.*** 40**%** of the trips were intra-district, as they started and ended in the same district, while the rest were inter-district, starting and ending in a different district. These results show that the everyday mobility of over half of the study area covers at least two different districts and therefore account for considerable distances and travel times.

***Attraction and trip generation indexes***. Figure 7 shows that districts located in the city center present a higher attraction index, likely because those districts are closer to the central business district and have a more equipped built environment, access to jobs, services, retail, and recreational spaces. Conversely, districts that generate more trips than they attract are located on the periphery of the city, which are mostly residential and have less access to services and recreation spaces.

***Trip duration.*** Trips made by older adults had an average duration of 39 minutes. Table 4 shows the average trip duration in minutes by socioeconomic status, geographic destination, and gender. Results show important variations depending on gender and socioeconomic status. For example, an older female from a high socioeconomic status who travels intra-district, spends an average of 18.7 minutes on a trip, whereas an older male from low socioeconomic status who travels intra-district spends on average 42 minutes on a trip. In fact, older adults from a low socioeconomic status take the longest to travel inter- and intra-district, particularly older males. These results show interesting equity issues as poorer older adults conduct longer trips likely to go to work and without

a car and live in the city periphery, in comparison to elderly from high socioeconomic status who probably own a car and live in the city core. Research shows that wealthier older adults generally conduct more trips than their poorer peers (Ahmad et al. 2019). However, the intersectionality between elderly's time spent traveling in respect to their socioeconomic level is a topic that should be further studied.

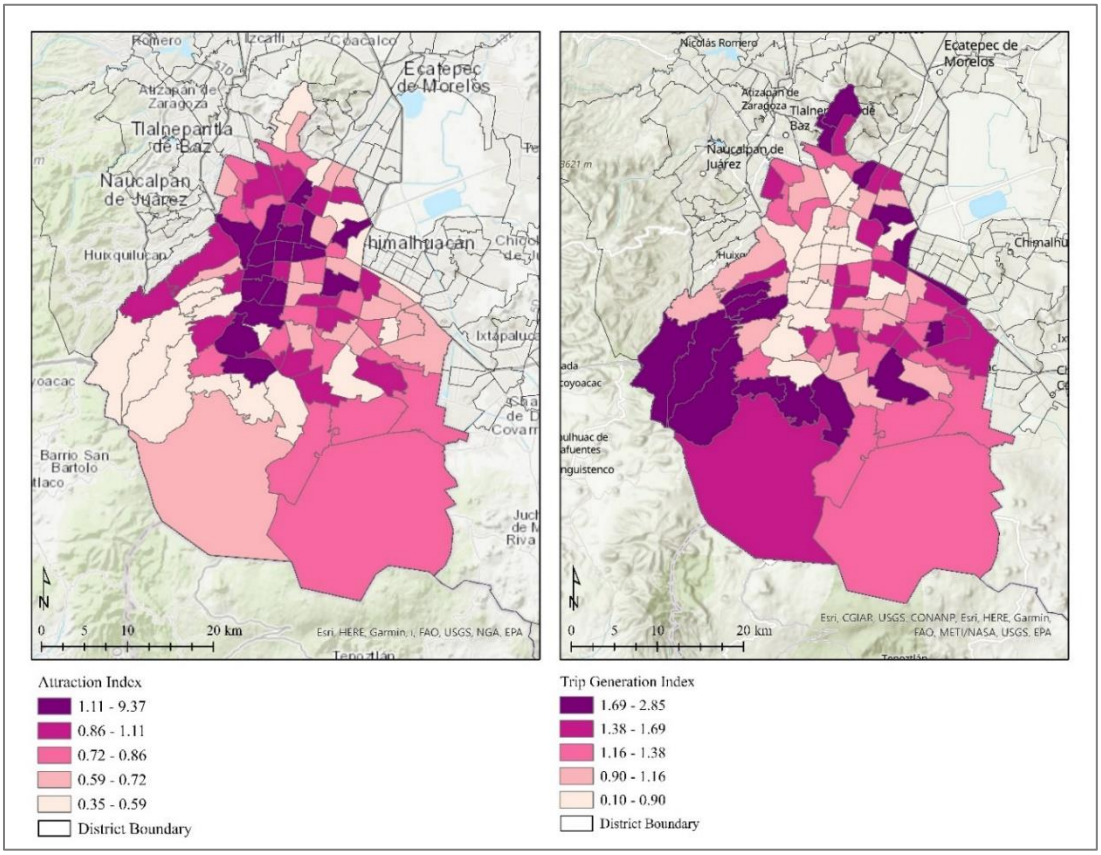


Figure 7. Attraction and trip generation indexes by district

Table 4. Average trip duration in minutes by socioeconomic status, destination, and gender

| Socioeconomic status | Average duration (min) Intra-district trips | | Average duration (min) Inter-district trips | |
|---|---|---|---|---|
| | Older males | Older females | Older males | Older females |
| Low | 42.0 | 21.1 | 113.4 | 58.1 |
| Medium low | 20.8 | 19.2 | 60.6 | 56.5 |
| Medium high | 17.6 | 17.7 | 52.5 | 47.1 |
| High | 19.0 | 18.7 | 48.5 | 45.5 |

***Trips by transportation mode***. The HODS 2017 includes 20 different types of transportation modes. I classified these modes into six categories to facilitate the calculation of the multinomial logit model (Table 5). Approximately 32% of older adult trips were conducted by walking, 40.5% by public transit, including buses and taxis, and 28% used some form of personal transportation such as bicycle, car, or motorcycle.

These findings are generally consistent with studies from other cities. Walking was also the most popular travel mode in studies with older adults in Seoul, South Korea (Choo et al. 2016) and Changchun, China (Hu et al. 2013). Similarly, Pettersson and Schmöcker (2010) reported that elderly in Manila preferred: public transit, walking, and car. Soltani et al. (2018) found private cars, taxis, and public transit were the three preferred modes of transport for elderly Iranians. However, their survey did not include walking as a mode.

It is worth noting that the subway, trolley, bus rapid transit (BRT), and light rail have networks that cover most of the core of the city; their service is constant and relatively reliable in terms of personal safety and comfort compared to the service provided by local

and regional buses that tend to be difficult to get on, have smaller seats, less reliable schedules, and generally are the only option for commuters in the city's periphery.

Table 5. Percentage of trips by transportation mode

| Groups | Included transportation modes | % of trips |
|---|---|---|
| Walking | Walking | 31.8% |
| Structured PT | Metro, trolley, BRT, light rail, commuter rail | 17.3% |
| Buses | Local and regional buses | 15% |
| Paid transit services | Taxi, ride-hailing services, bicitaxi, mototaxi, etc. | 8.2% |
| Bicycle | Bicycle | 1.2% |
| Vehicle | Car and motorcycle | 26.5% |

**Results of the model**

Table 6 shows the results obtained by each mode of transportation, where car is the base outcome. All other options are compared to the car. There were 17,431 trips in this model. I assigned one dominant mode of transportation to each trip to predict what variables explain that mode choice. Results show that older adults are more likely to use structured public transit, buses, or walking in comparison to driving when their trip purpose is going to work, run an errand, or to a doctor's appointment. Similarly, Navarrete-Reyes et al. (2017) found that the most common transportation modes for patients attending a doctor's appointment were: as passengers in a car, followed by walking, taking a taxi, and public transit. Only 17% of older adults in their sample reported driving to their appointments.

Older adults are more likely to prefer walking in comparison to driving during the weekend. As previously mentioned, 41% of elderly in the study area reported having a job, therefore they are more likely to have time to walk during the weekend. Older males

are more likely to choose walking, biking and use structured public transit than older females. Older females are more likely to use paid transit options such as taxis in comparison to older males. These results are similar to data from Sao Paulo, where older females are more likely to feel unsafe using public transit, therefore preferring to use paid transit (Mação Bernal et al. 2019).

Table 6. Results of the multinomial logit model

| **Car is the base outcome** | **Walking** ***n = 5,855*** | **Structured Public Transit** ***n = 3,034*** | **Buses** ***n = 2,739*** | **Paid Transit** ***n = 1,240*** | **Bicycle** ***n = 207*** |
|---|---|---|---|---|---|
| | | | **Coef.** | | |
| Trip's length | 0.402*** | 0.55*** | 0.465*** | 0.299*** | 0.144*** |
| Purpose - work | 1.07*** | 0.915*** | 0.865** | 0.015 | 0.811 |
| Purpose - care | 0.041 | -0.261 | -0.004 | -0.719* | -0.2 |
| Purpose - social | 0.846*** | 0.048 | 0.302 | 0.162 | 0.57 |
| Purpose - responsibility | 1.506*** | 1.381*** | 1.617*** | 1.805*** | 0.309 |
| Day of the week | -0.339 | -0.065 | 0.004 | -0.116 | -0.187 |
| Gender | 0.57*** | 0.274*** | 0.023 | -0.346*** | 3.437*** |
| Age | -0.007 | -0.018*** | -0.015*** | 0.025*** | -0.018 |
| Retirement status | 0.093 | 0.166* | 0.142* | 0.21** | -0.142 |
| Socioeconomic status | 0.538*** | 0.446*** | -0.034 | 0.218*** | -0.363** |
| Num of vehicles | 1.583*** | -0.041 | -0.156*** | 0.015 | 0.06 |
| Num of people | -0.169*** | 0.013 | 0.03* | 0.051** | 0.04 |
| Attraction index | -0.009 | -0.243*** | -0.271*** | -0.267*** | 0.112 |
| Access index | -0.013* | 0.06*** | -0.023*** | 0.009 | -0.053** |
| Alpha | -4.528*** | -4.812*** | -2.111*** | -4.975*** | -4.137*** |

***p < 0.001; **p < 0.01; *p < 0.05.
Log likelihood = -19333.423
Pseudo R2 = 0.2839
Number of observations = 17,431
LR chi2(65) = 15326.49
Prob > chi2 = 0.0000

Older females are more likely to use paid transit options such as taxies in comparison to older males. These results are similar to data from Sao Paulo, where older females are more likely to feel unsafe using public transit, therefore preferring to use paid transit (Mação Bernal et al. 2019).

As older adults grow older, they use their private car instead of walking, using structured public transit or buses. Public transit usage decreasing with age was also found in studies by Ahmad et al. (2019), Pettersson and Schmöcker (2010), and Olawole (2017). However, I found that taxis and ride hailing services are preferred over private cars as the cohort ages, as these options are safer and more comfortable. The more people who live in one household, the less likely older adults are to choose walking instead of driving, likely because their family members provide elderly the support they need to run close by errands, therefore they don't have the need to walk as much. Older adults who own vehicles are less likely to use buses instead of driving as they are more convenient and provide a greater sense of independence and freedom.

Additionally, the higher the attraction index of a district, the less likely older adults are to choose structured public transit, buses, or paid transit instead of a vehicle. This is likely because districts with the highest index of attraction are located in the city center, where older adults go accompanied by their family members, therefore choosing to use cars.

A major finding shows that the higher the accessibility index of a district, the more likely older adults are to use structured public transit in comparison to driving, and less likely to choose buses or bicycles. This result shows that when older adults live close to

good PT infrastructure, they use it. The finding is consistent with Ahmad et al. (2019) who found that most of the older adults they interviewed said that they would use public transit more if it were improved. Manoj and Verma (2015) argued that improvements in PT systems can influence the travel behavior of workers and non-workers. Similarly, Pettersson and Schmöcker (2010) consider that if investments were made to the transport network in Manila, car trips made by younger older adults could decrease and be substituted by public transit trips.

