



**DOSSIER
AGEING, TERRITORY, AND
ENVIRONMENT**

Editors

Patrícia Samora and Alejandro Pérez

Conflict of interest

The authors declare that there is no conflict of interest regarding the publication of this article.

Funding

Fundação de Amparo à Pesquisa do Estado de Minas Gerais (FAPEMIG, Research Support Foundation of the State of Minas Gerais) (Process APQ-01359-22); Conselho Nacional de Desenvolvimento Científico e Tecnológico (CNPq, National Council for Scientific and Technological Development), through the Universal Demand Notice (Process 409726/2022-2); the Instituto de Estudos Avançados Transdisciplinares (IEAT, Institute of Advanced Transdisciplinary Studies) from the Universidade Federal de Minas Gerais (UFMG, Federal University of Minas Gerais); and the productivity grant (Process 312623/2023-2).

Received

May 15, 2024

Final Version





Nov. 13, 2024

Approved

Feb. 4, 2025

Elderly Mobility and Family Structure

Mobilidade de idosos e estrutura familiar

Eugênia Dória Viana Cerqueira¹ , Ana Marcela Ardila Pinto² , Daniela Antunes Lessa³ , Ana Clara Carreira⁴ , Júlia Ribeiro Borges⁴ 

¹ Universidade Federal de Minas Gerais, Faculdade de Filosofia e Ciências Humanas, Programa de Pós-Graduação em Sociologia, Centro de Estudos Urbanos. Belo Horizonte, MG, Brasil. *E-mail:* eugeniadoria@gmail.com

² Universidade Federal de Minas Gerais, Faculdade de Filosofia e Ciências Humanas, Programa de Pós-Graduação em Sociologia, Centro de Estudos Urbanos. Belo Horizonte, MG, Brasil.

³ Universidade Federal de Ouro Preto, Escola de Minas, Programa de Pós-Graduação em Engenharia Ambiental; Universidade Federal de Minas Gerais, Programa de Pós-Graduação em Geotecnia e Transportes. Ouro Preto; Belo Horizonte, MG, Brasil.

⁴ Universidade Federal de Minas Gerais, Faculdade de Filosofia e Ciências Humanas, CEURB. Belo Horizonte, MG, Brasil.

How to cite this article/Como citar este artigo: Cerqueira, E. D. V. et al. Elderly Mobility and Family Structure. *Oculum Ensaios*, v. 22, e2512799, 2025. <https://doi.org/10.24220/2318-0919v22e2025a12799en>

Abstract

The present study highlights the main findings of an investigation aimed at analyzing the mobility of the elderly population in the Metropolitan Region of Belo Horizonte and its relationship with existing family structures. Descriptive statistical methodology using data from the Origin and Destination Survey (2012) led to the identification of significant relationships between family structure, socioeconomic characteristics and travel patterns of elderly individuals. We illustrate that elderly individuals in couple family structures tend to travel by individual motorized means, while those living alone or in single-parent structures primarily travel on foot or by public transport. Additionally, a relationship between family structure, age, and reasons for travel can be observed. In this regard, the findings support the need for a more comprehensive analysis of travel-behavior within the studied population.

Keywords: Aging. Mobility practices. Family. Older adults.

Resumo

O presente estudo evidencia os principais resultados de uma investigação que se propôs a analisar a mobilidade da população idosa na Região Metropolitana de Belo Horizonte e sua articulação às estruturas domiciliares existentes. Foi utilizada uma metodologia estatística descritiva a partir dos dados da Pesquisa de Origem e Destino (de 2012), que permitiu explorar a articulação entre estrutura domiciliar, características socioeconômicas e padrões de viagens das pessoas idosas. Verifica-se que idosos inseridos em uma estrutura domiciliar de casal tendem a se deslocar por meios motorizados individuais, enquanto idosos sozinhos ou em estruturas monoparentais deslocam-se prioritariamente a pé ou por transporte público. Além disso, pode-se observar uma relação entre estrutura domiciliar, idade e motivos de viagens. Nesse sentido, os achados corroboram a necessidade de uma análise mais abrangente dos comportamentos de mobilidade da população estudada.

Palavras-chave: Envelhecimento. Família. Pessoas idosas. Práticas de mobilidade.

Introduction

A notable trend in Brazilian demographic studies is the continuous aging of the population over the last decades. According to the *Instituto Brasileiro de Geografia e Estatística* (2023), any individual aged 60 years or older is classified within this category. In the 2000s, this group corresponded to 5.6% of the population, a proportion that increased to 10.7% in 2010 and 19.5% in 2022. This increase generates significant challenges in terms of the demands for goods, services, and infrastructure. Urban mobility, in particular, constitutes one of the most relevant policy sectors, considering its role in guaranteeing access to opportunities for participation in urban life. Faced with this scenario, it becomes urgent to discuss and understand how the aging process articulates with the demand for mobility services and which factors influence the configuration of the travel behaviors of this population group.

A significant portion of the research dedicated to older adults population highlights aspects that affect their level of movement, such as the incidence of physical and mental disabilities; sociodemographic and economic dimensions; and location within the city (Banister; Bowling, 2004). However, the recognition of relational aspects of mobility, related to the role of different agents in structuring travel decisions, is increasingly gaining importance in academic literature (Thrift, 1977).

The present work seeks to analyze travel patterns based on indicators of travel rates, reasons, and modes, according to different household units of elderly individuals in the *Região Metropolitana de Belo Horizonte* (RMBH, Metropolitan Region of Belo Horizonte). In recent decades, the RMBH has been characterized by a significant increase in the aging process, above the national average. In Brazil, it is estimated that by 2030 and 2040, elderly individuals will represent approximately 18.7% and 23.5%, respectively (Instituto Brasileiro de Geografia e Estatística, 2018); while in the RMBH, projections indicate a growth in the elderly population to 22.6% and 30.8% in 2030 and 2040, respectively (Fundação João Pinheiro, 2018). Furthermore, the spatial structure of the capital of Minas Gerais is considered, characterized by a strongly monocentric structure (Cardoso, 2007; Cerqueira, 2018), and by the presence of mobility inequalities resulting from the inadequate supply of public transportation (Lessa, 2019). The high rate of private motorization in comparison with other Brazilian metropolitan regions is noteworthy. According to the historical series provided by the Institute for Transportation & Development Policy Brazil (ITDP Brasil, 2022), this region presented the largest percentage increase in the last two decades, in relation to other Metropolitan Regions (MR): from 207 vehicles/1000 inhabitants in 2001, it rose to 735 vehicles/1000 inhabitants in 2022, representing an increase of 2.5% in this rate.

Thus, this study intends to investigate the mobility practices of the elderly population in the Metropolitan Region of Belo Horizonte, using a methodology of descriptive statistical analysis combined with a relational perspective, which reveals the significant heterogeneity in travel behaviors. The diversity of observed practices is related to multiple dimensions, such as life cycle (age), gender, participation in specific household arrangements, and characteristics of the urban context. Based on data from the 2012 Origin and Destination Survey (ODS), the most recent survey available (Minas Gerais, 2012), the study seeks to expand the understanding of mobility practices beyond the individualized view, highlighting the role of family structures and their influence on the movements of the elderly. These household arrangements present a plural character, reflecting not only the definition and internal dynamics of families but also the urban spaces in which these interactions develop.

