# SOCIODEMOGRAPHIC DETERMINANTS OF MOBILITY LIMITATION AMONG OLDER ADULTS IN CANADA AND NIGERIA

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## DEDICATION

This thesis is dedicated to my beloved wife, Kelechi, and our wonderful children, Kelechi and Kachi. Your unwavering patience, love, and support while waiting in Nigeria have been my greatest source of strength. Despite the miles separating us, your encouragement and sacrifices have fueled my determination to complete this journey in faraway Canada. I could not have achieved this without you. Thank you for being my pillar of hope and resilience.

## ABSTRACT

This thesis explores the sociodemographic determinants of mobility limitations among older adults (≥ 65 years) using a multi-method approach. The first study is a systematic review and meta-analysis that synthesized evidence from 57 studies involving 130,060 participants to identify associations between sociodemographic factors and performance-based mobility outcomes. Older age, female gender, non-Caucasian race, and lower education were significantly associated with mobility limitations, while gaps were identified in research on marital status, religion, and socioeconomic and residential factors. The second study analyzed six-year longitudinal data from 3,882 participants in the Canadian Longitudinal Study on Ageing, revealing significant predictors of mobility decline, including older age, female gender, retirement, non-Caucasian ethnicity, lower income, lower social status, and lack of homeownership. The third study analyzed three-year longitudinal data from 837 participants in the Ibadan Study of Ageing (Nigeria). A gender-disaggregated growth curve analysis showed that gait speed decline was slower in men compared to women, with significant predictors including widowhood and chronic disease burden for women and religiosity and high socioeconomic status for men. The fourth study, a qualitative description design, explored the perspectives of 36 older adults (18 each from Canada and Nigeria) on life-course sociodemographic determinants of mobility decline and identified demographic, socioeconomic, sociocultural, and socioenvironmental factors as critical influences on mobility trajectories. Canadians highlighted disparities in rural mobility outcomes, while Nigerians noted greater challenges for women and urban dwellers, reflecting cultural nuances. Collectively, these studies provide a comprehensive understanding of the sociodemographic factors shaping mobility trajectories in diverse contexts. The findings offer valuable insights for developing culturally sensitive, equitable policies and interventions to promote healthy ageing globally.

## CONTRIBUTIONS OF AUTHORS

Onyeso, O. K., Odole, A. C., Scott, D. R., Akinrolie, O., Kalu, M. E., & Awosoga, O. A. (2023). Association between sociodemographic factors and mobility limitation among older adults: A systematic review and meta-analysis protocol. *Systematic Reviews*, *12*(1), 19. https://doi.org/10.1186/s13643-023-02190-9.

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Onyeso, O. K., Victor, J., Onyeso, K. M., Ojembe, B., Alumona, C. J., Odole, A. C., Doan, J., & Awosoga, O. A. (2024). Life-course sociodemographic determinants of mobility decline: a comparative qualitative study of Canadian and Nigerian older adults' perspectives. *BMC Geriatrics* (under review).

Ogochukwu Kelechi Onyeso contributed 80% of the paper, including study conception, design, interview, qualitative analysis, visualization, manuscript drafting, and critical intellectual revision, and served as the guarantor/corresponding author of the paper. All other authors contributed 20% through the study conception to journal submission.

## ETHICS STATEMENT

The work described in this thesis received research ethics approval from the University of Alberta Research Ethics Board, Edmonton, Alberta, Canada, and the Health Research and Ethics Committee of the Faculty of Health Sciences and Technology, Nnamdi Azikiwe University, Awka, Anambra, Nigeria, under the following applications:

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## USE OF GENERATIVE AI

Generative AI was not used in this project. However, a Microsoft Word add-in, Grammarly®, was used for grammatical error corrections, including sentence rephrasing where applicable.

## PREFACE

The ageing population is rapidly increasing worldwide, yet the attention given to the needs of older adults remains inadequate. My journey into studying mobility limitations among older adults stems from observing this demographic shift and recognizing its implications. Significant progress made in reducing maternal and child mortality and improving medico-social services has led to an increase in life expectancy, creating a burgeoning population of older adults. With the inevitable biological decline accompanying ageing, mobility problems frequently emerge, limiting older adults' access to economic, social, and health opportunities. These limitations result in ageing complications, diminished quality of life, an increased care burden for families, and dependence on already stretched public resources.