**Conclusions**

This study offers a first comprehensive overview of the everyday mobilities of older adults in Mexico City and contrasts findings with the literature coming from other countries in the Global South. In summary, I found a relatively young sample of older adults from a medium-low socioeconomic status who have the necessity to continue working. They likely work in informal or lower skilled jobs because of their limited education attainment and the fact that they are likely not receiving a monthly pension. Also, only 1 in 10 older adults live by themselves and 1 in 2 own a vehicle. The trip characteristics of older adults in the study area present interesting findings: 1) that older females are slightly more mobile than older males as they conduct about 53% of the total trips; 2) older males seem more likely to start a trip at an office than older women, whereas older women are more likely to start a trip at a retail store, market, or shopping mall; 3) the most frequent trip destination was a retail store, market, or shopping mall, with 46.1% of the total trips; 4) 40% of the total trips ended in a different district where they started showing that elderly are mobile and travel to different areas of the city; 5) the

districts that attracted the most older adults are located in the city center while the districts generating the most trips are located in the outskirts of the city; 6) gender and socioeconomic status influence the duration of a trip, as poorer older adults spend more time traveling than wealthier elderly; and 7) 40.5% of older adults reported using PT, 32% walking, 26.5% driving, and only 1.2% biking.

Mobilities resulting from gender differences must be further studied as results show that older females are less likely to use structured public transit, walking, and biking in comparison to older males. Literature that shows older females are more likely to become victims of harassment in PT (Vilalta 2011). Additionally, we must consider that relationships of care tend to require more chained trips from older females as they are usually in charge of running errands for their family members such as going to the groceries (Bautista-Hernández 2020). Lastly, older females, particularly from low socioeconomic levels, are less likely to drive in contrast to older males. which leads them to use paid transit options. Therefore, more research should focus on better understanding these gender differences among elderly populations.

Additionally, future research must focus on designing specific actions towards policies that address older adults' mobility needs and takes into consideration their right to a pleasant and safe transport experience. Also, there is a need to conduct more qualitative research that addresses the human factor that plays a role when making mode choice decisions and that cannot be captured by any regression model.

Family dynamics and intergenerational relationships should also be further studied, as I do not know the frequency in which older adults report to conduct trips by car but as

passengers, not as drivers. This situation was also brought up by Navarrete-Reyes et al. (2017) and Pettersson and Schmöcker (2010). This would help us understand better how mobility opportunities intersect with family relationships, especially in the Global South where older adults generally live with other family members.

Research also suggests that poor older adults present more mobility barriers, such as poor public transit infrastructure and therefore travel less (Ahmad et al. 2019). However, in the case of Mexico City, I discovered that poorer older adults travel for longer periods of time in comparison to their wealthier peers. Results show that despite mobility barriers, poor elderly in Mexico City need to reach places to work and continue supporting themselves as they probably do not have the option to retire.

Additionally, my results show that when older adults have access to good public transit infrastructure, they use it, regardless of car ownership status. Therefore, policies in Mexico City should consider growing structured PT networks to marginalized areas of the city, such as the outskirts, as older adults living in those areas are likely poor and continue working. To this respect, Mação Bernal et al. (2019) argue that investing in multimodal public transit terminals, as important tools for transport planning, could present an important inclusion factor for older adults.

In terms of research limitations, I first note a few limitations of the model: 1) the model assumes that older adults choose the transportation mode that maximizes the commuters' utility. This utilitarian assumption leaves no room for psychological decisions or emotions, therefore there are aspects that influence older adults' mode choice that we cannot add to this model and hence the justification for qualitative based

studies; 2) merging PT modes in four categories will limit the opportunity to capture preference for specific transport, and 3) the model does not provide information on geographic differences in travel mode choice within the study area. Other limitations of this study include: 1) the 2017 HODS data I used does not reflect the mobility changes that occur during or after the current pandemic, which shifted the everyday mobility patterns, 2) to this respect, having access to temporal mobility data would help better understand the changes in mobility patterns of older adults in Mexico City.

Lastly, I should continue efforts to improve active transportation modes such as walking and biking, as better walking infrastructure, such as sidewalks and complete street designs, have been shown to improve older adults' mental health and feelings of well-being and social inclusion (Hu et al. 2013; Cheng et al. 2019; Hsu 2020). This recommendation is particularly important for Mexico City, as 31.8% of the sample reported that walking was their main mode of transportation. Similarly, as 60% of elderly in the study area are 60 to 69 years old, I propose investing in better biking infrastructure, as it might give younger elderly the confidence and safety they need to use this active mode of transportation.

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# Chapter Four: Mobility Perceptions of Older Adults in Mexico City: A Qualitative Study

## Introduction

World aging has prompted the interest of transportation researchers to better understand how older adults' mobilities intersect other aspects of their lives, such as their well-being, quality of life, psychological benefits, community involvement, and feelings of independence, belonging and isolation (Metz 2000; Rosenbloom 2001; Banister and Bowling 2004a; Schwanen and Páez 2010a; van den Berg et al. 2016; Boschmann 2020b). Commonly this literature examines the mobility of older adults by analyzing differences and changes in travel behaviors as measured by the number of daily trips, transport mode choice, trip purpose, times preferred to travel, or trip distance (Cui, et al. 2017), or understanding preferred transport mode alternatives (Rahman, et al. 2016). However, research that studies the mobility perceptions of older adults to capture their mobility stories, experiences, narratives, and desires is less prevalent (Coughlin 2001).

In general, studies on the perceptions of mobility among older adults are focused upon three dominant themes (Goins et al. 2015). First, mobility is part of sense of self and feeling whole; it signifies freedom and independence for older adults, and is perceived as vital to health (Schwanen and Ziegler 2011; Ziegler and Schwanen 2011; Schwanen et al. 2012). Second, assisted mobility is fundamental to living, and brings

older adults renewed interest and supported social interactions (Murray and Musselwhite 2019). Third, adaptability is key to moving forward. This theme focuses on how older adults deal with declines in mobility over time (Banister and Bowling 2004a).

Furthermore, most existing aging and mobility literature – including the mobility perceptions of older adults – is situated in advanced economies of the Global North (Gorman et al. 2019) despite the fact that cities in the Global South are facing comparatively faster aging demographic transitions (United Nations 2020). In a review of the small number of studies of older adult mobilities coming from the Global South, I identified some of the main mobility perceptions among the elderly (omitted for blind review). As these older adults tend to be more reliant on public transportation (PT), PT-related concerns are more prevalent in the literature and are summarized here:

- *Accessibility concerns.* There is a lack of PT services that are recurrent and reliable, which leads to overcrowding issues (Aceves-González et al., 2016, 2015). Also, there is a lack of PT options for disabled older adults that are affordable and frequent (Cloos et al. 2010; Szeto et al. 2017; Ren et al. 2018). Likewise, the lack of proper pedestrian infrastructure restricts older adults' ability to walk safely (Munshi et al. 2018).
- *Comfort concerns.* This includes concerns about PT design such as poorly designed buses, unconformable seats, tall steps that make it difficult to get on and off buses, and poor access to PT stops and stops without appropriate shelter. There is also a lack of PT options that are physically and cognitively easy to use that do not require

multiple and long transfers to use, unlike some underground systems (Odufuwa 2006b; Ipingbemi 2010; Ahmad et al. 2019; Chui et al. 2019; Woolrych et al. 2020).

- *Safety concerns.* Studies in Mexico, Pakistan, and Nigeria found that older adults frequently report inpatient bus drivers, who suddenly accelerate and decelerate, making it dangerous for older passengers to get on and off buses safely (Odufuwa 2006b; Aceves-González et al. 2015; Szeto et al. 2017; Munshi et al. 2018; Ahmad et al. 2019; Woolrych et al. 2020). Additionally, other studies have reported older females' fear of harassment and crime when using PT by themselves (Ipingbemi 2010; Vilalta 2011; Dunckel-Graglia 2013; Rivadeneyra et al. 2015; Ávila et al. 2016; Dunckel Graglia 2016; Porter et al. 2018).
- *Psychological and health concerns.* Older adults experience feelings of isolation and social exclusion caused by not having a built environment that provides extensive PT options (Garcia-Valdez et al. 2019; Al-Rashid et al. 2021). Likewise, elderly report feelings of discrimination, invisibility, and vulnerability when PT drivers do not stop for elderly passengers or other when other passengers push them or do not respect reserved seats (Woolrych et al. 2020)

My review also identified the need for more qualitative-based studies on older adult studies (omitted for review). In particular, qualitative studies that address elderly mobility perceptions are relevant as such research can amplify the voices of elderly populations to better understand their opinions and insights on their everyday out of home mobility. Also, qualitative studies provide relevant information based on first-hand experiences that can guide policymakers towards policies that address elderly mobility barriers,

identify unmet mobility needs, and ultimately enhance ongoing elderly mobility experiences (Coughlin 2001). Such studies are well equipped to consider how older adults from different geographic contexts understand and perceive their mobility in different ways, according to their specific cultural, geographic, and socioeconomic backgrounds. These differences and nuances are even more relevant due to the variation of impacts on older adult mobility due to the COVID-19 pandemic (Liu et al. 2021; Shaer and Haghshenas 2021).

As a major city located in the Global South, Mexico City presents a fitting case study because it is one of the cities in Latin America that is aging at a fast pace (Negrete Salas 2003). Yet despite this growing aging population, only a few papers have examined older adults' mobility perceptions in Mexico or Mexico City. Aceves-González et al. (2015)identified older passengers' perspectives about the bus transport system in Guadalajara City. Similarly, Aceves-González et al. (2016) explored how current bus designs and service characteristics impact younger and older passengers by observing their behaviors when using buses in Guadalajara City. In Mexico City, Dunckel-Graglia (2013) looked at the relationship between women, the PT system, and public opinions of violence and women's equal rights to urban spaces. Mejia-Dorantes (2018) used a qualitative approach to understand what are the main factors that influence travel patterns of low-income working women, how they perceive PT services, and what travel challenges they face.

Additionally, a study on the daily travel behaviors and transport mode choice of older adults in Mexico City analyzed the results of the 2017 Household Origin-Destination

Survey (HODS 2017) and found that 40.5% of older adults in the city reported conducting everyday trips using PT, 32% walked, 26.5% drove, and 1.2% biked (citation removed for blind review). These results shed light on the importance of better understanding the experiences of one third of older adults in Mexico City who rely on PT to conduct their everyday trips. That study also revealed how different neighborhoods in Mexico City provide older adults with different levels of access to PT infrastructure. These geographic differences create different mobility experiences, and therefore more research is needed to study these differences in neighborhood location and access to PT.

This paper seeks to contribute to the literature of elderly mobility perceptions by 1) adding to the literature on the perceptions of mobility of older adults located in the Global South from which we know very little and 2) employing a qualitative methodology to capture perceptions and sentiments about mobility concerns and barriers faced by older adults living in different neighborhoods in Mexico City, which are currently unknown. The objectives are to uncover the mobility perceptions of older adults living in selected neighborhoods of Mexico City and with different access to PT. Also, analyze the themes found to identify specific travel needs, unequal mobility concerns, positive mobility perceptions, and recommendations to improve PT travel experiences.

## Study area and methods

### Mexico City context and PT characteristics

Mexico City is the largest city in Latin America with 9,209,944 inhabitants counted in the 2020 census (INEGI 2021) with16% aged 60 and older. This percentage is expected to increase in the upcoming decades (Negrete Salas 2003). The city also contains considerable income differences, with 20% of the population in a high income

class, 59% in the middle income class, and 21% in the low income class (ITDP 2014). In general terms, the higher income residents live in central areas, whereas lower income residents have been forced to move to the outskirts of the metropolitan area where housing is cheaper, jobs are scarce, and PT service unreliable and more expensive (Mejia-Dorantes 2018).