This study seeks to contribute significantly to the discussion of central issues in public policies aimed at guaranteeing the rights of elderly individuals, by emphasizing the role of families

as essential agents of protection, the importance of mobility for quality of life, and the need for accessibility policies. These aspects are currently integrated into the policy formulation process in the RMBH, which aims to promote accessibility and strengthen protection for older adults.

Bibliographic review

Studies on the mobility of the elderly population have gained relevance among authors concerned with urban travel dynamics. Their importance stems from the deepening of a social phenomenon that increasingly affects various societies. The aging process is associated not only with demographic weight but also with the growing visibility of older people in public policies and the public sphere across different geographical contexts (Rosenbloom, 2004). The expansion of this process has created a need to develop analytical models that allow us to identify the role of age and its particularities in travel behavior.

Academic research has highlighted several variables that affect the travel behaviors of this group. First and foremost, health conditions are the most significant factor in this field of study. The prevalence of chronic diseases and impairments and disabilities is linked to increased immobility (Curl; Musselwhite, 2018; Metz, 2012), a reduction in the number of trips, and the undertaking of shorter journeys (Barreto, 2012; Freitas; Queiroz; Sousa, 2010; Maresova *et al.*, 2023; Gomes; Pamplona, 2015; Hogan *et al.*, 2009). Other studies emphasize the importance of mobility for improving quality of life, autonomy, and enhancing social ties and political participation (Green; Jones; Roberts, 2014; Levasseur *et al.*, 2015).

Regarding transportation modes, public transportation is particularly emphasized (Ryan; Wretstrand; Schmidt, 2015; Szeto *et al.*, 2017), especially when access is facilitated by fare exemption policies or made necessary by poverty and vulnerability among older adults (Böcker; Van amen; Helbich, 2017). Car access may be high, particularly in Global North countries (Minton; Clark, 2018; Rosenbloom, 2004), unless restricted by disability or legal barriers (Whelan, 2006). Gender also plays a role: women tend to use public transport and walk more, whereas men are more likely to use private cars (Szeto *et al.*, 2017). These general trends are nuanced when considering other variables, revealing great heterogeneity in travel practices, especially when individual, psychosocial, and social aspects are considered (Community, urban, and policy levels) (Musselwhite; Haddad, 2017; Webber; Porter; Menec, 2010). Furthermore, there's a wide diversity in the urban contexts where older adults live, in terms of density, service location, segregation, and poverty (Esson *et al.*, 2016; Munshi; Sankar; Kothari, 2018; Musselwhite; Attard, 2021; Porter *et al.*, 2013; Whelan, 2006). The mobility system structure and transport supply can also significantly impact these trends, creating barriers to movement (Aguiar; Macário, 2017; Alsnih; Hensher, 2003; Cataldi, 2018; Metz, 2017; Rantakokko *et al.*, 2015; Velho *et al.*, 2016).

The role of family arrangements in shaping the mobility practices of older adults remains an important, yet underexplored, factor in the mobility debate. This research field can be divided into three main axes that guide the relationship between elderly mobility and family structures. The first axis refers to family as the reason for travel, being the final destination of many trips taken by this group (Montoro-Gurich; Moreno-Tapia, 2021; Villena-Sanchez; Boschmann; Avila-Forcada, 2022).

The second axis involves the comprehension of caregiving dynamics, highlighting both the role of mobility in enabling care by family members and the role of elderly people as caregivers for family members. Here, gender plays a particularly significant role (Madariaga, 2016). Most caregiving tasks are carried out by women who are part of the household. According to Rosenbloom

(2004), adult children, particularly daughters and daughters-in-law, often meet the needs of elderly family members by actively accompanying them on activities or performing essential errands like trips to the pharmacy, grocery store, or bakery.

At the same time, the role of older people as caregivers is also highlighted (Croucher *et al.*, 2021; Porter; Tewodros; Gorman, 2018). In the same sense, Hanrahan (2018) highlights how Ghanaian culture values the importance of caring for family members, and how these relationships, which span generations, create expectations of support from women. Intergenerational care responsibilities directly interfere with the mobility of Ghanaian women, since they are considered primary caregivers. The literature makes clear that social markers, such as gender and age, directly influence the mobility of older adults when considering caregiving roles within family structures (Feng *et al.*, 2013).

Finally, the third axis addresses the impact of household arrangements on the mobility decisions and needs of elderly individuals. It is possible to verify that the family is a structuring part of the way in which decisions are made regarding the movement of older people, as well as their mobility and accessibility needs. Family members' mobility is shaped in various ways, depending on household composition and cultural context in which they are inserted. Thaitatkul *et al.* (2022) show that in Thailand—and Southeast Asia in general—it is common for older adults to live in multigenerational households, making them more dependent on younger relatives for mobility. Other authors note differences between the Global North, where older adults' decisions tend to be more individualistic, and Asian societies, which emphasize family values and care for the elderly (Chao; Huang, 2016).

From the literature review, it becomes possible to understand that family structures have a significant impact on travel opportunities and the means available to carry them out. Factors such as living alone, cohabiting with a spouse, or living with younger family members can directly influence travel behavior. Individuals who live alone tend to rely more on public transportation services or active modes to meet their mobility needs. On the other hand, those who live with other household members may have access to more mobility resources and support in organizing their trips (Cerqueira; Motte-Baumvol, 2022). In addition to influencing modal choices, the presence of close relatives and the family environment also play a fundamental role in the mobility and quality of life of older adults. Family structure can also influence the reasons for travel. Older adults who live with other family generations make more home-related trips, such as accompanying children and shopping (Bertuzzi; Paskulin; Morais, 2012; Dong *et al.*, 2015).

Altogether, these studies show, firstly, that both the quantity and quality of elderly participation are not only the result of individual aging processes but also of the web of social relations they are part of. The living and neighborhood arrangements, the spaces in which they move, and the mobility infrastructures they use are central elements that explain the diverse practices of the population studied. This population group tends to be more dependent on local service arrangements, public policies that facilitate access and inclusion, and the quality of transport services. Secondly, they highlight their demands, although despite their importance, they are barely visible either in research or in the public sphere. The demands of the most vulnerable (i.e., older adults, people with disabilities, children, women), especially in situations of poverty, continue to be overlooked in transport policies, particularly in Global South countries (Ardila Pinto; Villamizar-Duarte, 2018). Addressing these aspects of mobility is thus imperative for academic research. Thirdly, although research conducted in other countries illustrates that family attributes have an important influence on individuals' daily activities and travel behavior (Zhao; Yuan, 2023),

few studies address this topic in the Brazilian context, especially regarding elderly people (Barbosa, 2014; Barreto, 2012).