My undergraduate training in medical rehabilitation and a master's degree in orthopedics, sports, and recreational physiotherapy naturally aligned with my interest in life-course mobility trajectories, particularly their implications for healthy ageing. As a clinician, I encountered the complex interplay of biophysical rehabilitation needs and social determinants of health in older adults. Recognizing the underexplored role of structural inequalities and social determinants in mobility limitations, I chose this doctoral research to shed light on this critical issue.

I employed a multi-method approach, combining systematic review and meta-analysis, secondary analyses of large datasets, and qualitative research, allowing me to integrate objective measures of mobility with in-depth subjective accounts of older adults' lived experiences. The findings of these complementary methods converged, providing robust evidence on the impact of demographic, social, cultural, economic and environmental factors on mobility outcomes. This thesis aims to fill critical gaps in social gerontology and mobility studies, advocating for the integration of social justice and equity in ageing research and policy. The findings serve as

empirical evidence for advocacy for geriatric service improvement and provide a foundation for enhancing infrastructure and implementing national policies aligned with the WHO's Decade of Healthy Ageing initiatives (2020–2030).

The contributions of several individuals and organizations supported the journey to completing this work. Dr Michael Kalu's research inspired my interest in mobility among older adults, while Dr Misheal Adje and Professor Adesola Odole encouraged me to take the first step. Professor Oluwagbohunmi Awosoga's mentorship and his lab's collaborative environment enabled me to navigate the complexities of a multi-methods study. My colleagues Henrietha Adandom, Suha Damag, and Chiedozie Alumona offered invaluable support throughout this journey. Special thanks to the custodians of the Canadian Longitudinal Study on Ageing and the Ibadan Study on Ageing for granting access to critical datasets. Scholarships and awards from the University of Lethbridge, the Edmonton Society of Demographers, the Prentice Institute, and the CAnD3 fellowship provided the necessary resources to advance this research.

Despite the challenges of limited external funding, international travel for data collection, and mastering new analytical software, this journey has broadened my understanding of culturally sensitive multi-centre research and enhanced my resilience. Completing this thesis has deepened my perspective on the multifaceted nature of mobility, ageing, and health disparities, emphasizing the importance of addressing social determinants alongside biophysical factors. The impact of this research extends beyond academic scholarship to inform policy and practical applications. Governments should prioritize healthy ageing by advancing age-friendly initiatives, improving infrastructure, and fostering gender equity. Social centres for older adults, lifelong learning agendas, effective pension schemes, and nutrition support are among the recommendations stemming from this study.

Future research should delve deeper into the intersectionality of systemic disparities such as ageism, sexism, and racism to identify vulnerable subpopulations. Testing the effectiveness of policy interventions through randomized trials will further strengthen the evidence base for promoting mobility and well-being among older adults. By addressing these critical issues, this work aims to contribute to creating a more equitable and inclusive society that values and supports its ageing population.

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## LIST OF ABBREVIATIONS

| | |
|---|---|
| 10MWT: | Ten-metre Walk Test |
| -2LL | -2 Log Likelihood |
| 4MWT: | 4-metre Walk Test |
| 6MWT: | Six-minute Walk Test |
| AIC: | Akaike Information Criterion |
| ANOVA: | Analysis of Variance |
| BIC: | Schwarz Bayesian Criterion |
| BL: | Baseline |
| BW: | Backward walking |
| CA: | Canadian Participant |
| CINAHL: | Cumulative Index to Nursing and Allied Health Literature |
| CLSA: | Canadian Longitudinal Study on Ageing |
| CMA: | Comprehensive Meta-Analysis |
| COVID-19: | Coronavirus Diseases of 2019 |
| EMBASE: | Excerpta Medica Database |
| FU1: | Follow Up 1 |
| FU2: | Follow Up 2 |
| GCA: | Growth Curve Analysis |
| GRADE: | Grading of Recommendations Assessment Development and Evaluation |
| HGS: | Habitual Gait Speed |
| ICF: | International Classification of Functioning, Disability and Health |
| ISA: | Ibadan Study on Ageing |
| JBI: | Joanna Briggs Institute |
| Log: | Logarithm |
| MEDLINE: | Medical Literature Analysis and Retrieval System Online |
| MeSH: | Medical Subject Headings |
| MOOSE: | Meta-analysis of Observational Studies in Epidemiology |
| NHIS: | National Health Insurance Scheme (in Nigeria) |
| NG: | Nigerian Participant |
| NSCC: | National Senior Citizens Centre (in Nigeria) |
| PBT: | Performance-based Tests |
| PCA: | Principal Component Analysis |
| PRISMA: | Preferred Reporting Items for Systematic Review and Meta-Analysis |
| PROBAST: | Prediction model Risk of Bias Assessment Tool |
| PROSPERO: | International Prospective Register of Systematic Reviews |
| ROB: | Risk of Bias Assessment |
| SDOH: | Social Determinants of Health |
| SPPB: | Short Physical Performance Battery |
| THI: | Total Household Income |
| TUG: | Timed Up and Go |
| UG: | 8-Foot Up-and-Go |
| WHO: | World Health Organization |