The HODS 2017 characterizes 11 different types of PT modes in the city (INEGI 2017). For this research, I re-classified the most popular modes in two different groups. *Structured PT modes* include the subway, bus rapid transit (BRT) or 'metrobus', trolley, light rail, and certain subsidized bus routes commonly known as 'RTP' (see Figure 8). These options are characterized by wide connectivity, designed stops, scheduled times, and subsided by the city government and therefore free for older adults 60 and older. *Less structured PT modes* include: 'combis' or mini vans and 'peseros' or local buses (see Figure 9). These modes are more prevalent in the outskirts of the city, do not have assigned formal stops, are generally older and less comfortable vehicles, are concessions and therefore not subsidized for older adults. For example, 'pesero' concessions are given to individuals who own one or more units. These owners give out their concessions to drivers who in exchange pay them a percentage of their income or a flat fee. This type of agreement exacerbates the competition for passengers among drivers, creates accidents, incentivizes lack of professionalization of drivers, diminishes the state of the units, and contributes to pollution and traffic (Mejia-Dorantes 2018).


Figure 8. Examples of structured PT modes. From upper left to right, subway, ‘metrobus’, trolley, and ‘RTP’


Figure 9. Examples of less structured PT modes ‘combis’ (left) and ‘peseros’ (right)

**Neighborhood selection**

This paper is part of a larger *explanatory sequential mixed methods design* (Creswell and Plano Clark 2017) research project. In an earlier study, I created an accessibility index to locate neighborhoods in Mexico City with the highest densities of older adults and with statistically low or high accessibility to PT stops (citation removed for blind review). The accessibility index used only data related to PT infrastructure and population density. However, due to Mexico City’s monocentric form where economic activities and upper class residences are concentrated in the city center (Mejia-Dorantes

2018), I inferred that older adults living in low accessibility neighborhoods (LAN) have a low or medium-low socioeconomic background, and elderly from high accessibility neighborhoods (HAN) are from medium and medium-high socioeconomic levels. Figure 10 shows the study area which comprises the neighborhoods in the city with statistically high or low accessibility to PT infrastructure. Participants were selected from these neighborhoods to participate in semi-structured interviews. Additionally, places where preliminary fieldwork was conducted are also mapped.

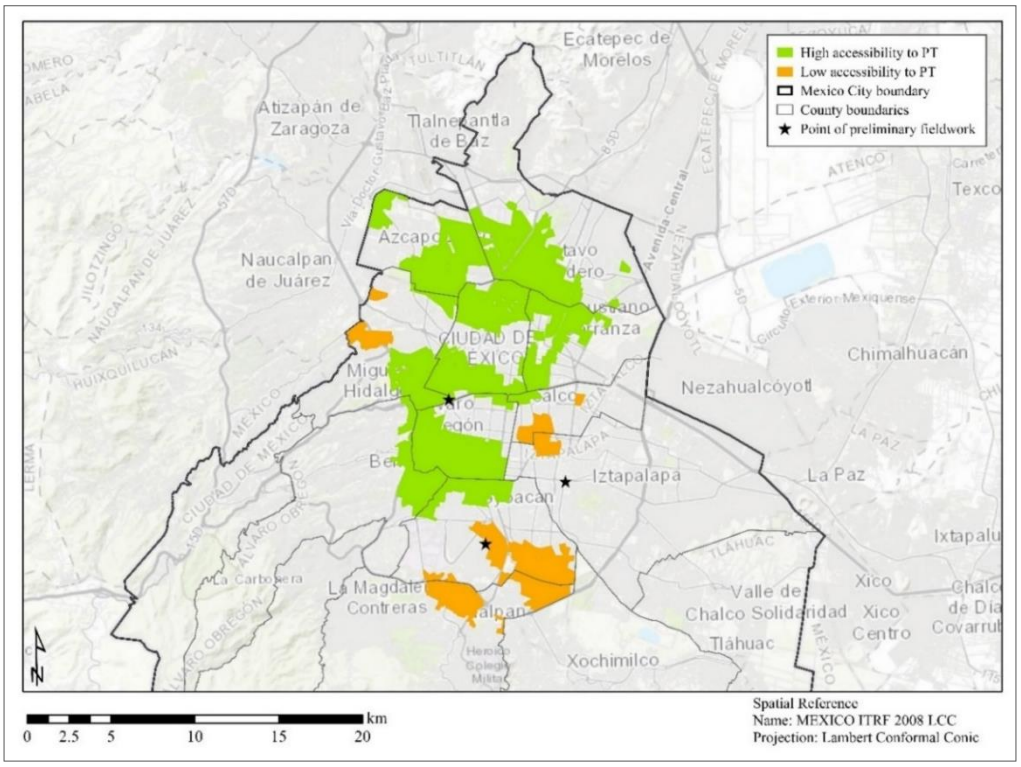


Figure 10. Study Area

**Qualitative Research Design**

A phenomenological qualitative framework was used for this research. Phenomenology focuses on describing what participants have in common as they experience a phenomenon, and the researcher seeks to describe the essence of that lived

experience (Creswell and Poth 2018). This approach supports my objective of learning more about the lived mobility experiences of older adults who use PT and have a residence in selected neighborhoods in Mexico City.

Purposive sampling was used as I aimed to identify information-rich cases and select individuals that are especially knowledgeable about my phenomenon of interest (Palinkas et al. 2015; Creswell and Poth 2018). This included using *criterion-i* to identify and select cases that meet some predetermined criterion. In this study, I selected participants who live within the geographical boundaries previously drawn by the accessibility index. I also used *snowballing*, as my participants referred me to other older adults who also lived within the study area. This study does not claim to find results that are representative of all older adults in Mexico City. However, I did aim to find saturation in the data as I continued contacting participants until there was no substantive new information acquired. Additionally, my sampling efforts followed the seven principles proposed by Kemper et al. (2003) as it was 1) logically defined according to a phenomenological conceptual framework, 2) generated a thorough database to study the phenomenon of interest, 3) able to draw clear inferences and credible interpretations, 4) able to add to the literature of elderly mobilities in other settings, 5) feasible, 6) ethical, 7) efficient and practical.

**Data collection**

Preliminary fieldwork based on focus groups and one-on-one interviews was conducted in June and July 2018 to identify big picture mobility issues and gather data to guide future interview questions. The primary author (PA), as a native to the city,

conducted three focus groups and four one-on-one interviews, for a total of 25 participants (see Annex A). Places with high densities of older adults were selected for preliminary fieldwork (see Figure 10). These conversations informed consequent telephone semi-structured interviews, the data from the preliminary fieldwork is not analyzed in this paper but the findings are consistent. As interviews were analyzed a high degree of overlap was found.

Due to the traveling restrictions during the COVID pandemic, the PA recruited participants following two strategies. First, local contacts in Mexico City placed flyers in the study area to promote this research (see Annex B. Flyer). Second, snowballing recruitment was used whereby the PA asked each interview participant if they knew other older adults who would be interested in participating in this research. All interviews were conducted by telephone. Participants were compensated for their time with a gift card, and all materials and procedures were approved by the authors' Institutional Review Board for human subjects research.

The PA facilitated and recorded 22 semi-structured telephone interviews in Spanish with older adults aged 60 and older. This age range was selected as structured PT systems are completely subsidized and free when older adults turn 60. Thirteen participants lived in LAN and nine in HAN. Thirteen participants were female and nine males. All interviews lasted between 30 and 50 minutes and took place from July to September 2020. During each interview, the PA asked general questions about older adults' everyday mobility experiences before and during the pandemic, the modes of transportation they preferred to use, mobility challenges they faced, positive PT

perceptions, and their recommendations to improve their everyday trips (see Annex C. Interview Protocol).

Another aspect of the data collection was one month of photo ethnography conducted by the PA in Mexico City in August 2021. The purpose of these photographs was to capture meaningful PT images informed by the participants' experiences to complement their reflections of different PT modes in the city.

**Data analysis**

For data analysis I followed the steps of conducting phenomenological research as outlined by Creswell and Poth (2018):

1) *Transcription.* Using Microsoft Word, the PA transcribed all interviews and checked for errors.
2) *Coding.* Using the NVivo computer assisted qualitative data analysis software, initial codes were generated to help analyze the transcripts (see Annex D. Codes). All transcripts were checked for duplication and similar codes were grouped.
3) *Horizonalization.* The PA highlighted significant statements, sentences, and quotes that provided an understanding of the experienced phenomenon.
4) *Clusters of meanings*. These significant statements were grouped to create themes.
5) *Develop structural descriptions.* The themes were then used to write descriptions of participants' mobility experiences and the specific context that influenced those experiences.

6) *Validation.* These results were validated with the assistance of two external researchers who speak Spanish and who are familiar with the Mexico City context.
7) *Writing the essence of the phenomenon.* Detailed descriptions were utilized to present the found themes in an organized outline and written narrative.

## Results

Five dominant themes emerged from the data: 1) different options to commute to work, 2) bad drivers and safety concerns, 3) affordability, connectivity, and exciting new PT investments, 4) mobility changes after the pandemic and adaptation strategies, and 5) recommendations to fix perceived PT challenges. Each is described in detail below.

### Different options to commute to work

The most popular response to my question "what places did you go to before the pandemic and why?" was "to work". Only three participants worked in formal jobs with benefits, seven reported not working, and the rest reported working or having worked in informal jobs and living in a LAN. For example, a few older women mentioned selling candy outside schools, jewelry in small markets, or stationary products from their homes. One older male said he was a carpenter and worked on small projects from his home. Another male mentioned recycling waste in a landfill. Job informality among elderly populations is very common in Mexico City (Angel et al. 2016) and creates specific mobility needs as these older adults mostly do not own a car and have to use PT to get to bigger markets to buy their products to sell in their neighborhoods or travel long distances to the outskirts of city where their jobs are located . For example, Mirna (69, LAN) mentioned the following regarding her trips to buy jewelry products: "I used the

bus ‘Route 100’ and from there to go to ‘La Merced’, because that is where I went to buy earrings to sell. Besides that, I didn't go out much because I can’t do long trips anymore.”

Additionally, job informality and low paying jobs bring distress to older adults who have the need to keep providing for their families and use PT to get to their jobs, as explained by León (68, LAN), who works in a landfill in the outskirts of the city:

“Many times when I arrive late to work my boss asks me, ‘Why until now?’, and I respond, ‘well, the ‘combi’ didn't pass’, but he responds, ‘that's not an excuse, wake up earlier!’ and I tell him ‘But I do, my commute takes from an hour to an hour and a half’, and many times I get up earlier, because I already know how problematic it is to take public transportation.”

In contrast, older adults living in HAN reported working formal jobs or being retired, and generally had higher levels of education. These adults mentioned having better job opportunities, less financial stress, and more time for recreation. However, regardless of those socioeconomic differences, they also reported using PT on a regular basis and to reach different destinations. For example, Elisa (66, HAN), when asked about her commute to work, said:

“Daily, from Monday to Friday, I went to work and went back home using public transport. Depending on the time I left, I would take the subway or walked a lot to catch a bus. When I got off work early, I used to go to a shopping center to do some shopping or to the market, it was always like this.”