This study starts with the assumption that family plays a central role in structuring mobility practices and operates as a coupling constraint. This concept, defined by Hägerstrand and cited by Thrift (1977), helps to understand how space-time mobility needs are intertwined with interpersonal interactions in the performance of certain tasks. These tasks encompass a range of activities, including providing support and assistance to family members, ensuring livelihood, or engaging in social interactions. Older adults in particular may serve as caregivers or require care from other family members, especially when it comes to their mobility needs. In general, they rely on other family members for transportation, physical assistance, and emotional support to ensure active community participation and access to essential services. Household structure, therefore, plays a critical role in mobility. From this perspective, this research seeks to explore the relationship between elderly mobility and household structure in the Metropolitan Region of Belo Horizonte. In this sense, the importance of understanding the behavioral strategies and activities of elderly people in different home contexts is highlighted. It is postulated that the appreciation of this debate, as well as the presentation of this information, could contribute to the formulation of measures and the creation of more appropriate mobility systems.

Methodology, Study Scope, and Database

The research was conducted in the Metropolitan Region of Belo Horizonte (MRBH) (Figure 1), based on the analysis of data extracted from the 2012 Origin and Destination survey (ODS) of the MRBH (Minas Gerais, 2012). This is a periodic and sample-based survey carried out in Belo Horizonte and its metropolitan region since 1972. The latest version was developed and made available in 2012 by the Metropolitan Region of Belo Horizonte Development Agency, a body linked to the Government of the State of Minas Gerais. The data used in this study were collected through household questionnaires, comprising Household and Individual modules. These questionnaires recorded information provided about trips made the day before the survey by all residents of randomly selected households. The surveys were conducted in person, enabling the collection of comprehensive data on mobility practices, sociodemographic characteristics of individuals, as well as general information on the household context and place of residence.

The population considered in this study corresponds to elderly individuals aged 60 years or older, the age established by Brazilian Federal Legislation (Brasil, 2003) as the criterion for defining public policy and access to targeted goods and services, such as subsidies, pensions, and priority care. The sample used in this investigation represents a subset of elderly respondents, totaling 514,723 individuals out of the 4,868,071 interviewed in the survey, thus representing 10.6% of the sample. The age groups considered for the research were established according to gerontological studies (Beard *et al.*, 2016), which distinguish between the young-old (60 to 74 years), the middle-old (75 to 84 years), and the oldest-old (85 years and older). The first group generally maintains good health and independence, with many still active in the labor market or recently retired. The middle-old group presents a higher prevalence of chronic diseases and physical limitations. Finally, the oldest-old are the most vulnerable, frequently dependent on long-term care because of the high prevalence of chronic conditions and functional limitations. Regarding gender, the ODS employs the sex variable, which, although limited for understanding the gender distribution of the population, is the only information available.

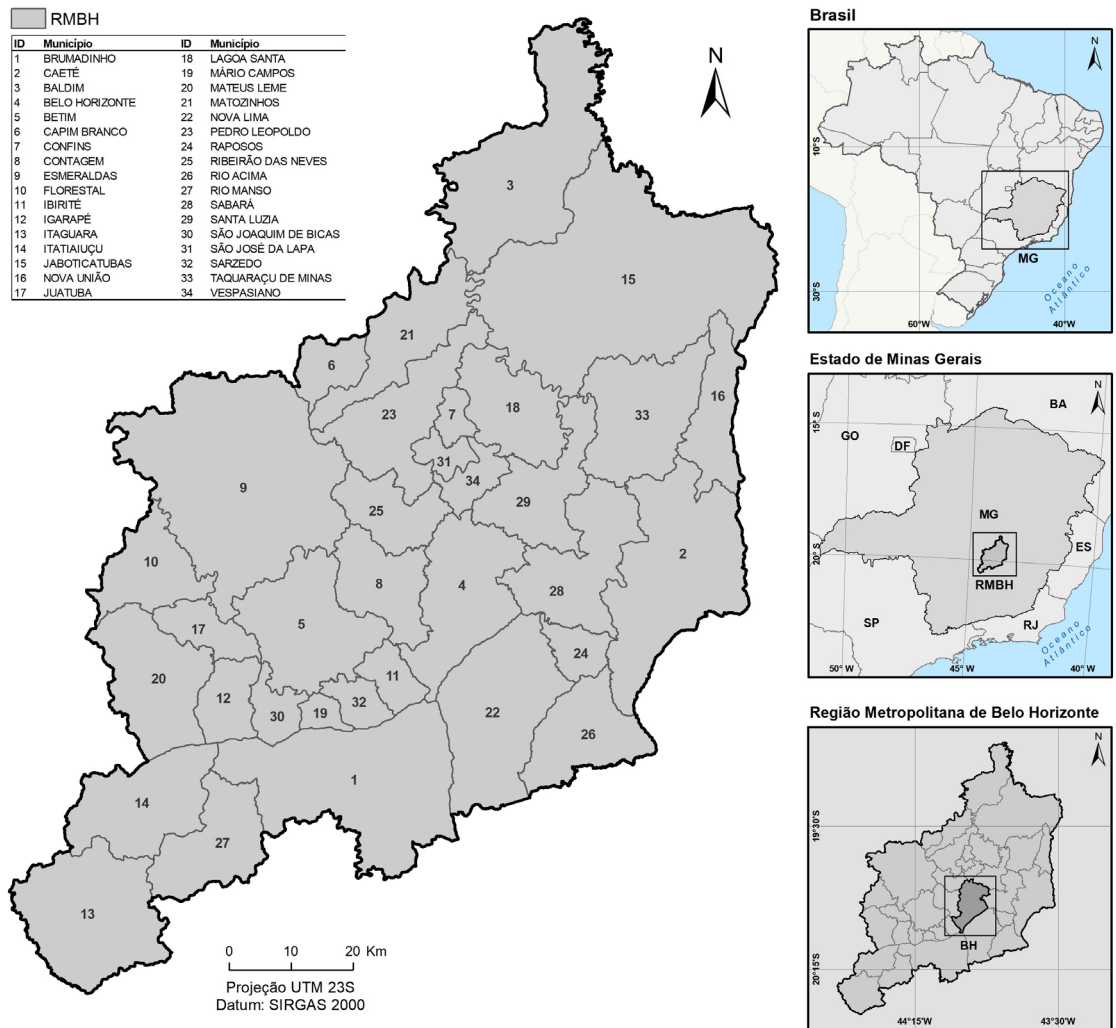


Figure 1 – The Metropolitan Region of Belo Horizonte
 Source: Prepared by the author

Thus, it is considered that mobility practices should be understood from a relational perspective, primarily involving the household sphere. Therefore, the hypothesis is adopted that decisions about how, when, and who travels are associated with (a) the household arrangements in which individuals participate; (b) the different stages of the life cycle; (c) gender; and (d) specific urban contexts.

The absence of data regarding family structure in the ODS led to the use of the Minimum Household Unit (MHU), established by Leiva (2012). This is the smallest disaggregable unit of household elements within the dwelling, capable of making economic decisions to expand benefits. In this sense, an optimal size for this unit was estimated, avoiding underestimation at the level (large MHU) or overestimation (fragmentation of the household). Thus, a typology of MHU was developed to be implemented in the empirical analysis of urban mobility in relation to the life cycle, with an emphasis on the elderly population of the MRBH. This was carried out based on the correspondence between household arrangements extracted from the 2012 ODS.