# CHAPTER 1: INTRODUCTION

> "Mobility is not just the ability to move but the essence of autonomy, dignity, and participation. When mobility is limited, the journey of life itself becomes constrained, demanding resilience and adaptation in the face of ageing." – Author's reflection.

Ageing is a natural and progressive process leading to human senescence (McHugh & Gil, 2018). It is associated with decreased physiological, cognitive, and social functionality (National Institute on Aging [NIA], 2020a). Ageing is a globally relevant phenomenon (World Health Organization [WHO], 2020a) that affects people of various races, cultures, social classes, and geographical entities (Fung, 2013). In most societies, age is socially constructed, and older adulthood is often marked by the beginning of biophysical and psychosocial decline – when active community involvement becomes limited (Ayokunle et al., 2015; Gorman, 1999). To categorize people on an ageing continuum, scholars have attempted to define older adults using the chronological age approach (Lee et al., 2018). This approach is arbitrary (Orimo et al., 2006) or, at most, relies on global health parameters such as life expectancy and the global burden of diseases (Kowal & Dowd, 2001). For instance, older adults in Canada are 65 years and older (Azagba & Sharaf, 2014), while in Nigeria, a benchmark of 55 years is appropriate (Ayokunle et al., 2015; Kowal & Dowd, 2001). Conventionally, the chronological benchmark of 65 years has been used to define older adults from a research methodological standpoint (Orimo et al., 2006; Turcotte, 2007).

The increase in population ageing, life expectancy, chronic diseases, and sociodemographic disparities will continue to strain healthcare systems globally (Awosoga et al., 2023; Cristea et al., 2020; van Hoof & Marston, 2021). There will be an unprecedented rise in the population of older adults worldwide from 2030 onwards (Bloom et al., 2015). By 2050, the number of individuals aged 65 and older is expected to rise from 800 million (10% of the world

population) to approximately 2 billion, accounting for 22% of the global population (Bloom et al., 2015; Freiberger et al., 2020). With such an anticipated increase in the population of older adults, it can be predicted that age-related mobility limitations will increase the demands on social, economic, and healthcare systems (Freiberger et al., 2020; Metz, 2000). In response to this demographic shift, the WHO launched the Age-Friendly Cities and Communities program (van Hoof & Marston, 2021) and the Decade of Healthy Ageing (2021–2030) initiatives (WHO, 2020b). Similarly, countries worldwide, including Canada (Wilson et al., 2012) and Nigeria (Federal Republic of Nigeria, 2020), are refining their national ageing policies to create supportive environments that promote health, well-being, and social inclusion for older adults. These WHO and national-level efforts focus on community-based interventions and ensuring equitable access to resources that could mitigate age-related mobility limitations.