Additionally, the most common response to the question “do you own a driver’s license?”, was “no, I don’t” or “No, I have never driven before”. This is a recurrent result

found in the literature in other studies in the Global South (removed for blind review). Interestingly, I found that older adults living in LAN were more likely to say that they did not drive because they had never owned a car in their lives, whereas driving older adults HAN responded that even when they do have a driver's license and own a car, they choose not to drive on an everyday basis, due to health concerns, not wanting to deal with traffic, cost of gas, or feeling more comfortable using PT. For example, Samuel (68, HAN) mentioned: "I used to leave my house 4 times a week to go to work. I took a 'combi' and subway because they are cheaper and faster than my car. I used to drive to work only twice a week." Only Guillermo (62, HAN) mentioned driving to work on a regular basis before the pandemic, he shared: "From Monday to Friday, I went to work, and I used my private car to go to work. I live very close to my work, I am about 3 km away, but I use my vehicle."

**Bad drivers and safety concerns**

The most common complaint of older adults who regularly use less structured PT options such as 'combis' or 'peseros' included impatient, ill-mannered, and reckless drivers. These sentiments are described by Gabriela (63, LAN):

"There are many ['pesero'] drivers who are very reckless. It seems like, instead of driving people, they are driving donkeys! (laughs). And young people, the truth is, they hold on well, but if drivers catch me distracted and accelerate, there I go on top of other people!"

These complaints make participants feel frustration, anger, and vulnerability, as they believe that their age and limited physical mobility make them easy targets of

discrimination by insensitive drivers, as argued by Woolrych et al. (2020). Gloria (78, LAN) commented “They [pesero drivers] have yelled at me when I try to get off ‘Ma'am, I don't have all the time in the world!’, they make me nervous, and I become more clumsy. I want to get off fast, that's when accidents happen.”

During the ethnographic work, the PA observed several instances where ‘pesero’ drivers did not fully stop and wait for passengers to safely get on or off their units, as seen on Figure 11. Concerns about drivers are mentioned in several other studies (Odufuwa 2006b; Aceves-González et al. 2015; Munshi et al. 2018; Ahmad et al. 2019; Woolrych et al. 2020). Additionally, having the need to use less structured PT modes, brings other externalities, such as longer travel times, higher costs, and constant exposure to crime.


Figure 11. Passenger getting on a ‘pesero’ while the unit is in movement

Unfortunately, the second most common concern for participants was becoming victims of pickpockets in PT, an issue that has been well documented (Ipingbemi 2010; Vilalta 2011; Ávila et al. 2016). These types of crimes were more commonly experienced in ‘peseros’, ‘combis’, buses, and the subway.

Elderly who regularly use less structured PT modes, particularly during rush hours, reported having been robbed in multiple occasions as pickpockets take advantage of overcrowded spaces to steal. Interestingly, some participants mentioned developing strategies to avoid being easy targets. For example, Elisa (66, HAN) who uses buses and subway regularly mentioned, “I always hold on to my bag very well, I never take out my cell phone in the subway, even if I hear someone is calling me I don't take it out because I don't want to expose myself.”

Elderly from LAN and HAN reported being victims of pickpockets, however, some adults living in HAN who do not have the need to travel during peak hours or use PT as frequently, do not suffer from these crimes as frequently as working elderly from LAN.

Other concerns about PT trips include:

- A few older females commented on feeling harassed when the subway is overcrowded (Rivadeneyra et al. 2015; Dunckel Graglia 2016). As explained by Mirna (69, LAN) “The gentlemen are very abusive. When the subway is very full I don't know how to move, I feel like I am being harassed. That is always very uncomfortable for me.” And as exemplified by Mayra (84, HAN) “in the subway, oh God, one gets on and you feel like a garlic clove all squeezed up!”
- Walking long distances when making a transfer in the subway (Chui et al. 2019). Mara (81, HAN) mentioned “I wish that the ‘Raza’ [subway] transference was not so long to walk. They even call it the ‘time tunnel!’” In fact, due to this long transfer, she reported taking a taxi directly to a subway station without a long transfer as a strategy to avoid walking long distances to get to her destination.

- Lack of comfort in ‘peseros’ and ‘combis’ as seats are small, old, and not frequently cleaned (Aceves-González et al. 2015; Aceves-González et al. 2016). As argued by Jorge Angel (62, LAN) “[In the older ‘peseros’] there are many people and few seats and the seats are very small, and it is uncomfortable for two people to sit in two seats because they are very small. It is uncomfortable.”
- Difficulties to climb ‘peseros’ steps as some are quite high for elderly (Aceves-González et al. 2015). Mayra (84, HAN) commented “There are some ‘peseros’ that are very tall, they have a very tall step, and I can't climb them.”
- Lack of empathy from other users, as some participants reported not feeling respected by others and not being offered a seat when using PT (Woolrych et al. 2020). Macario (67, LAN) questioned “Do people really think that an older person can travel standing for 20 or 30 minutes?”
- Lack of reliability as ‘combis’ and ‘peseros’ do not follow specific schedules nor have specific stops assigned (Mejia-Dorantes 2018). As expressed by León (68, LAN) “I don’t want to express badly of them [‘combi’ drivers], but they work whenever they want, they stop for passengers whenever they want, even when people are waiting for them. If they provided more frequent and punctual service. How nice would that be!”

**Affordability, connectivity, and exciting new PT investments**

The most common positive aspect mentioned was PT affordability. In particular, having the subway completely subsidized for adults 60 and older gives them access to the longest PT network in the city. As expressed by Gloria (78, LAN) “I am happy with the

service provided by the subway, the price is very affordable, and now that I am an older adult I can travel for free and before the price was very reasonable." Even less structured PT modes such as 'peseros' were generally considered affordable, especially when compared with PT prices in Mexico State, where buses charge more than double than in Mexico City. All participants had very positive comments to make about the government card, colloquially known as INAPAM card or "tarjeta del INAPAM", that grants them authorization to travel for free, among other service discounts (Lacavez Berumen et al. 2017)

A second positive opinion is the extensive connectivity of PT modes, such as the subway and BRT. When asked about her opinion about the new BRT or 'metrobus' routes, Salma (77, HAN) said "the metrobus is very good, it has come to alleviate a lot of us, and it takes us to very deep corners of the city." It is relevant to notice that older adults living in HAN have the opportunity to use these modes without needing to use less structured PT modes first, as elderly in LAN do. This is an interesting finding that raises relevant equity issues as elderly living in LAN spend a higher percentage of their income in transportation (Guerra 2017).

Third, the ability to get to places quickly via subway was also frequently mentioned as a positive. For example, Macario (67, LAN) said "[the subway] sometimes takes a while to get to the station, but as soon as it arrives it moves as fast as the devil!" Similarly, having escalators in certain subway stations was greatly valued by some participants as it makes trips less tiring, to this respect Pepe (90, LAN) said "[Before retiring] when I used the subway, I used the escalators a lot to avoid walking. I really like

those." Additionally, the subway and the BRT systems were considered safer in comparison to other modes. As mentioned by León, (68, LAN) "The metrobus and metro are safe because they have security cameras. Also, I have seen two or three policemen getting on a train and get off in the next two stations and then others get on."

A few older females mentioned that they appreciate the subway areas that are exclusive for women because they feel safer traveling among other women and without men. In contrast, Gabriela (63, LAN) commented about the exclusive trains for women in the subway "It's the same, not because the train has all women goes quieter. I think girls and women can be more aggressive." Women-only transportation options continues to be a controversial idea, as mentioned by Dunckel-Graglia (2013).

Fourth, one participant mentioned excitement about recent improvements in biking infrastructure and recurrent cycling weekend events organized by the city. These weekend events called "Cyclist Rides" or "Paseo Ciclista", are part of the "Move on Bikes" or "Muévete en Bici" city program, created in 2007, in which of 55 km of streets are temporarily closed to vehicles and used by pedestrians, runners, rollerbladers, and cyclists (Medina et al. 2019). Guillermo (62, HAN) comments "On Sundays, I go to the 'Paseo Ciclista'. At least one or two weeks a month I go and ride my bike with my family. We leave at 9 and return between 1 or 2 in the afternoon." Figure 12 shows examples of city efforts to improve biking infrastructure such as building designated bike lanes and providing affordable bike sharing services. However, no older adults living in LAN mentioned or seemed interested in biking. This is a topic that needs to be further studied as we know very little about biking elderly in the Global South (removed for

blind review). Lastly, the trolley is another PT mode that elderly see positively for several reasons: it is free for them, it is considered comfortable, drivers are considered skilled and patient, most older adults grew up using this PT mode, and new routes and units are being introduced. In fact, electric trolley service was first introduced in the city in 1900, and by 1950 there were 514 trolleys in service (Wirth 1997). Figure 13 shows the look of the recently introduced trolley units. Excitement for these new trolley units was shown by Guillermo (62, HAN):

"The government has just announced the introduction of 50 trolleys, 50 is a world of trolleys in that city! There are new routes. The main one is the one that crosses the entire 'Eje Central', which goes from south to north. I tell you; those modern trolleys give the city a modern look. They are very nice, I tell you, I have used them, and they are very comfortable."

The recent efforts of the Mexico City government to invest in trolleys was a celebrated strategy as this PT mode had been forgotten in previous decades, which caused closure of certain routes. To his respect, Mirna (69, LAN) shared: "There used to be a trolley route here. Here in 'Apatlaco', that was our transport, and we do miss it very much." Fortunately, the route that Mirna was referring to was reinstated in 2021, with the introduction of those new units along with new infrastructure investment in transit stops as seen on Figure 14.

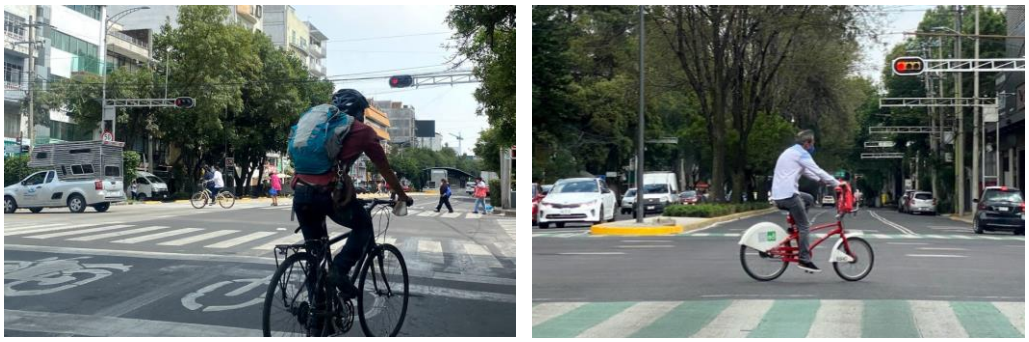

Figure 12. Biking infrastructure in a HAN


Figure 13. Recently introduced trolleys

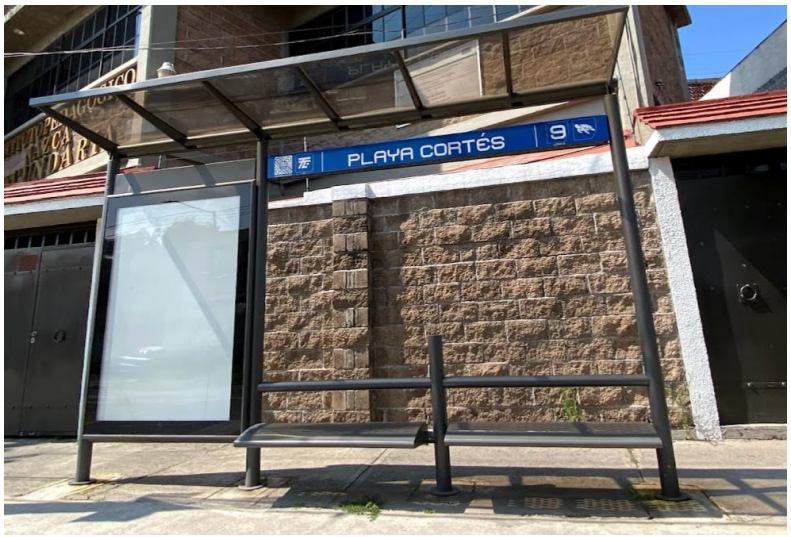


Figure 14. Example of a recently constructed trolley stop

**Changing mobilities during COVID and adaptation strategies**

As expected, participants reported traveling less once the pandemic started. Unfortunately, older adults working in informal sectors mentioned losing their jobs, not being able to do their informal jobs, even when they need the income, or needing to continue working even when that meant taking great health risks, as they had to continue providing for their families. The pandemic caused financial distress, mostly for elderly in LAN. For example, Jorge Angel (62, LAN), who works as a mechanic, shared:

"I believe that 90% of the population in Mexico City has the need to go outside to work. If not, how do we buy food? At this moment I am not working due to the pandemic, so I told one of my children to bring me food this week, and to the other the week after. But if they lost their job too, how would I ask them for help?"