Furthermore, the use of the MHU in this study is notable for considering the organization of the household based on the perspective of the reference individual, allowing for the identification of

differences in the mobility structure given the individual's position within the same household unit. Even when examining MHU arrangements separately, the focus remains on the individual. When the objective shifts to the household level, the approach then aggregates MHUs accordingly. The classifications of MHUs defined by Leiva (2012) are: MHU 1 (Living alone) considers all those who identify as a single household unit, even when sharing the same dwelling. MHU 2 (Couple without children) is the unit in which the declared presence of a head of household and a spouse is observed. MHU 3 (Couple with children) assumes the same structure as MHU 2 with the addition of members identified as children. And finally, MHU 4 (Single-parent) when there is only the presence of the head of household with children.

Once the MHU typologies were defined, an initial descriptive analysis was carried out, based on the data and units presented, which allowed us to identify the relationship between the individual characteristics of the analyzed group and the respective MHUs. Subsequently, this information was cross-referenced with variables identified in the ODS/2012, namely: (a) Car ownership; (b) Trip rate, calculated from the ratio between trips made and the number of corresponding individuals. This variable was calculated for each of the ages of the elderly groups identified in the Individuals module of the ODS/2012; (c) Aggregated modes (Individual motorized – car and motorcycle, Collective – bus and subway, and non-motorized – on foot and bicycle); and (d) Reasons for destination (Accompaniment, Shopping/Errands; Leisure, Health and Work/Study).

Results and Discussion

This analysis of the relationship between mobility practices and household structure is organized into two parts. The first part presents an overview of the relationship between individual characteristics and household structure in the MRBH, based on Household Units (MHUs). The second part examines these relationships according to variables related to travel behavior, including car ownership, trip rate, mode, and reason.

The descriptive analysis of the 2012 Origin and Destination Survey data allowed for outlining an overview of the relationship between individual characteristics and household structure in the MRBH. In aggregate terms, it was identified that approximately 75% of elderly residents in the MRBH are part of a household structure that includes at least one other resident (MHU 1). As presented in Table 1, roughly 49% of elderly individuals' households include the presence of a child in the household structure (MHU 3 and MHU 4). All of these data highlight the importance of family for this population group within care networks.

On the other hand, approximately 25% of structures are classified as MHU 1 – Living alone – a significantly higher proportion than the general population average. When this percentage is related to the age of the elderly groups (Table 2), it is observed that elderly individuals living alone are more prevalent among those over 85 years old. With the aging of the population, many find

Table 1 – MHU of elderly individuals in the MRBH (2012).

Household structure	Total population (%)	Elderly (%)
MHU 1 – Living alone	9.0	24.5
MHU 2 – Couple without children	9.0	26.6
MHU 3 – Couple with children	56.7	30.0
MHU 4 – Single-parent	25.0	18.6

Source: Prepared by the author, based on Minas Gerais (2012).

themselves as the sole surviving members of their families, potentially leading to single-person households. Conversely, younger elderly individuals are notably situated in MHU 3 – Couple with Children.

Table 2 – MHU of elderly people by age group in the MRBH (2012).

Household structure	Living alone (MHU 1)	Couple without children (MHU 2)	Couple with children (MHU 3)	Single-parent (MHU 4)
From 60 to 74 years	21.7	27.3	34.3	16.7
From 75 to 84 years	28.5	31.7	21.2	18.4
85 years and over	43.0	24.0	13.4	19.2

Source: Prepared by the author, based on Minas Gerais (2012).

The articulation between the number of vehicles per household and the MHUs demonstrates strong motorization among couples, especially couples with children (Table 3). Conversely, a contrasting reality is evident for elderly individuals living alone or in a single-parent MHU. Approximately three-quarters of individuals living alone, and half of those in a single-parent household structure, do not own any vehicles in their households. This situation can be attributed to various factors, including difficulties driving due to advanced age, retirement, and dependence on public transportation services or third-party assistance for travel (Albert *et al.*, 2018; Gardezi *et al.*, 2006).

The calculation of the trip rate reveals a gradual decrease in the number of trips per person as age increases (Figure 3). This finding corroborates previous investigations that indicate a decline in the number of trips among elderly individuals in the oldest-old age range (Freitas; Queiroz; Sousa, 2010; Maresova *et al.*, 2023). As individuals age, their travel patterns change, frequently resulting in fewer out-of-home trips. Other studies indicate this same trend and attribute it to factors such as the incidence of disabilities, decreased physical capacities, participation in labor markets, as well as an increasing preference for remaining in familiar environments (Aguiar; Macário, 2017; Curl; Musselwhite, 2018; Villena-Sanchez; Boschmann; Avila-Forcada, 2022).

Table 3 – MHU of elderly MRBH and number of vehicles per household (2012).

Household structure	None	One	Two or more
MHU 1 – Living alone	72.7	22.0	5.29
MHU 2 – Couple without children	47.0	40.7	12.3
MHU 3 – Couple with children	28.2	37.8	34.0
MHU 4 – Single-parent	48.2	34.8	17.1

Source: Prepared by the author, based on Minas Gerais (2012).

The investigation by sex, presented in Figure 2, indicates two main dynamics in travel behavior. The first is related to elderly women, for whom trip rates show a significant segmentation between those living alone (MHU 1) and those belonging to a household group, regardless of the arrangement (MHU 2, 3, and 4). While for elderly men, this differentiation occurs between arrangements without or with children (MHU 1 and 2 versus MHU 3 and 4, respectively).

Specifically, this analysis by sex illustrates that elderly women living alone (MHU 1) exhibit higher average trip rates than those in other MHUs. Elderly men, on the other hand, show a higher average number of trips when part of MHU 3 (Couple without children). Studies indicate that elderly women living alone tend to be more autonomous and make more trips to maintain their

social networks and access essential services. This reflects a more active behavior to combat social isolation (Schwanen; Ziegler, 2011). Furthermore, elderly men living with their spouses but without children often take advantage of the flexibility of this arrangement to engage in more outdoor activities and maintain an active life (Mitra; Yao; Ritchie, 2021).

Regarding modes of transportation, individuals living alone tend to travel by non-motorized modes of transportation, especially women (Figure 3). Conversely, elderly individuals in a Couple with children MHU are the most likely to travel by motorized individual modes, with a high prevalence of elderly men. Gender differences are a recurring phenomenon in different spatial contexts, given that women tend to use public transportation more and walk more, compared to men, who generally use private cars more (Albert *et al.*, 2018; Musselwhite; Haddad, 2017). Indeed, it is observed that, in all MHUs (except Couple without children), public transportation is mainly used by women.

Finally, the analysis of travel reasons reveals that trips for shopping and personal errands (such as banking, lottery, *etc.*) represent a significant percentage of elderly individuals' trips across all household structures (Figure 4). The literature suggests that elderly individuals often limit their travel to essential trips, such as medical appointments, grocery shopping, or visits to family and friends (Cerqueira, 2018; Maresova *et al.*, 2023). In MHUs with children, elderly women make more trips for Shopping/Errands, reinforcing the previously discussed notion of a socially constructed mobility of women, which entails more trips related to provision, domestic organization, and caregiving than men (Croucher *et al.*, 2021; Hanrahan, 2018; Cerqueira; Motte-Bauvmol, 2022).