Mobility has been defined in various ways and contexts (Reijnierse et al., 2023). In the present study, mobility is defined as a person's ability to walk around safely and independently, with or without an assistive device (Carver et al., 2016; Shumway-Cook et al., 2005; Webber et al., 2010). The inability to achieve or maintain full mobility potential is termed mobility limitation (Shumway-Cook et al., 2005). Mobility is fundamental to active ageing, health status, and quality of life (Manini, 2011). Conversely, mobility limitation is an early predictor of physical disability and institutionalization among older adults (Hirvensalo et al., 2000). It also leads to frequent falls and injuries (Webber et al., 2010), sedentary behaviour and dependency (Freiberger et al., 2020; Satariano et al., 2012), depression (Iezzoni et al., 2001), social isolation (Mezuk & Rebok, 2008), reduced quality of life (Shafrin et al., 2017), and death among older adults (Hirvensalo et al., 2000). While there is a paucity of data on the prevalence of mobility limitation among Nigerian older adults, approximately 20.6% of community-dwelling Canadians (≥ 65 years) have mobility

limitations as of 2012, and the trend increases with age (Bizier et al., 2016). Therefore, older adults, caregivers, geriatricians, researchers, and policymakers are keenly interested in knowing the modifiable determinants of mobility decline among older adults.

However, older adults' mobility studies are often biased toward biomedical factors (Satariano et al., 2012; Shumway-Cook et al., 2005), yet sociodemographic factors are significant determinants of health access, health equity, and healthy ageing (Gornick, 2002; Kalu et al., 2022; Raphael, 2011). Sociodemographic determinants of health include age, gender, marital status, religion, income, occupation, education, location, race, housing, and social status (Bryant et al., 2011; Cornwell & Cagney, 2010; Wani, 2019). Similarly, O'Neill et al. (2014) developed an acronym, PROGRESS-Plus, to help scholars identify and integrate the elements of social determinants of health in research and policy interventions. PROGRESS refers to place of residence, race/ethnicity/culture/language, occupation, gender/sex, religion, education, socioeconomic status, and social capital (O'Neill et al., 2014). Plus refers to personal characteristics associated with discrimination (e.g. age, disability), features of relationships (e.g. stereotypes of Indigenous Peoples) and time-dependent relationships (e.g. instances where a person may be temporarily at a disadvantage). Gornick (2002) suggested that the addition of sociodemographic determinants could enhance the biophysical model of health outcomes. Understanding the impact of sociodemographic factors on older adults' mobility would assist health care workers and policymakers in developing comprehensive strategies to enhance mobility among older adults.

Objective (performance-based) and subjective (self-report) instruments have been developed to assess mobility in older adults under the quantitative research paradigm (Bean et al., 2011; Nielsen et al., 2016). Performance-based tests such as Timed-Up-and-Go (TUG), Four-

Meter Walk Test (4MWT), and Habitual Gait Speed (HGS) are commonly used to evaluate ambulation and transfer in older adults due to their objectivity (Bouça-Machado et al., 2020; Roedersheimer et al., 2016; Soubra et al., 2019; VanSwearingen & Brach, 2001). Self-reports are also important mobility measures in older adults because they capture self-perception and provide context, though respondents' cognition and literacy levels may affect their validity (Gómez et al., 2013; Nielsen et al., 2016).

Conversely, there is a paucity of qualitative studies on older adults' experiences of mobility and their perspectives on life-course sociodemographic determinants of mobility decline (Goins et al., 2015). Quantitative methods can examine what happens in a cohort and to what extent, but qualitative methods investigate deeper into why it is happening (Gough & Madill, 2012). Therefore, researchers are increasingly adopting mixed-methods (Nastasi, 2020) and multi-methods (Morse, 2003) research for a holistic understanding of a particular phenomenon.

This multi-method study adopted qualitative and quantitative methods to evaluate sociodemographic determinants of mobility decline among older adults comprehensively. Specifically, the study involved a systematic synthesis and meta-analysis of available evidence on the association between sociodemographic factors and mobility in older adults between 1947 and 2023, followed by a separate longitudinal secondary data analysis of the Canadian Longitudinal Study on Ageing (CLSA) (Raina et al., 2019) and Ibadan Study on Ageing (ISA, Nigeria) (Gureje et al., 2007), and a qualitative descriptive enquiry (Bradshaw et al., 2017) into the perspectives of Canadian and Nigerian older adults regarding the sociodemographic determinants of mobility decline among older adults.