Older adults working in formal sectors or are retired had the opportunity to continue working remotely and expressed feelings of isolation instead of financial distress. As mentioned by Elisa (66, HAN) who works remotely for the Department of Education:

“The lockdown is distressing. I am used to going out to do my things and right now it is not possible. Sometimes I feel stressed out, so I grab my dog, go to the park, and come back feeling calmer”

The pandemic also changed mobility patterns. For example, some working elderly reported having to wait longer periods of time for the subway or a bus to arrive and also observing very low ridership levels. Esmeralda (61, LAN) who works for the government said: “The subway is practically empty now, and train cars are almost empty or carry very few people.”

Other adults changed their preferred PT mode for other perceived safer options. Although, the ability to choose a safer option was not an opportunity for everyone, and it was more frequently mentioned by elderly from HAN. For example, Samuel (68, HAN) who is and engineer commented: “I keep going to work but right now I'm just driving my car. Right now I am not taking the subway because the subway is more risky. Right now I drive my car to work, nothing else.” In contrast, Jorge Angel (62, LAN) shared:

“Public transport is a source of infection, a hot spot for infections, but I have to use it, unfortunately. How nice would it be if all Mexicans of driving age could afford a car, right? we would say ‘I'm not using ‘pesero’, I'm driving my car’ then getting infected would not be a worry. But it is not possible for me. I do not have enough money to buy a car”

Besides needing to go to work, participants reported only making essential trips including going to the doctor and to the groceries, usually accompanied by a family member. For example, Valentina (64, LAN) said: “Right now I just go to the groceries to

buy my food, nothing more. One specific day I choose to go to [the grocery store] 'Aurrera' to buy milk, beans, no more than two or three days a week." As previously stated, most participants live with family members, in multigenerational households, or with friends and only three reported living alone. Therefore, many mentioned delegating some essential trips to family members, neighbors, or even delivery services. These living situations resemble trends in other countries in the Global South(United Nations 2020). To this respect, Macario (67, LAN) mentioned: "We ask a young neighbor to make us the favor of bringing us meat, vegetables, everything to cook so we don't need to go outside often." These support networks were greatly valued by elderly.

**How do we fix PT challenges?**

Interview participants were asked for recommendations of how to improve PTn and make their trips more comfortable, safer, and enjoyable. These valuable suggestions based on firsthand mobility experiences are summarized as follows:

- *Educate and train drivers.* There is a great need for decent, educated, and patient drivers, so older adults can get off buses safely and not feel discriminated against for not being able to move as fast as younger passengers. As Jorge Angel (LAN) said "To change public transport, we need to change the way drivers drive, they have to change their 'chip'. They need to understand that they have to respect themselves, the passengers, and pedestrians. We have to start with the drivers." Also, PT drivers should be constantly evaluated, and the city government should make sure they follow the law, impose sanctions when necessary, and move away from corrupt practices that incentivize drivers to not follow the law.

- *Invest in service improvements.* Several participants suggested having formal schedules for ‘combis’ and other less structured PT modes, so passengers do not have to wait long periods of time, and if possible, replace less structured PT routes with more extensive formal PT networks, for example, replace ‘combis’ with BRT or trolley routes. Additionally, introduce more types of PT modes, such as cable cars and light rail. Also, increase the number of security cameras in all PT modes and make these security systems efficient to discourage pickpockets from stealing. Similarly, increase the number of trains in the subway system to decrease waiting times and overcrowding. Lastly, include more clean and free or affordable bathrooms in PT stations and efficient ventilation systems in the subway trains and BTR cars.
- *Invest in maintenance and accessibility improvements.* Increase the number of escalators, elevators, and moving sidewalks in subway stations so older adults do not have to walk for longer periods of time, also make sure those elements are all working properly and get fixed promptly. Also, introduce in all PT modes more exclusive seats for disabled and elderly passengers and have campaigns that promote respect for those seats. Additionally, have a clear maintenance plan to make sure PT units are running properly and meeting safety standards to avoid losing trains or buses to mechanical deficiencies.
- *Invest in new units.* Introduce newer buses and ‘peseros’ with platform systems that allow for a more comfortable experience to get on them safely, especially for elderly and disabled users. Also, make sure that new PT infrastructure projects consider their environmental impact to avoid losing more green spaces to asphalt.

## Discussion and Conclusion

This qualitative study gathered information about mobility experiences from older adults in Mexico City. I conducted 22 semi-structured telephone interviews with elderly who live in neighborhoods with statistically low and high accessibility to PT stops. In sum, I uncovered five themes using a phenomenological approach. The first theme examined the different ways older adults get to work, the second summarized the major challenges reported when using structured and less structured PT modes, the third identified positive perceived aspects of using PT in the city, the fourth looked at how the pandemic changed every day elderly mobilities; and the fifth summarized participants' suggestions to fix relevant PT challenges.

Interesting neighborhood differences were uncovered. Older adults living in LAN generally have a low or medium-low socioeconomic income, work in informal sectors, reported feeling distress due to their challenging financial situations, having the need to use less structures PT modes more frequently, and therefore spend more money in transportation as those modes are not free for them, no older adults from LAN reported driving or owning a personal vehicle. Additionally, they reported dealing with unkind and impatient 'pesero' and 'combi' drivers more frequently than their peers from HAN. Several adults from LAN reported losing their jobs due to COVID and feeling an economic burden because of it.

In contrast, elderly from HAN belong to higher socioeconomic levels and reported working in formal sectors or being retired. Older males from these neighborhoods were the only ones in my sample that reported driving, as they have the income to afford a personal vehicle. They certainly use PT modes too, but they have the privilege to choose

when to use them because they have access to a car or can afford more expensive PT services, such as taxis. They also have higher access to structured PT modes such as subway, BRT, and trolley, which are free for them. Issues regarding how neighborhood attributes and urban form relate to money spent in PT in Mexico City Metropolitan Area are addressed by Guerra (2017), and more research focused on how these complex socioeconomic and spatial relationships intersect elderly mobilities is needed. Moreover, one older male from a HAN was the only one who mentioned attending biking weekend events called 'Paseos Ciclista.' Also, I found that biking opportunities and biking infrastructure generally benefits higher income and older male populations. These results are not surprising as the literature (Elmashhara et al. 2022) shows that factors such as gender, income, and age influence biking behaviors. These biking gaps within elderly populations in the Global South should be further researched. Finally, adults in HAN had the opportunity to continue working remotely after the pandemic and did not report losing their jobs. They also had the privilege of choosing driving instead of taking PT, as they did not want to risk getting infected.

Some challenges were identified by participants from both types of neighborhoods, such as being victims of crimes in PT, older females dealing with fear of harassment in subway and buses, and lack of comfortability in less structured PT modes. Some positive aspects identified by participants regardless of their neighborhood of residence were opinions on affordability, fast service, and good connectivity of structured PT modes, primarily the subway. Trolleys were seen very positively by the majority of the participants, who were also excited about new units and routes being added to the system.

My findings confirm some of the PT related concerns found in the literature of mobility perceptions of older adults in the Global South. For example, my participants mentioned accessibility concerns, also raised by Aceves-González et al. (2016, 2015) and Cloos et al. (2010) that included lack of reliable and recurrent PT services and overcrowding issues. Comfort concerns were also voiced by participants, specially regarding unkind bus drivers, poorly designed buses, uncomfortable seats, and long subway transfers, confirming findings by Ahmad et al. (2019); Chui et al. (2019); Ipingbemi (2010); Odufuwa (2006); Szeto et al. (2017); and Woolrych et al. (2020). Safety concerns were prevalent regardless of neighborhood of residence, these fears of crime and harassment confirm findings by Ávila et al. (2016); Dunckel Graglia (2016); Dunckel-Graglia (2013); Rivadeneyra et al. (2015); and Vilalta (2011).

This study does not claim to report the mobility perceptions of all older adults in Mexico City and my results are not generalizable. I do not claim that all older adults in LAN and HAN agree with the responses reported. However, I do attest that this qualitative research was designed to find data saturation and that proper steps to address validity concerns I conducted. My results add to the literature of older adults' mobility perceptions by uncovering contrasting mobility experiences created by unequal accessibility to PT infrastructure, which resulted in different mobility opportunities and challenges. For example, I learned that older adults in LAN face the most mobility challenges, as they generally rely only on PT modes to meet their everyday mobility needs, including working. The literature on older adults' mobility suggests moving away from "one-size fits all" approaches (Villena-Sanchez and Boschmann 2022), to this

respect I suggest that future research should take into consideration not only Global North versus Global South mobility differences, but also small-scale differences to uncover locally rooted mobility inequalities that are not visible when studying larger study areas. Lastly, more empirical research is needed to address the complex relationships between elderly populations, their socioeconomic background, local accessibility to PT, and neighborhood characteristics. I must plan for PT systems that are accessible, affordable, inclusive, efficient, comfortable, and safe for all older adults.

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# Chapter 5. Conclusions

## Structure of this chapter

This chapter briefly summarizes the contributions of the literature review, quantitative, and qualitative papers. Later, I discussed the relevance of employing a mixed methods approach by presenting the results that emerged from analyzing the quantitative and qualitative phases in the form of *joint displays*, as proposed by Creswell and Poth (2018). Then, I proposed policy recommendations to improve older adults' daily mobility experiences organized as short, medium, and long term recommendations. Lastly, I named limitations of this research and propose arguments for a future research agenda.

## Contributions from this research

### Literature review

*"No full picture has emerged of the travel and transport needs and patterns of the elderly in the Global South"* (Soltani et al. 2018, 110)

The first paper "A scoping review of the daily mobilities of older adults in the Global South" bridged a gap in the literature identified by Soltani et al. (2018) by systematically organizing 57 papers focused on elderly mobilities in the Global South and found in six different electronic databases. After analyzing these papers, emerging themes were categorized. Three dominant themes were found: trip mode choice, unmet mobility needs, and socio-economic aspects of mobility. The first, speaks to the important of identifying

what modes of transportation elderly choose or use and uncovered the important role of walking and using public transit. The second identified major mobility concerns among elderly who use PT including: safety concerns, unreliable services, unequal accessibility, equity issues, gender inequalities, etc. Recommendations to address these concerns include adopting an active ageing or age-friendly framework to ensure older adults' right to reach places safely. The third theme identified socio-economic aspects that intersect elderly mobility patterns, including employment status, living arrangements, caregiving relationships, and social networks.