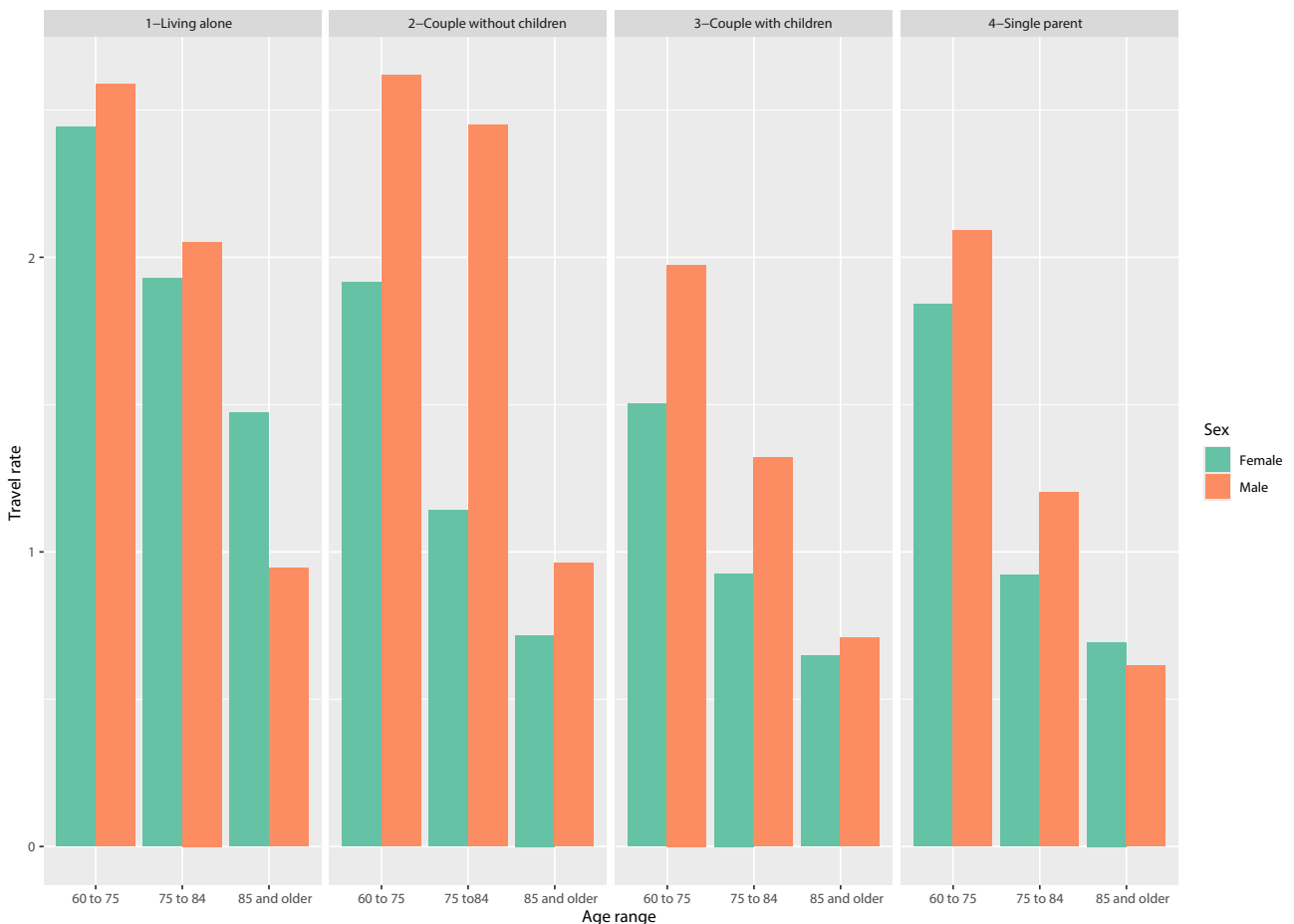


Figura 2 – Taxa de viagens dos idosos na RMBH por UDM e sexo (2012).

Fonte: Elaboração própria, baseado em Minas Gerais (2012).

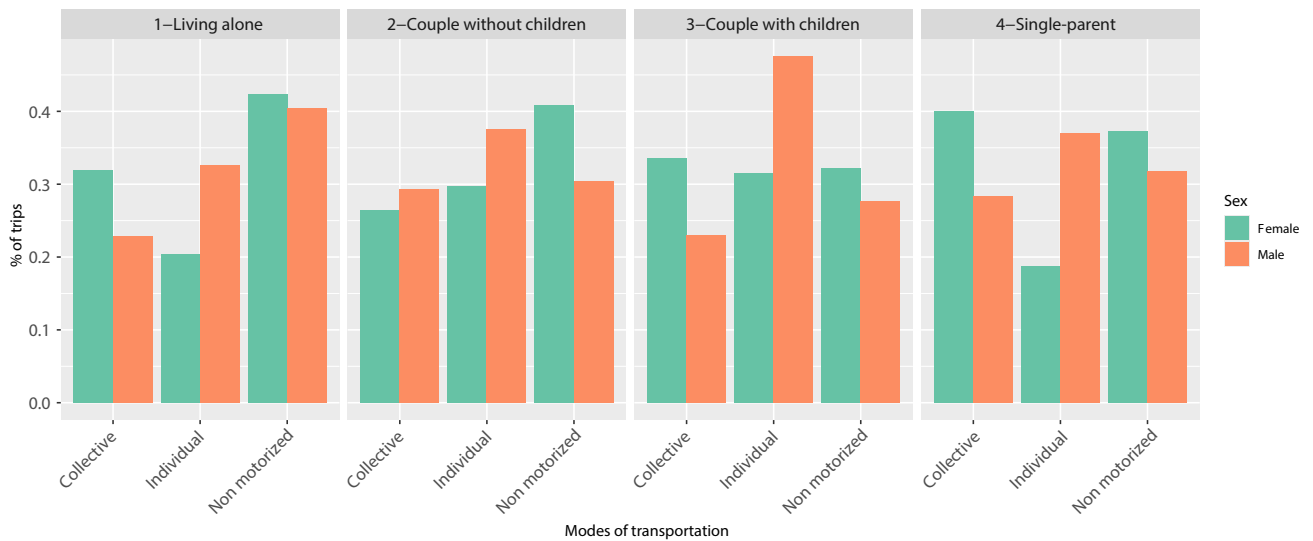


Figure 3 - Relationship between MHU of elderly people, sex and modes of transport in MRBH (2012).

Source: Prepared by the author, based on Minas Gerais (2012).

On the other hand, it is observed that men make more trips for Work/Study, especially those in the Couple with Children MHUs. The analyzes listed above illustrate that elderly individuals in this type of MHU frequently fall into younger age groups, which could explain a higher rate of professional activity. This scenario is also attributed to gender differences in the labor market and work culture, where men historically maintain a greater presence in the workforce until more advanced ages.

Trips for Accompaniment represent almost 10% of trips in household structures with children. Although this function has been documented in the literature as related to the female population (Hanrahan, 2018), a predominance of men's trips for accompaniment is observed in MHUs where children are present (MHU 3 and MHU 4), a scenario that appears to be associated with the greater motorization of men in the MRBH, especially in households with children. This context reinforces the role of older adults not only as recipients of care but also as caregivers, configuring bidirectional relationship dynamics with family members (Porter *et al.*, 2013; Zhou; Yuan; Yang, 2020).