## Study Objectives

The overarching aim of the study was to contribute new knowledge to the body of literature on sociodemographic determinants of mobility limitation among older adults. Specifically, the study aimed to (1) determine the association between sociodemographic factors such as age, gender, race, location, income, occupation, education, and social status and performance-based walking parameters such as walking distance, time, and speed among older adults from observational studies published between 1947 and 2023 (Onyeso et al., 2023); (2) investigate the prevalence of mobility limitation, mobility decline trajectory, and the association between sociodemographic variables and mobility limitation among Canadian and Nigerian older adults using the CLSA and ISA data; and (3) to explore the perspectives of Canadian and Nigerian older adults on sociodemographic determinants of mobility limitations in older adults.

## Research Questions

### *Systematic review and meta-analysis*

1. What is the direction of the association between sociodemographic factors (age, gender, race, location, income, occupation, education, and social status) and mobility limitation among older adults (65 years and older) as reported in observational studies published from 1947 to 2023?

### *Quantitative research*

2. What is the size of the association between sociodemographic factors and mobility limitation among older adults, as reported in observational studies published from 1947 to 2023?
3. What is the prevalence of mobility limitation among older adults in Canada?

4. What sociodemographic factors can best predict the mobility trajectory of older adults residing in Canada?
5. What is the prevalence of mobility limitation among older adults in Nigeria?
6. What sociodemographic factors can best predict the mobility trajectory of older adults residing in Nigeria?

***Qualitative research***

7. What sociodemographic factors do Canadian older adults perceive as pivotal in their life-course mobility experiences, and what strategies do they suggest could improve mobility?
8. What sociodemographic factors do Nigerian older adults perceive as pivotal in their life-course mobility experiences, and what strategies do they suggest could improve mobility?

**Null Hypotheses for Quantitative Analyses**

1. There would be no significant homogeneity of coefficients of the association between sociodemographic factors and mobility limitation among older adults in observational studies included in the meta-analysis.
2. There would be no significant difference in the sociodemographic distribution of the CLSA participants at baseline (BL), follow-up 1 (FU1), and follow-up 2 (FU2).
3. There would be no significant correlation between CLSA participants' TUG and 4MWT scores at BL, FU1, and FU2.
4. There would be no significant mean differences in the CLSA participants' TUG and 4MWT scores at BL, FU1, and FU2 across categories of sociodemographic factors.
5. There would be no significant zero-order associations between CLSA participants' TUG and 4MWT scores and sociodemographic factors at BL, FU1, and FU2.

6. There would be no significant multivariate longitudinal association between CLSA participants' TUG and 4MWT scores and sociodemographic factors.
7. There would be no significant gender difference in ISA participants' sociodemographic distribution.
8. There would be no significant difference in ISA participants' mean gait speed across study cycles (1 to 3) and categories of selected sociodemographic variables.
9. There would be no significant linear and quadratic effect of time on ISA participants' gait speed trajectory over the three-year follow-up period.
10. There would be no significant fixed effects of sociodemographic variables on the ISA participants' gait speed trajectory.
11. There would be no significant difference in the gait speed changes across individual participants (random slope variance) in the ISA dataset.

**Study Rationale**

Mobility is a crucial indicator of health, socioeconomic participation, and quality of life among older adults globally (Freiberger et al., 2020; Hirvensalo et al., 2000). The population of older adults in Canada (Raina et al., 2009; Statistics Canada, 2022) and Nigeria (Mbam et al., 2022; Tanyi et al., 2018) continue to increase due to the rise in life expectancy in both countries The population of older adults in Canada was 14% in 2006 (Raina et al., 2009) and has risen to 19% in 2021 (Statistics Canada, 2022). Similarly, Nigeria's population of older adults has increased from 3.1% to about 5% from 2012 to 2022 (Mbam et al., 2022; Tanyi et al., 2018). Accordingly, researchers are looking for ways to improve the quality of life of older people (Raina et al., 2009; Tanyi et al., 2018). While biophysical decline has been associated with mobility limitation, morbidity, and mortality in older adults, there is a paucity of research on the

contribution of sociodemographic factors (Gornick, 2002; Kalu et al., 2022). Therefore, exploring the sociodemographic correlates of mobility decline could be essential for a comprehensive overview of the life-course mobility trajectories and for improving the well-being of older adults (Manini, 2011; Onyeso et al., 2023).