**Quantitative phase**

*"One should not assume that developing countries and newly industrialised countries will exhibit the same trends with regard to ageing and mobility that Western countries have experienced and currently experience."* (Schwanen and Páez 2010, 592)

The second paper "Daily travel behaviors and transport mode choice of older adults in Mexico City" addresses the call from Schwanen and Páez (2010) who argue that mobility trends from developing countries are likely to be different from those in Western countries and that more research is needed about older people outside the Western world. This paper analyzed travel behavior patterns and transport mode choice of older adults in Mexico City, which had not been studied before. Utilizing the HODS 2017, variables related to elderly everyday mobilities, and socioeconomic characteristics were analyzed. Results show that 40.5% of older adults use PT, 32% walk, 26.5% drive, and only 1.2% bike. These trends reveal PT as a highly used mode of transportation. The created accessibility index which ranks neighborhoods by level of access to PT infrastructure,

revealing unequal access to PT services, with older adults living in the outskirts of the city presenting the lowest levels. Lastly, the creation of a multinomial logit model revealed aspects that influence older adults' mode choice when given a set of geographic and socio-economic factors. In particular, trip purpose, day of the week, gender, age, retirement and socio-economic status, number of vehicles, accessibility index, attraction index, and number of people in a household were relevant factors that influence elderly mode choices.

**Qualitative phase**

*"But despite all the quantitative data regarding trip-making by older persons, little research has been conducted to determine the perceptions and preferences among this group about their transportation choices and trip-making activity."* (Coughlin 2001, v)

Qualitative studies that address elderly mobility perceptions are crucial to amplify the voices of elderly populations and to better understand the barriers and challenges they face on their everyday out of home trips. As previously found, 40.5% of older adults in Mexico City reported conducting everyday trips using PT and accessibility to PT was unequal in neighborhoods with high densities of older adults. These results highlight the importance of uncovering experiences of elderly living in selected neighborhoods with contrasting levels of access to PT to identify complementary and more localized results not captured by the HODS 2017. Five themes were found by interviewing elderly from selected neighborhoods 1) different options to commute to work, 2) bad drivers and safety concerns, 3) affordability, connectivity, and exciting new PT investments, 4) mobility changes after the pandemic and adaptation strategies, and 5) recommendations

to fix perceived PT challenges. Findings confirmed some of the PT related concerns found in the literature of mobility perceptions of older adults in the Global South and demonstrated the need for more qualitative research that addresses locally rooted mobility inequalities that are not visible when studying larger study areas.

**Mixed methods results**

*"Given transport's strong background in quantitative approaches, and increasing interest in critical geography issues, transport geography represents a fertile subfield in which the qualitative–quantitative divide can be effectively bridged."* (Goetz et al. 2009, 331)

According to Creswell and Poth (2018), a mixed method interpretation is the centerpiece of mixed method research and involves looking across the quantitative results and the qualitative findings and assess how the qualitative results corroborate, complement, or contradict the quantitative results. Afterwards, conclusions and interpretations are drawn from both methods. Indeed, inferences in mixed methods research add insights beyond the information provided by only one analysis and develop and understanding that combines statistical results with personal experiences.

Integration in an explanatory sequential design involves describing how the quantitative results were used to guide the purposeful sampling for the qualitative phase. In this research, the first point of integration occurred when using the accessibility index map to identify the neighborhoods where interviews needed to be conducted due to their statistically different levels of access to PT. The second point of integration was achieved by connecting the quantitative results with the follow-up qualitative results with *joint*

*displays*. The purpose of joint displays is to make specific the links between two sets of results to help visualize the enhanced findings.

***Joint displays***

The following four joint displays show different ways in which the qualitative results provide an explanation that further explain and contextualize specific results from the initial quantitative phase.

Figure 15. This joint display includes table 1 from the quantitative phase which presents the percentage of elderly working population by gender and age group. From this table, I learned that there are over 1 million older adults living in Mexico City, that 41.3% reported being employed, especially younger older males, and that this percentage is a result of the prevalence of job informality, which results in scarce access to pensions and the need for elderly to continue working past retiring age.

By adding some quotes from the qualitative phase, interesting findings that complement the results from this table are uncovered. First, interviews revealed that 46% of participants were born in the city and 54% in another state, migrating to the city at a very young age. The quotes in the upper part of the joint display show two examples of background stories, one from a participant who immigrated to Mexico City from a small town, and another from an older female who grew up in the city. In fact, during the 1940's Mexico went through a phase of economic growth, known as the "Mexican Miracle", that sparked a boom of 30 years of relative prosperity and population growth. From the 1940s to 1970s, families from rural parts of the country migrated to Mexico City in search of better job opportunities, which led to an increase in percentages of urban

population in the country, going from 20% in 1940 to 44.9% by 1970 (Alba and Potter 1986). Both quotes are examples of historic processes that lead to Mexico City being currently home of over a million elderly.

The quotes in the bottom part of the joint display adds to the conversation beyond percentages of employment by exemplifying the varied range of employment opportunities that older adults had or have access to e.g. those who worked or work in the informal sector, those who worked or work in the formal sector, those who do not work and are pensioned, and those who do not work and do not receive a pension.

Figure 16 shows a graph from the quantitative phase that presents the percentage of older adults and their highest education levels. From this graph, I learned that 5.4% of older adults reported not having any education, 67.6% completed a K-12 education, and 26.8% earned a degree in higher education. The quotes that complement this joint display add to the quantitative results by providing more context for these percentages. For example, Diego (65, LAN) mentioned that throughout his life he only worked minimum wage jobs because he did not have the opportunity to go to school when he lived in a rural town and when he moved to the city he had the need to work from a young age. In contrast, Salma (77, HAN) mentioned studying the equivalent to an associate, an undergraduate, and a master's degree, which gave her access to formal job opportunities and an overall good quality of life, in comparison to Diego. Another common response from participants showed that they attended school but dropped it after a few years, which shows lack of resources to continue studying and a recurrent need to help their families financially. These socio-economic results are relevant because research has

shown that lower categories of socio-economic class and education attainment and an increase in age are more associated with the use of PT (Bautista-Hernández 2021).

Figure 17. This joint display combines older adults' mode choice preferences and their perceptions towards certain transportation modes. The HODS 2017, revealed that 40.5% of older adults use PT, 32% walk, 26.5% drive, and only 1.2% bike. To obtain these percentages and run the multinomial model transportation modes were grouped into categories that included several types of modes. For example, the category "public transit" included subway, trolley, BRT, light rail, and commuter rail. Later, the qualitative phase captured participants' opinions on specific modes. The seven most frequently mentioned modes were added to the X axis along with relevant quotes. The Y axis shows mobility perceptions according to participants' responses, where the most positively perceived modes are at the top of the axis and the least positively perceived at the bottom. In general terms, the subway was perceived positively by most participants and 'combis' were the least positively perceived. The pictures added a visual to better understand participants preferences.

Figure 18. This joint display includes examples of mobility experiences in neighborhoods with statistically low and high accessibility to PT. The accessibility map, created in the quantitative phase, identifies the neighborhoods with high densities of older adults and contrasting access to PT. The quotes from the qualitative phase support one important finding which argues that elderly in LAN spend more time and money traveling to connect with the structured PT system (namely subway, metrobus, etc.) In other words, access to PT is not equitable in Mexico City, as older adults living further

away from the city center rely more on less structured PT modes, which are not subsidize and generally not positively perceived. For example, one participant from LAN mentioned how she lives close to subway stations, but still needs to take a pesero to get connected to the subway.

Pepe (90, LAN) "I was a farmer. I know how to ride a horse, work the land. I came to Mexico City when I was a 20 years old man."

Mayra (84, HAN) "I am originally from here [Mexico City]. I was born in 'Santa Cruz Atoyac.' I have lived in 'Colonia Portales' for more than 60 years"

| Age group | Older males | % Older males | | Older females | % Older females | |
|---|---|---|---|---|---|---|
| | | Working | Not working | | Working | Not working |
| 60 - 64 | 175,823 | 76.7 | 23.3 | 204,774 | 41.6 | 58.4 |
| 65 - 69 | 129,265 | 61.5 | 38.5 | 154,566 | 29.3 | 70.7 |
| 70 - 74 | 94,472 | 44.0 | 56.0 | 106,749 | 22.4 | 77.6 |
| 75 - 79 | 52,773 | 35.9 | 64.1 | 69,651 | 13.9 | 86.1 |
| 80 - 84 | 30,567 | 20.9 | 79.1 | 41,002 | 13.3 | 86.7 |
| 85 - 89 | 13,459 | 14.2 | 85.8 | 15,901 | 6.6 | 93.4 |
| 90 and more | 4,625 | 9.1 | 90.9 | 6,038 | 0.0 | 100 |

Diego (65, LAN) "I work as a courier for several insurance companies. I bring bills, checks, and documents to different places in the City"

Pepe (90, LAN) "I used to sell sweets outside a school, until I couldn't anymore, now I am just home"

Yulia (73, HAN) "Yes, I'm still working. I work for one of the largest funeral agencies in the city. I am a sales consultant."

Rosalia (62, HAN) I'm retired. I was an educational assistant at a Child Development Center.