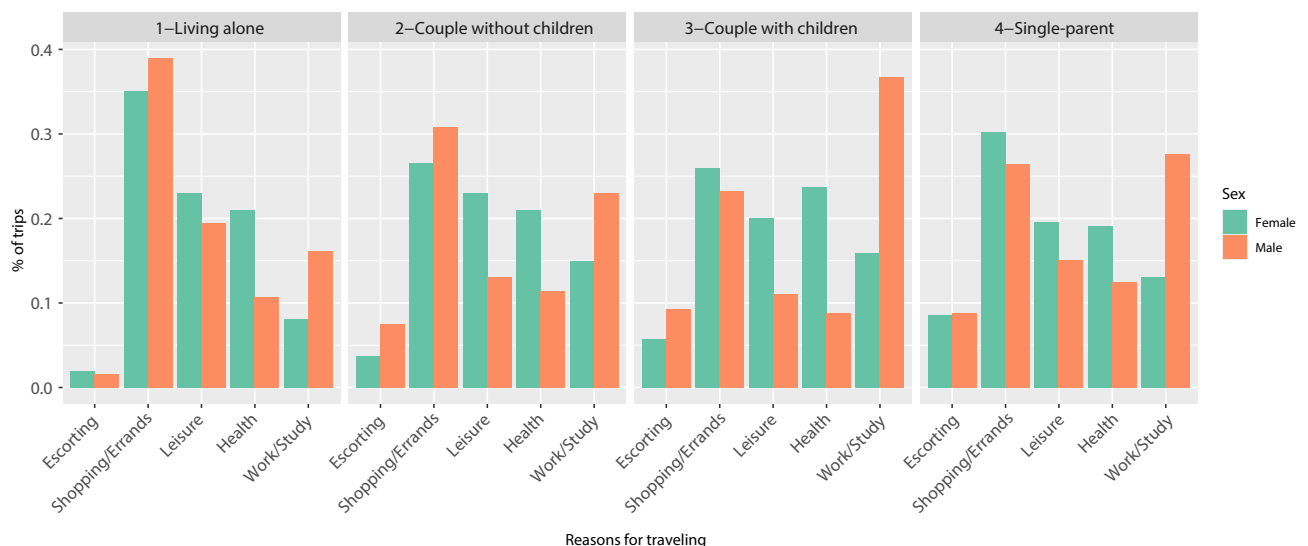


Figure 4 - Relationship between MHU of elderly people, sex and travel reasons in MRBH (2012).

Source: Prepared by the author, based on Minas Gerais (2012).

The listed results provide relevant contributions regarding the relationship between the household structure of elderly individuals and their daily travel, revealing the importance of understanding mobility dynamics beyond an individual perspective. By analyzing the different MHUs, as well as age and sex, significant differences in travel patterns are evident. Consequently, the family constitutes an important constraint by significantly influencing the reasons for travel in relation to the definition of tasks and movement demands. It also plays a central role in access to mobility resources, especially the use of private modes of transportation, or the ability to perform accompanying tasks. Regarding travel time, relevant differences were not identified between elderly individuals in different household arrangements, nor in relation to sex and age group, which is why it was not considered in this study. It is understood that this indicator may be influenced by other limitations associated with environmental conditions, urban structure, and the organization of the mobility system.

Final Considerations

This investigation aimed to discuss the articulation between household structure and the mobility of elderly individuals in the MRBH, highlighting the fact that how people live and interact within their household structures has a significant impact on their travel patterns and choice of transportation modes. The analysis of trips made by the elderly, through descriptive statistics, corroborates these premises. It is noteworthy, however, that household structure arrangements are not homogeneous but are mediated by other dimensions, such as gender and age. The findings of this work contribute significantly, at least in two specific axes: the identification of household arrangements in the MRBH and the understanding of the coupling functions of families according to gender and age.

The family represents a relevant condition in decision-making regarding the distribution of resources and the organization of mobility activities in the MRBH. This aspect is confirmed by the finding that 75% of households are composed of structures with two or more individuals. It is also identified that at least 50% of households include children, whether in couples or single-parent units. This configuration certainly contributes to the increased demands for movement among elderly individuals. These demands, in turn, can influence the quality of life of these individuals, as they increase the opportunity for active aging. Isolation and loneliness constitute a growing trend in various countries, especially in the Global North, and have significant effects on the mortality and morbidity of elderly individuals (Fakoya; McCorry; Donnelly, 2020).

Regarding travel practices, it is observed that household arrangement has a significant influence on travel decisions. A detailed analysis of the relationship between mobility practices and household structure reveals a gradual reduction in the frequency of trips as age advances, regardless of gender. Furthermore, regarding travel modes, and corroborating much of the academic literature, it is verified that individuals living alone or in single-parent structures are more likely to use non-motorized or public modes of transport. On the other hand, in structures where children are present, the use of the motorized individual mode is more recurrent.

In addition, household structure influences the frequency of trips made when considering the gender of individuals. It was observed that women, when inserted into arrangements with at least one other individual (couples without or with children, and single-parent households), tend to reduce the number of trips made. Conversely, men inserted into household contexts with children (couples with children or single-parent households) tend to increase this number. Another

noteworthy finding is that although care-related activities have been widely associated with women in the literature (Hanrahan, 2018), this research verifies the predominance of male trips with the reason of accompaniment (associated with care activities). This scenario may be related to the level of motorization of elderly men in the MRBH, especially in households with children (couples with children and single-parent households). Indeed, many grandparents assume the role of caregivers for their children and grandchildren, playing a vital role in the emotional stability and development of the younger ones (Pickering *et al.*, 2023).

Household arrangement and gender were also relevant when considering modal choice and travel reasons. In general, trips related to shopping and personal errands represent a considerable portion of the travel patterns of the studied group. Regarding women, the use of public transportation is more significant compared to men in all MHUs, except in couples without children. Regarding the reasons for their trips, Leisure and Health are identified as the predominant ones. As for men, concerning the reasons, Work/Study is identified as the most relevant, especially in the Couple with children MHUs.

The MRBH is characterized by the high motorization of trips, including those made by elderly individuals. This characteristic differs from other metropolitan realities, in which elderly individuals tend to significantly increase their trips by public transportation and active mobility. The number of vehicles is particularly high in the Couple with children MHUs, while in those living alone or in a single-parent household structure, the prevalence of households without cars is observed. Not owning a car in a monocentric city with a quite reduced public transportation supply, especially in the municipalities located further from the core city of Belo Horizonte, can pose serious challenges to accessing urban opportunities (Lessa, 2019).

It is fundamental to emphasize that the absence of more recent data on mobility in the MRBH constitutes one of the main limitations of this study, restricting the capacity to identify patterns in the current context. With the gradual aging of the population in Brazil, it is possible to infer that significant transformations in both household structure and mobility trends may have been observed in the last ten years in the MRBH. Furthermore, in order to understand relational mobility and mobility for care, the availability or collection of more detailed data regarding the trips of elderly individuals and the dynamics between members of a household structure would be essential, for example, regarding trips for the reason of accompaniment.