The rationale for this study was to bridge the gaps in the literature regarding sociodemographic determinants (direction and magnitude) of mobility limitations in older persons, through a robust multi-methods design. The study was grounded in the social determinants of health (SDH) framework (Raphael, 2011), which discusses critical pathways through which demographic, social, and structural factors influence health outcomes. Raphael (2011) proposed seven SDH discourses: identifying individuals in need of health and social services; recognizing modifiable medical and behavioural risk factors; indicating material living conditions that shape health outcomes; highlighting disparities in material circumstances based on group membership; demonstrating how public policy decisions made by governments and societal institutions shape the distribution of SDH; exposing the role of economic and political structures and their justifying ideologies in health inequities; and revealing how the power and influence of those who benefit from health systems perpetuate these inequities. Additionally, life course theories were employed to conceptualize how accumulated intersecting social disadvantages lead to disparity in mobility in later life (Marengoni & Calderon-Larrañaga, 2020). Beyond the systematic synthesis of empirical literature and analyses of objective data, older adults' subjective perceptions were also explored to ensure proper contextualization of the policy implications and recommendations.

Canada and Nigeria were selected for their contrasting sociocultural, economic, and policy contexts, which offer a valuable opportunity for comparative analysis of ageing experiences. Canada represents a high-income country with well-developed social welfare systems (Statistics

Canada, 2023), while Nigeria exemplifies a low-resource setting with community-based informal support systems (Mbam et al., 2022). This two-setting approach addresses global knowledge gaps by integrating perspectives from both the Global North and South, contributing to both universal and context-specific insights. The researcher's expertise and familiarity with both countries enhance the study's depth and authenticity.

**Contribution and Significance**

The outcome of the study is specifically important to older adults in Canada and Nigeria and could be transferable to other global communities. This study directly supports the WHO Decade of Healthy Ageing (2021–2030) by addressing critical issues surrounding mobility decline among older adults through the lens of social determinants of health. By identifying modifiable sociodemographic risk factors that predispose older adults in Canada and Nigeria to early mobility impairment, the research highlights actionable insights for improving health outcomes in diverse sociocultural and economic contexts.

The findings are particularly relevant to older adults' caregivers and global communities, as they enhance understanding of the factors contributing to dependency among older adults. This knowledge is crucial for shaping targeted interventions to reduce health disparities, consistent with the WHO's emphasis on equitable health systems and age-friendly environments. The comparative analysis of Canada and Nigeria provides valuable context-specific perspectives: Canada offers lessons from high-resource systems, while Nigeria highlights the challenges and opportunities in low-resource, community-driven settings. These insights reinforce the call for social justice and fairness in policymaking across the Global North and South.

Policymakers may utilize the findings of this study in making an informed decision during budgeting and allocation of resources to aim at bridging inequalities and minimizing the impact of

ageing and disabilities, considering the vulnerability of older adults. The implication for society is that ageing is universal, and the health of our aged dependents is our collective responsibility. Therefore, social justice, equity, and fairness demand that our policies be formed and implemented in cognizance of sociodemographic inequalities. National resources, infrastructures, basic amenities, and social welfare should be distributed with the understanding of the real, perceived, and potential impacts of the mobility decline in the ageing population.

**Operational Definition of Terms**

- Mobility limitation is a situation where an individual experiences a decline in the ability to ambulate safely and independently.
- Mobility outcomes are objectively measured walking parameters such as walking distance, time, and speed.
- Walk distance is the longest path in meters (m) an individual can cover in a single bout while walking at their habitual gait speed.
- Walk time is the amount of time in seconds (s) it takes an individual to walk a given distance.
- Walking (gait) speed is the quotient of the walked distance and walked time. It is calculated in meters per second (m/s).
- Sociodemographic factors are determinants of health inequality or disadvantage based on economic and socially constructed parameters such as income, savings, lifetime occupation (unskilled non-manual, unskilled manual, skilled non-manual, and skilled manual), educational level (informal, primary school, secondary school, college/diploma, and bachelor, masters, and doctoral degree), residence (rural and urban), house type, homeownership (owned or rented), and social status (high, middle, and low). Others are gender (men and women), race

(Non-Caucasian and Caucasian), marital status (single, married, separated/divorced, and widowed), religion (religious and irreligious) and age.