Figure 15. Older adults' employment and age group percentages with experiences

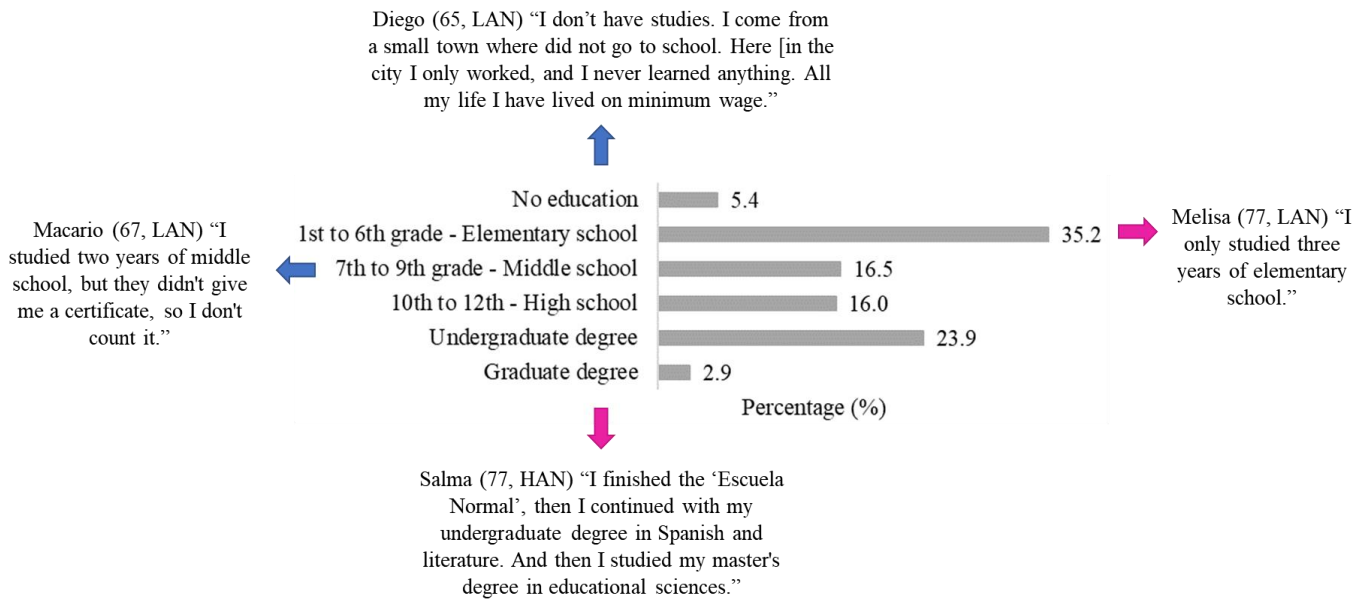


Figure 16. Level of education and examples of academic trajectories

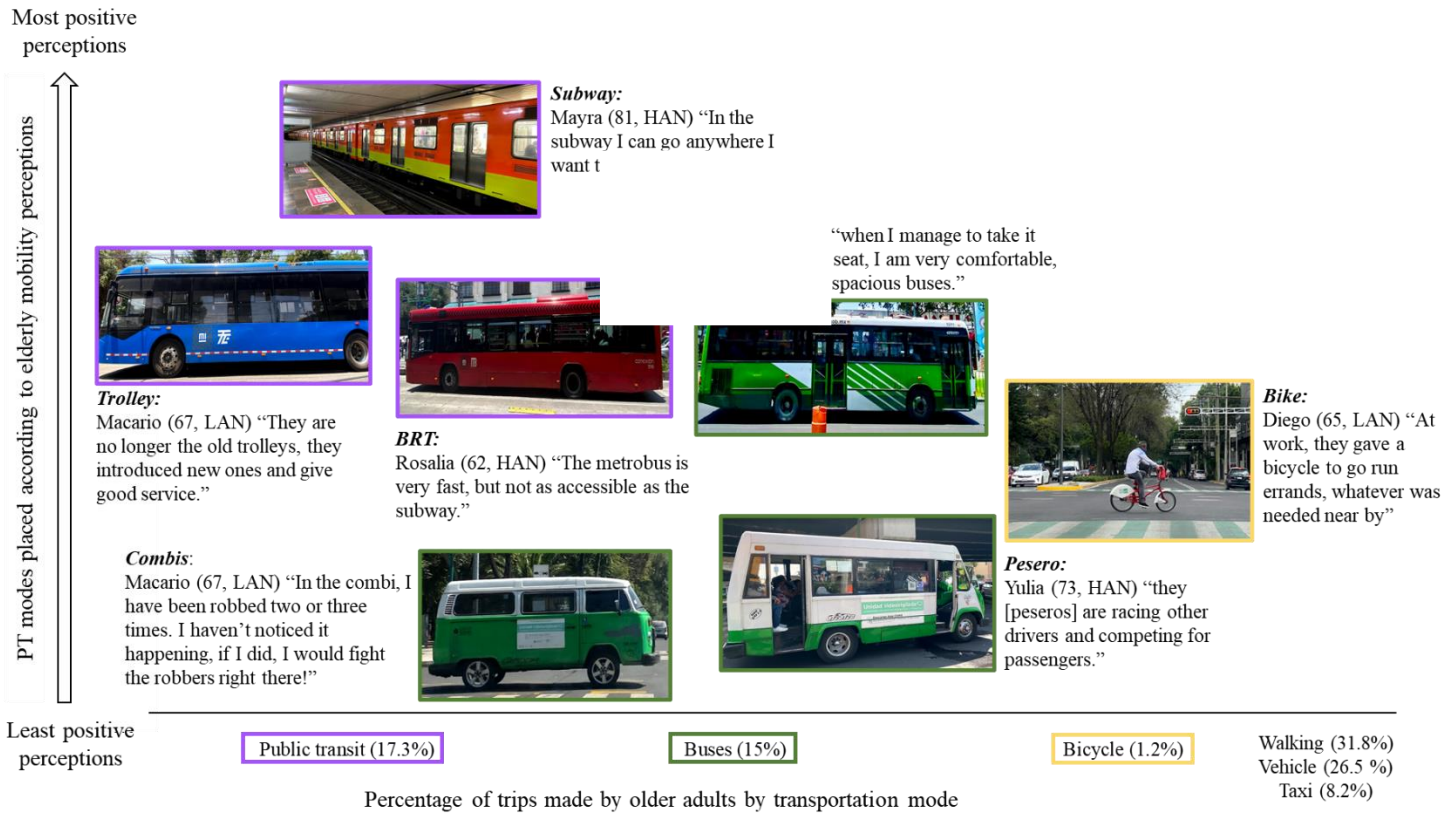


Figure 17. Older adult's PT preferences according to their perceptions

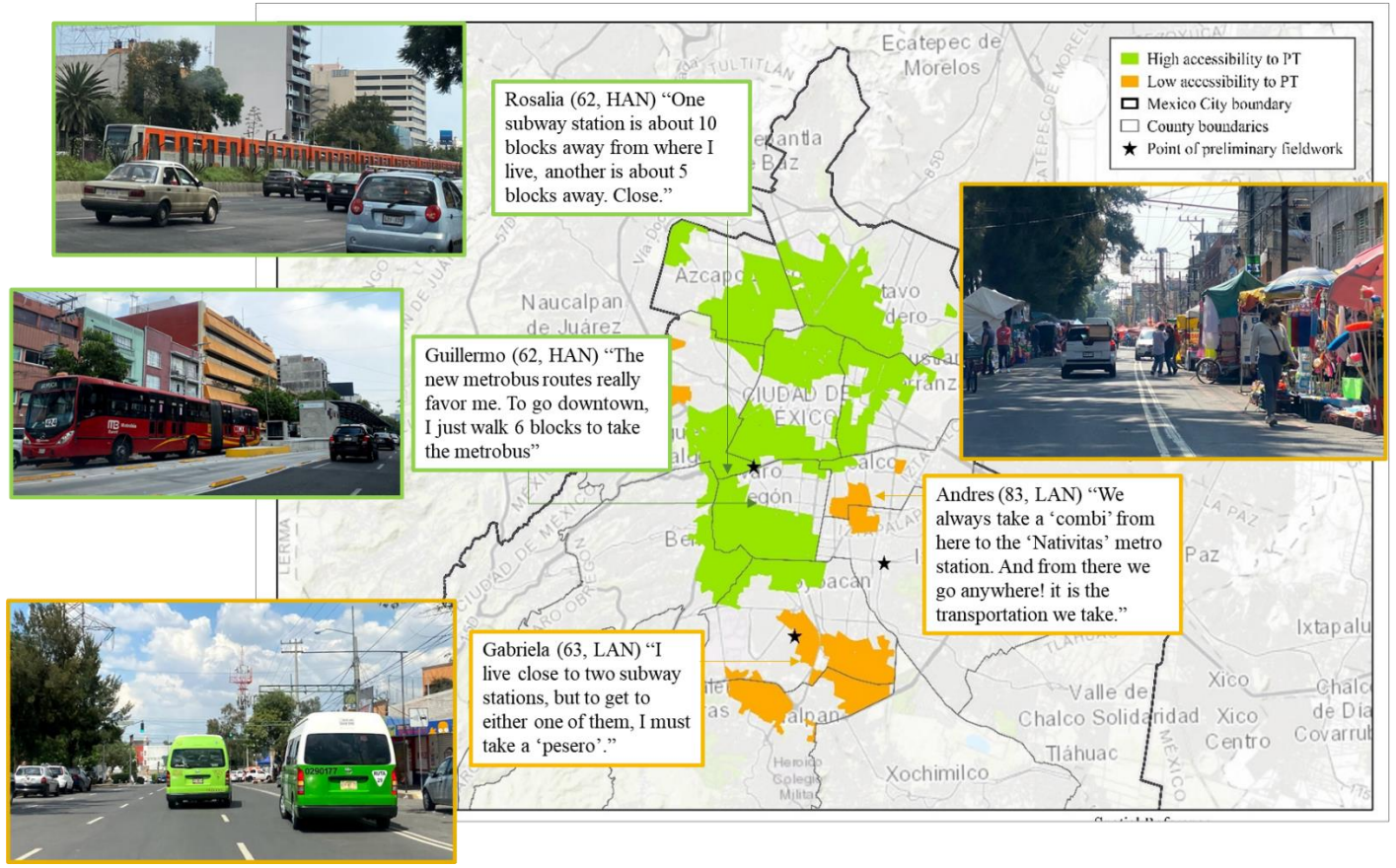


Figure 18. Examples of mobility experiences in neighborhoods with statistically low and high accessibility to PT

## Policy recommendations

The following broad policy recommendations aim to improve elderly mobilities in Mexico City and are guided by the results from this research and keeping older adults' opinions and desires for change as priorities. I determined three different periods of time, as some recommendations can be implemented more rapidly while others can take more time and resources.

### Short-term recommendations

- Educate and train drivers on road safety and service expectations, especially pesero and combi drivers. This issue was constantly mentioned by older adults who want to feel well treated, respected, safe, and free to take any PT mode without fear of discrimination from unkind drivers.
- Invest in more campaigns that reinforce respecting seats for people with disabilities, the elderly, pregnant women, and women with children. In several instances, participants reported, a lack of empathy from other PT passengers, who do not respect exclusive seats. These acts bring feelings of discrimination as their physical limitations are ignored or undermined. City officials should plan more awareness campaigns to respect exclusive seats in all types of PT and have clear signs for them.

### Medium-term recommendations

- Require a regular driving test for all PT drivers. Along with bad manners, PT drivers were constantly described by participants as bad drivers, especially 'combi' and 'pesero' drivers. One of the major reasons for this lack of skill is that there is no driving test for drivers in Mexico City (Angel 2018). The city needs to address this

issue, as it is imperative that PT drivers are qualified to do their job and constantly tested so passengers can ride comfortably knowing that they will make it to their destination safely.

- Retire old units and invest in new ones that meet safety and comfortability standards. Old PT units were generally perceived as uncomfortable and dangerous. Older adults need to have access to proper seating, good ventilation systems, units that are not too tall so they can get on and off easily, etc. Fortunately, there have been recent initiatives to retire old "peseros" (SEMOVI 2021), and the city needs to continue allocating more resources to purchase equipped and modern units in all areas of the city, not just the city center.
- Improve the safety measurements in PT and make it easier for crime victims to access security footage in a timely manner. As previously mentioned, this is one of the major concerns for the majority of older adults' interviewed. To address these well documented safety issues in PT (Vilalta 2011; Magaloni 2019), the city government has made progress to address crimes in PT modes, for example, the creation of the "Agencia Digital de Innovación Pública", or *Digital Agency of Public Innovation*, which has made a revolutionary advancements towards digitization information of crime incidents in the city. These efforts need to continue as PT crime rates have not decreased as desired (Magaloni 2019)

**Long-term recommendations**

- Restructure the system that allows 'pesero' drivers to rent a unit and pay a monthly fee to their owners as that structure reinforces competition and poor state of units. As

explained before, ‘pesero’ concessions are given to individuals who own one or more units. These owners give out their concessions to drivers who in exchange pay them a percentage of their income or a flat fee. This type of agreement exacerbates the competition for passengers among drivers, creates accidents, incentivizes lack of professionalization of drivers, etc. (Mejia-Dorantes 2018). The city needs to address this system and make changes so that concessions are given in different terms, to qualified drivers who are constantly evaluated.

- Invest in more options for PT that are not only in the city center but also connect the outskirts of the city and that are affordable or free for older adults. There are improvements to the PT infrastructure that the city is making, for example introducing new trolleys and ‘peseros’, metrobus lines, new cable cars, etc. and these advancements are a great way to continue towards a more connected and accessible PT system. However, we must make sure improvements are also located in areas where low income older adults reside. City officials must keep in mind transportation equity ideals to bring positive mobility changes for everyone, but especially for vulnerable older adults, who need it the most.