Based on these conclusions, it is suggested that, despite the progress in policies associated with the Age-friendly cities programs, future research and public policies consider the specificities of household arrangements and the issue of aging. There is a pressing need to further investigate the burden of caregiving activities, as well as the provision of demands for public transportation and adequate public spaces. Such advances can contribute to guaranteeing the autonomy and safety of older people, especially women and groups with greater vulnerability, whether socioeconomic, physical, and/or cognitive.

References

- Aguiar, B.; Macário, R. The need for an Elderly centred mobility policy. *Transportation Research Procedia*, v. 25, p. 4355-4369, 2017.
- Albert, G. *et al.* The challenge of safe driving among elderly drivers. *Healthcare Technology Letters*, v. 5, n. 1, p. 45-48, 2018.
- Alsnih, R.; Hensher, D. A. The mobility and accessibility expectations of seniors in an aging population. *Transportation Research Part A: Policy and Practice*, v. 37, n. 10, p. 903-916, 2003.

- Ardila Pinto, A. M.; Villamizar-Duarte, N. Ciudad(anía) en movimiento: construcción social de instrumentos de políticas de movilidad en Bogotá y Belo Horizonte 1995-2015. *Universitas Humanística*, v. 85, n. 85, 2018.
- Banister, D.; Bowling, A. Quality of life for the elderly: the transport dimension. *Transport Policy*, v. 11, n. 2, p. 105-115, 2004.
- Barbosa, R. R. *Análise da dependência espacial da mobilidade urbana do idoso: aplicação aos dados da pesquisa domiciliar de 2007 da região metropolitana de São Paulo*. Dissertação (Mestrado em Transportes) – Universidade de Brasília, Brasília, 2014.
- Barreto, K. M. L. *Envelhecimento, mobilidade urbana e saúde: um estudo da população idosa*. Tese (Doutorado em Saúde Pública) – Centro de Pesquisas Aggeu Magalhães, Recife, 2012.
- Beard, J. R. *et al.* The World report on ageing and health: a policy framework for healthy ageing. *The Lancet*, v. 387, n. 10033, p. 2145-2154, 2016.
- Bertuzzi, D.; Paskulin, L. G. M.; Morais, E. P. D. Arranjos e rede de apoio familiar de idosos que vivem em uma área rural. *Texto & Contexto – Enfermagem*, v. 21, n. 1, p. 158-166, 2012.
- Böcker, L.; Van Amen, P.; Helbich, M. Elderly travel frequencies and transport mode choices in Greater Rotterdam, the Netherlands. *Transportation*, v. 44, n. 4, p. 831-852, 2017.
- Brasil. *Lei nº 10.741, de 1º de outubro de 2003*. Estatuto do Idoso. Brasília: Presidência da República, 2003. Disponível em: http://www.planalto.gov.br/ccivil_03/leis/2003/L10.741.htm. Acesso em: 20 mar. 2024.
- Cardoso, L. *Transporte público, acessibilidade urbana e desigualdades socioespaciais na Região Metropolitana de Belo Horizonte*. Tese (Doutorado em Geografia) – Universidade Federal de Minas Gerais, Belo Horizonte, 2007.
- Cataldi, M. ¿Cómo viajan las mujeres y hombres mayores? Envejecimiento, género y movilidad. *Ts. Territorios-Revista de Trabajo Social*, n. 2, p. 83-101, 2018.
- Cerqueira, E. D. V. As desigualdades de mobilidade nas periferias da Região Metropolitana de Belo Horizonte: um estudo das atividades de comércio, lazer e saúde. *Cadernos Metrôpole*, v. 20, n. 41, p. 35-51, 2018.
- Cerqueira, E.; Motte-Baumvol, B. Flexible work arrangements and household-related journeys. Who takes the lead in dual-earner heterosexual couples? *Travel Behaviour and Society*, v. 26, p. 240-249, 2022.
- Chao, T. S.; Huang, H. The East Asian age-friendly cities promotion – Taiwan's experience and the need for an oriental paradigm. *Global Health Promotion*, v. 23, n. 1, p. 85-89, 2016.
- Croucher, K. *et al.* The mobilities of care in later life: exploring the relationship between caring and mobility in the lives of older people. *Ageing and Society*, v. 41, n. 8, p. 1788-1809, 2021.
- Curl, A.; Musselwhite, C. (ed.). *Geographies of Transport and Ageing*. Londres: Palgrave Macmillan, 2018.
- Dong, R. *et al.* Study based on the structural equation model on the relevance of urban elderly travel behavior characteristics: a case study of Kunming. In: Cota International Conference of Transportation Professionals, 15., Pequim, China, 2015. *Anais [...]*. Pequim: [s.n.], 2015.
- Esson, J. *et al.* Livelihoods in motion: Linking transport, mobility and income-generating activities. *Journal of Transport Geography*, v. 55, p. 182-188, 2016.
- Fakoya, O. A.; McCorry, N. K.; Donnelly, M. Loneliness and social isolation interventions for older adults: a scoping review of reviews. *BMC Public Health*, v. 20, n. 1, p. 129, 2020.
- Feng, J. *et al.* The impacts of household structure on the travel behaviour of seniors and young parents in China. *Journal of Transport Geography*, v. 30, p. 117-126, 2013.
- Freitas, M. C.; Queiroz, T. A.; Sousa, J. A. V. O significado da velhice e da experiência de envelhecer para os idosos. *Revista da Escola de Enfermagem da USP*, v. 44, n. 2, p. 407-412, 2010.
- Fundação João Pinheiro. *Projeções populacionais: Minas Gerais e territórios de desenvolvimento 2010-2060*. Belo Horizonte: Diretoria de Estatística e Informações (Direi), Diretoria de Políticas Públicas (DPP), 2018. Disponível em: <http://fjpdados.fjp.mg.gov.br>. Acesso em: 20 mar. 2024.
- Gardezi, F. *et al.* Qualitative Research on Older Drivers. *Clinical Gerontologist*, v. 30, n. 1, p. 5-22, 2006.
- Gomes, P. S.; Pamplona, J. B. Envelhecimento populacional, mercado de trabalho e política pública de emprego no Brasil. *Revista Economia & Gestão*, v. 15, n. 41, p. 206, 2015.