- Older adults are men and women aged 65 years and above.
- Quantitative study curates and analyzes numerical data to answer relevant research questions.
- Observational study is a type of quantitative design in which the researcher does not intervene and instead assesses the strength of the relationship between variables. Examples are cohort studies, case-control studies, cross-sectional studies, and longitudinal studies.
- Longitudinal study is an observational study in which the researchers repeatedly examine and collect data on the same individuals at predetermined time points to detect any changes that might occur over a time frame.
- Qualitative research studies phenomena' existence, nature, and dimensions (Aspers & Corte, 2019), including the contextual background and perspectives from which a phenomenon can be perceived (Lindgren et al., 2020). It involves collecting and analyzing non-numerical data such as voices, texts, pictures, and actions to understand the essences and forms of human opinions, lived experiences, and behaviours (Sutton & Austin, 2015). Qualitative research can be used to construct and interpret the meaning of abstract concepts, such as arts and inanimate objects (Crotty, 2003; Johnson & Christensen, 2019).
- Qualitative description research encompasses the distinctive aspects of qualitative research, different from ethnography, which centres on culture; phenomenology, which delves into lived experiences; and grounded theory, which focuses on theory development. Qualitative description research intends to uncover and grasp a phenomenon, a process, or the perceptions and perspectives of the people involved (Bradshaw et al., 2017; Caelli et al., 2003). The qualitative description approach is particularly relevant where direct insights are sought from

those experiencing the studied phenomenon, time and resources are constrained, or as a part of mixed-methods (Neergaard et al., 2009) or multi-methods research (Morse, 2003).

**Study Limitations**

This section provides an overview of the study's limitations, further details are included in each manuscript (Chapters Four to Eight). The systematic review and meta-analysis synthesized results from observational studies, meaning the aggregated effect sizes represent correlations rather than causal relationships between the included variables (Nielsen et al., 2018). Additionally, the review was restricted to articles published in English, which may have led to the exclusion of high-quality studies that met the inclusion criteria but were published in other languages. In some studies, gender and sex were used interchangeably to depict gender. Sex at birth is primarily understood in terms of biophysical features such as genitals and hormones, while gender is a multidimensional concept influenced by societal norms and roles, cultural contexts, and individual identity, making it fluid and dynamic across different cultures and historical periods.

The longitudinal studies used for secondary analysis were observational and involved non-randomized participants, limiting the ability to make causal inferences. The researcher was not directly involved in the primary data collection and therefore could not address recruitment biases, the representativeness of the sample, or the generalizability of the data beyond the study cohort. However, assurances were provided by the original investigators regarding the internal and external validity of the data. While the overall design of this research is exploratory, the secondary analysis was constrained by the variables available in the dataset obtained by the researcher. For instance, fewer sociodemographic factors were available in ISA compared to CLSA.

In the qualitative study, potential participants who were not fluent in English were systematically excluded, and most recruitment took place in urban areas. These factors may affect

the transferability of findings to broader geographical and sociodemographic strata. English language proficiency among Nigerian participants and urban residence among Canadian participants are likely correlated with higher socioeconomic status, which may result in an underrepresentation of individuals with lived experiences of sociodemographic disadvantages.

**Thesis Organization**

Chapter One provides an introduction to the study, outlining the research objectives, hypotheses, justification, relevance, operational definitions, and an overview of the limitations. Chapter Two presents an in-depth literature review and the study background, including the conceptual and theoretical frameworks, concept map and analytic framework, a review of theoretical and empirical literature on social determinants and mobility limitations, and gaps identified in the literature which the following chapters attempt to address.

Chapter Three describes the philosophical underpinning of the study and an overview of the individual manuscript's methodology. Chapter Four is the systematic review and meta-analysis protocol. The protocol was registered in the International Prospective Register of Systematic Reviews (PROSPERO) and published in *Systematic Reviews* (Onyeso et al., 2023). Chapter Five reports the results of the systematic review and meta-analysis, in adherence to the updated Preferred Reporting Items for Systematic Reviews and Meta-Analyses (PRISMA 2020) (Page et al., 2021) and the Meta-analysis of Observational Studies in Epidemiology (MOOSE) guidelines (Stroup et al., 2000). This chapter also includes a risk of bias assessment for the included studies.