**Limitations and future research**

**Literature review**. First, the database search parameters and inclusion/exclusion criteria likely overlooked some relevant papers. Therefore, the scoping review does not claim to be exhaustive. In fact, representing very diverse geographic contexts, it is difficult if not unwise to suggest generalizable conclusions from the literature. As new research emerges from the Global South, it is essential for future research to recognize

the heterogeneity across the regions and to understand the geographically specific contextual nature of older adult mobility, the nuances between places, and differences within localities, in sum more empirical research on the mobility of older adults in the Global South is needed.

**Quantitative phase.** Some limitations of this phase include that the 2017 HODS data used does not reflect the mobility changes that occur during or after the current pandemic, which shifted the everyday mobility patterns, therefore, having access to temporal mobility data would help better understand changes in mobility patterns of elderly. Also, merging PT modes to calculate the multinomial logit model limited the opportunity to capture elderly preferences for specific transport modes. There are many more opportunities for future quantitative research. For example, we need more research on the mobility of disabled older adults, as they usually need extra care, including assistance to travel to places. This research did not focus on this segment of older adults, but this is a great area of opportunity for future studies. Similarly, according to the HODS 2017 results, 31% of older adults mentioned walking as a dominant mode of transportation. This paper did not focus on walking barriers, concerns, recommendations, etc. Therefore, this represents another important line of research to understand how we can make elderly walking trips safer and rewarding.

**Qualitative phase.** This phase does not claim to report the mobility perceptions of all older adults in Mexico City; therefore, the results are not generalizable. Likely, the experiences reported by participants are not the same for all older adults in LAN and HAN, the intention was to explore what were major themes to have as a foundation on

this topic from which we knew very little. Future qualitative research should continue engaging elderly communities for longer periods of time and in different areas of the city to build trust, capture local mobility needs, and achieve a more complete understanding of elderly mobility barriers. Other methods such as community mapping, photovoice, story mapping, etc., are great resources to continue sharing ideas and building community rooted knowledge focused on elderly needs.

**Mixed methods results.** The results obtained by this mixed methods approach are limited to the information gathered in previous phases, therefore, future research should consider other creative methods to combine results in effective ways. Joint displays are not commonly found in Geography research, and we need to continue addressing this gap to bridge the qualitative-quantitative debate in our discipline.

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## Annex A. Summer 2018 Fieldwork

### Approach

In the summer of 2018, I spent six weeks in Mexico City to conduct preliminary fieldwork for my dissertation. During this time, I located areas in the city with high percentages of older adults, later I conducted three focus groups, two in high income neighborhoods and one lower income, and four one-on-one interviews, two in low income and two in high income neighbors.

### Findings

In my fieldwork, I found interesting contrasting realities experienced by older adults coming from different neighborhoods. These focus groups allowed me to identify several aspects that then became part of my interview protocol and code book, including:

- Gender differences
- Family support
- Education level
- Job informality
- Importance of community building
- Health status and access to healthcare
- Retirement status
- Percentage of income spent in transportation
- Preferred modes of transportation
- Relationship with the personal vehicle
- Overcrowding, pickpockets, lack of empathy from other passengers, lack of safety

### Subsequent data collection

These topics allowed me to understand the importance of capturing responses from older adults who live in different neighborhoods in the city as their access to public infrastructure and their socioeconomic income, along with gender, appeared to be important factors that explained their mobility decisions. Another important inside was to ask about challenges and positive aspects that participants come up when thinking about specific modes of transportation.

## Appendix B. Interview Protocol

Thank you for talking more about your mobility experiences! This interview is part of my research involving older adults that live in specific neighborhoods in Mexico City. This phone interview will be audio recorded and will last about 45 minutes. Just a reminder that for all the questions I will ask you, there is no right or wrong answer! All your comments and opinions are valuable for my research. Do you have any questions for me before we get started?

First, I'll ask you a few sociodemographic questions:

- How old are you?
- What is your gender?
- Do you own a driver's license?
- Do you drive?
- What is your marital status?
- What is your employment status, are you retired?
- What is your current monthly income?
- How many people live with you in your household?
- Do you have and use your INAPAM card?

| |
|---|
| ➔ **First, let's talk about your everyday life BEFORE COVID-19.** |
| **1. What places did you go to before the pandemic and why?**<br><br>**Follow up: What modes of transportation did you normally use and why?**<br>Listen for/Follow up: identify PT preferences<br>Can you tell me more about… that… what you mean by… |
| **2. How would you describe your access to public transportation in the city? (subway, microbuses, trolleybus, metrobus)**<br><br>**Follow up: How far away is the subway for you? is it only a short walk?**<br>Listen for/Follow up: sentiments of content/discontent<br>Can you tell me more about… that… what you mean by… |
| **3. Have you ever been robbed/mugged when using public transport?**<br><br>Listen for/Follow up: sentiments of content/discontent/fear/specific frustrations |
| **4. If you had to describe the quality of public transportation to a person who has never traveled in Mexico City, how would you describe it?**<br><br>Listen for/Follow up: sentiments of content/discontent<br>Can you tell me more about… that… what you mean by… |

| |
|---|
| **5. What emotions would best describe your perception about the public transit modes you normally used before the pandemic?**<br><br>**Follow up: what do you like and dislike about using public transportation?**<br>Listen for/Follow up: sentiments of content/discontent<br>Can you tell me more about… that… what you mean by… |
| **6. Is there anything you wish you could change about the transportation systems you normally use?**<br>Listen for/Follow up: specific recommendations/complaints/desires/hopes.<br>Can you tell me more about… that… what you mean by… |
| ➔ **Now, please focus on your current experiences AFTER COVID-19.**<br><br>**7. Since the start of this pandemic, there has been many changes in our everyday lives. How frequently do you leave your home and why?**<br><br>**Follow up: what places did you use to go that you don't go to anymore?**<br><br>Listen for/Follow up: major changes in their mobility patterns<br>Can you tell me more about… that… what you mean by… |
| **8. During these months there has been closures in some transportation systems, such as the subway, have these service shortages affected you personally?**<br><br>Listen for/Follow up: sentiments of content/discontent<br>Can you tell me more about… that… what you mean by… |
| **9. Have you had the need to go out of your household despite the current stay at home restrictions?**<br><br>Listen for/Follow up: family support needed? Employment status, are they essential workers?<br>Can you tell me more about… that… what you mean by… |
| **10. Do you consider public transit a safe option to travel?**<br><br>Listen for/Follow up: fear of getting infected, feelings of isolation, etc.<br>Comments on specific modes of transportation such as subway, buses, BRT, trolley system, etc. |

Is there anything else you would like to add about the topics we have discussed today? To finalize, I just want to let you know more about what we'll be doing with all the information you've shared today. I'll be transcribing or typing out this interview on the computer, and again, if I share this phone interview, I will only do so in a form that does not give away your identity and I will not use your name if I include anything from this interview when I write or talk about the study. Thank you for talking about your mobility experiences with me, I really appreciate it.

## Annex C. Recruitment Flyer

75 YEARS
GEOGRAPHY & THE ENVIRONMENT
UNIVERSITY of DENVER
1945 - 2020

### ¿A dónde viajan los adultos mayores y por qué?

**Investigador principal: Jessica Villena Sanchez**

**El propósito de este estudio de investigación de la Universidad de Denver es comprender mejor las experiencias de movilidad de los adultos mayores que viven en barrios específicos de la Ciudad de México. Para participar en este estudio de investigación, debe:**

- **Tener 60 años cumplidos o más**
- **Ser residente de este vecindario**

**La participación en este estudio implica una entrevista telefónica que se grabará.**

**Cada entrevista telefónica demorará entre 30 y 45 minutos en completarse. Recibirá una tarjeta de regalo de $ 20 dólares por correo postal después de haber completado la entrevista.**

**Información del contacto**
**Para obtener más información sobre este estudio, comuníquese con:**
**Jessica Villena Sanchez**
**(+01) 720-7555-2557 | Jessica.villenasanchez@du.edu**

**Este estudio ha sido aprobado por la Junta de Revisión Institucional de la Universidad de Denver.**


## Annex D. Codes, notes, and memos

| Pre-structured codes | Added codes | Notes and memos |
|---|---|---|
| Driving and drivers' license | I have never driven before | Note the considerably small role that the personal vehicle played in participants' lives. Only for a couple participants from HAN. |
| | I have a license and I drive | |
| | I had a license at some point in my life, but I do not drive anymore | |
| | I have a license, but do not drive. | |
| Education level | Elementary school not completed | Considerably more participants only completed a basic education and differences are clear between HAN and LAN. |
| | Elementary school completed | |
| | Junior high school completed | |
| | Undergraduate degree completed | |
| | Masters completed | |
| | No education obtained | |
| Employment status | I work in the formal sector | Relevant to learn how common was for participants to share that they worked in the informal sector, mostly those living in LAN. |
| | I work in the informal sector | |
| | I used to work in the formal sector | |
| | I worked in the informal sector, but it stopped due to the pandemic | |
| | I am retired | |
| | I used to work in the informal sector | |
| | Feelings of dealing with financial stress | |
| | I do not work, and I do not receive a pension | |
| Housing arrangements | I live alone | Interesting to find how common is to live with core family and how only a few participants lived by themselves. These results follow trends from other countries in the Global South. |
| | I live with my core family members | |
| | I live with other people who are not my family | |
| | I live by myself in a multigenerational home. Other family members live in the same property but independently. | |
| Trip purpose | To visit family and friends | Traveling to go to work was the most common response. Trips to the groceries to small markers were far more recurrent on an everyday basis than going to a supermarket. |
| | To buy groceries to the market/supermarket | |
| | To work | |
| | For leisure | |
| | To take care of family members | |
| | To the doctor | |
| | To church | |

| | | |
|---|---|---|
| | To run errands | |
| Positive sentiments about PT | Quick services | Structured PT modes were generally ranked more positively than unstructured PT modes. |
| | Good infrastructure | |
| | Affordability | |
| | Good connectivity | |
| | Safety | |
| | Friendly passengers | |
| | Only-women areas | |
| Negative sentiments about PT | Pickpockets and robberies | 'Peseros' and 'combis' are the PT modes that seem to bring the most recurrent negative sentiments. These modes are used by all participants, regardless of neighborhood of residence. However, participants from LAN rely more on them because they do not drive. |
| | Overcrowding | |
| | Lack of proper infrastructure | |
| | Unfriendly/unkind/impatient/inexperienced drivers | |
| | Unfriendly/unkind passengers | |
| | Lack of comfortability and old units | |
| | Unreliable service | |
| Family support to reach places | Support from family members | Family support to help out with the basic everyday travels. |
| | Support from neighbors | |
| | Support from others | |
| Recommendations to address PT issues | Drivers need training | Participants had a great variety of recommendations, both general and particular to specific PT modes. |
| | Drivers need to reflect and be more empathetic | |
| | Invest in newer units that are comfortable | |
| | Invest in PT infrastructure to make stops more accessible and easy to use | |
| | Improve PT services to make them reliable and reduce waiting times. | |
| | Improve safety measures in all PT modes, specially 'peseros', 'combis' and the subway | |
| Changing mobilities during COVID | Self-isolation and mental issues that emerged from it | Interesting equity disparities appeared. Participants from HAN had the opportunity to choose the safest ways to travel, while LAN participants did not. |
| | Losing informal jobs and therefore an income | |
| | Shift in preferred PT modes | |
| | Change in mobility patterns | |
| | Family support and caregiving relationships | |