- Green, J.; Jones, A.; Roberts, H. More than A to B: the role of free bus travel for the mobility and wellbeing of older citizens in London. *Ageing and Society*, v. 34, n. 3, p. 472-494, 2014.
- Hanrahan, K. B. Caregiving as mobility constraint and opportunity: married daughters providing end of life care in northern Ghana. *Social & Cultural Geography*, v. 19, n. 1, p. 59-80, 2018.
- Hogan, A. *et al.* The Health Impact of a Hearing Disability on Older People in Australia. *Journal of Aging and Health*, v. 21, n. 8, p. 1098-1111, 2009.
- Instituto Brasileiro de Geografia e Estatística. *Projeção da População (revisão 2018)*. Rio de Janeiro: IBGE, 2018.
- Instituto Brasileiro de Geografia e Estatística. *Censo 2022*. Rio de Janeiro: IBGE, 2023.
- ITDP Brasil. *Mobilidades*. Belo Horizonte: Instituto de Políticas de Transporte e Desenvolvimento, 2022. Disponível em: <https://mobilidades.org.br/rms/rmbh>. Acesso em: 17 maio 2024.
- Leiva, C. G. *Composição, formação e localização de domicílios: um estudo dos domicílios com jovem adulto*. Tese (Doutorado em Demografia) – Centro Federal de Educação Tecnológica de Minas Gerais, Belo Horizonte, 2012.
- Lessa, D. *Acessibilidade e mobilidade espacial da população: evidências e contradições no caso de Belo Horizonte/Mg*. Tese (Doutorado em Geografia) – Universidade Federal de Minas Gerais, Belo Horizonte, 2019.
- Levasseur, M. *et al.* Importance of proximity to resources, social support, transportation and neighborhood security for mobility and social participation in older adults: results from a scoping study. *BMC Public Health*, v. 15, n. 1, p. 1-19, 2015.
- Madariaga, I. S. Mobility of care: Introducing new concepts in urban transport. *In: Fair Shared Cities*. Londres: Routledge, 2016. p. 33-48.
- Maresova, P. *et al.* Challenges and opportunity in mobility among older adults—key determinant identification. *BMC Geriatrics*, v. 23, n. 1, p. 447, 2023.
- Metz, D. Demographic determinants of daily travel demand. *Transport Policy*, v. 21, p. 20-25, 2012.
- Metz, D. Future Transport Technologies for an Ageing Society: Practice and Policy. *In: Musselwhite, C. (ed.). Transport and Sustainability*. Leeds: Emerald Publishing Limited, 2017. v. 10, p. 207-220.
- Minas Gerais. *Relatório completo pesquisa origem e destino 2011/2012*. Belo Horizonte: SEGEM; Agência de Desenvolvimento da Região Metropolitana de Belo Horizonte, 2012. Disponível em: <http://www.agenciarmbh.mg.gov.br/wp-content/uploads/2016/06/Relatorio-Completo-Pesquisa-OD-2012-1.pdf>. Acesso em: 20 mar. 2024.
- Minton, J.; Clark, J. Driving Segregation: Age, Gender and Emerging Inequalities. Em: Curl, A.; Musselwhite, C. (ed.). *Geographies of Transport and Ageing*. Londres: Pallgrave Macmillan, 2018. p. 25-50.
- Mitra, S.; Yao, M.; Ritchie, S. G. Gender differences in elderly mobility in the United States. *Transportation Research Part A: Policy and Practice*, v. 154, p. 203-226, 2021.
- Montoro-Gurich, C.; Moreno-tapia, C. El impacto de las infraestructuras de movilidad vertical en la calidad de vida de las personas mayores: Pamplona como estudio de caso. *Ciudad y Territorio Estudios Territoriales*, v. 53, n. 209, 2021.
- Munshi, T.; Sankar, M.; Kothari, D. Out-of-Home Mobility of Senior Citizens in Kochi, India. *In: Curl, A.; Musselwhite, C. (ed.). Geographies of Transport and Ageing*. Londres: Pallgrave Macmillan, 2018. p. 153-170.
- Musselwhite, C.; Attard, M. *Public transport use in later life*. Londres: Routledge, 2021.
- Musselwhite, C.; Haddad, H. The Travel Needs of Older People and What Happens When People Give-Up Driving. *In: Musselwhite, C. (ed.). Transport and Sustainability*. Leeds: Emerald Publishing Limited, 2017. v. 10, p. 93-115.
- Pickering, J. *et al.* Social isolation and loneliness among older adults living in rural areas during the COVID-19 pandemic: a scoping review. *BMC geriatrics*, v. 23, n. 1, p. 511, 2023.
- Porter, G. *et al.* Transport and mobility constraints in an aging population: health and livelihood implications in rural Tanzania. *Journal of Transport Geography*, v. 30, p. 161-169, 2013.

- Porter, G.; Tewodros, A.; Gorman, M. Mobility, Transport and Older People's Well-Being in Sub-Saharan Africa: Review and Prospect. In: Curl, A.; Musselwhite, C. (ed.). *Geographies of transport and ageing*. Springer International Publishing, 2018. p. 75-100.
- Rantakokko, M. *et al.* Associations between environmental characteristics and life-space mobility in community-dwelling older people. *Journal of Aging and Health*, v. 27, n. 4, p. 606-621, 2015.
- Rosenbloom, S. Mobility of the Elderly: Good News and Bad News. In: Clarke, A. J. (ed.) *Transportation in an ageing society: a decade of experience*. Washington, D.C: Transportation Research Board, 2004. p. 3-21.
- Ryan, J.; Wretstrand, A.; Schmidt, S. M. Exploring public transport as an element of older persons' mobility: A Capability Approach perspective. *Journal of Transport Geography*, v. 48, p. 105-114, 2015.
- Schwanen, T.; Ziegler, F. Wellbeing, independence and mobility: an introduction. *Ageing & Society*, v. 31, n. 5, p. 719-733, 2011.
- Szeto, W. Y. *et al.* Spatio-temporal travel characteristics of the elderly in an ageing society. *Travel Behaviour and Society*, v. 9, p. 10-20, 2017.
- Thaithatkul, P. *et al.* Mobility, Activities, and happiness in old Age: Case of the elderly in Bangkok. *Cases Studies in Transport Policy*, v. 10, n. 2, p. 1462-1471, 2022.
- Thrift, N. J. *An introduction to time-geography*. Norwich: Geo Abstracts; University of East Anglia, 1977.
- Velho, R. *et al.* The effect of transport accessibility on the social inclusion of wheelchair users: a mixed method analysis. *Social Inclusion*, v. 4, n. 3, p. 24-35, 2016.
- Villena-Sanchez, J.; Boschmann, E. E.; Avila-Forcada, S. Daily travel behaviors and transport mode choice of older adults in Mexico City. *Journal of Transport Geography*, v. 104, p. 103445, 2022.
- Webber, S. C.; Porter, M. M.; Menec, V. H. Mobility in older adults: a comprehensive framework. *The Gerontologist*, v. 50, n. 4, p. 443-450, 2010.
- Whelan, M. *The elderly and mobility: a review of the literature*. Clayton, Vic.: Monash University Accident Research Centre, 2006.
- Zhao, P.; Yuan, D. Effects of family structure on travel behaviour. In: Pengjun, Z. (ed.). *Population growth and sustainable transport in China*. Singapura: Springer, 2023. p. 233-266.
- Zhou, Y.; Yuan, Q.; Yang, C. Transport for the elderly: activity patterns, mode choices, and spatiotemporal constraints. *Sustainability*, v. 12, n. 23, p. 10024, 2020.

Contributors

E. Cerqueira contributed to conceptualization, data curation, methodology, supervision, writing – draft, review & editing, validation; A. M. Pinto contributed to conceptualization, formal analysis, methodology, supervision, writing – draft, review & editing, validation, funding acquisition; D. Lessa contributed to conceptualization, data curation, methodology, supervision, writing, validation; J. Borges and A. C. Carreira contributed to conceptualization, writing – draft.