Chapter Six examines the six-year mobility decline trajectory of Canadian older adults and its sociodemographic correlates (Onyeso et al., 2024). Mixed-design ANOVA, bivariate, and multivariate regression analyses were used to complete cross-sectional and longitudinal analyses. The study also establishes concurrent validity between the 4MWT and TUG using data from the

CLSA. Chapter Seven investigates a three-year follow-up gait speed trajectory of Nigerian older adults, including gender-disaggregated analyses, through linear and quadratic growth curve modelling using ISA data (Onyeso et al., 2025).

Chapter Eight complements Chapters Six and Seven by exploring the perspectives of Canadian and Nigerian older adults regarding the life-course sociodemographic determinants of mobility decline. This comparative qualitative study employs in-depth interviews and content analysis to present cultural nuances and recommendations for mitigating social disadvantages in their mobility experiences.

Finally, Chapter Nine summarizes the study's findings, discusses policy implications, and offers recommendations for future research, as detailed in the individual manuscripts presented in Chapters Four through Eight.

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# CHAPTER 2: STUDY BACKGROUND AND LITERATURE REVIEW

This chapter presents the study background under four main sections – conceptual framework, theoretical and empirical literature review, and summary of gaps in the literature.

## Conceptual Framework

The global population of people 65 years and older will rise from 800 million to 2 billion in the next three decades (Bloom et al., 2015). Demographers believe these figures will keep rising due to the advances in sociomedical services (Cristea et al., 2020; Orimo et al., 2006). The increasing global population ageing will lead to demographic changes, such as a rise in the number of people with mobility limitations (Bloom et al., 2015; Freiberger et al., 2020). Mobility is fundamental to active ageing, health status, and quality of life (Carver et al., 2016; Freiberger et al., 2020; Hirvensalo et al., 2000; Shafrin et al., 2017; Soubra et al., 2019). Understanding the factors influencing mobility and maximizing movement potential in older adulthood will benefit the ageing population, medical, social, political, and economic communities, and policymakers.

The biophysical and psycho-cognitive aspects of older adults' mobility are researched more frequently, creating a literature gap on the implications of social factors (Kalu et al., 2022; Onyeso et al., 2023). Exploring the influences of sociodemographic factors may broaden our understanding of their contributions to mobility decline among older adults. Therefore, I conceptualized that the intersectionality of some modifiable sociodemographic factors may define the disproportionate mobility limitations among subpopulations of older adults. Investigation into mobility limitations in older adults has become an important area of research due to its social and economic implications (Freiberger et al., 2020; Satariano et al., 2012). This conceptual framework is presented in three parts: a hypothetical framework based on the World Health Organization's (WHO) International Classification System of Functioning, Disability and Health (ICF)

framework (WHO, 2002), the study concept map, and data analysis framework based on life-course and social determinants of health theories (Marengoni & Calderon-Larrañaga, 2020).

***Hypothetical framework based on the ICF model***

The ICF model was conceptualized as a universal framework that describes how people acquire and live with a health condition (WHO, 2002). All 191 WHO Member States officially endorsed the ICF model in the fifty-fourth World Health Assembly in 2001. The ICF framework (Figure 2.1) was slightly modified to show mobility limitation as the health condition, while environmental and personal factors constitute sociodemographic determinants. This model assumes that all levels of human functioning and sociodemographic factors are connected (Rejeski et al., 2008).

Mobility decline in older adults has cascading effects across all dimensions of health and functioning. As such, mobility limitation can be appropriately positioned as a health condition (disease or disorder) within the ICF model. At the level of *body functions and structures*, mobility decline is frequently associated with impairments such as reduced muscle strength, joint stiffness, and balance dysfunction, all of which disrupt neuromusculoskeletal and movement-related functions. These impairments, in turn, result in *activity limitations*, where individuals encounter difficulties performing essential tasks like walking, transferring, or climbing stairs, ultimately compromising their independence. The impact extends further to *participation restrictions*, as affected individuals may withdraw from social, occupational, or recreational engagements, leading to reduced quality of life.

The modified ICF model conceptualizes sociodemographic influence on the three main components of human functioning: body functions and structures, activities or participation in activities of daily living (ADLs) and the relationship with mobility limitation.

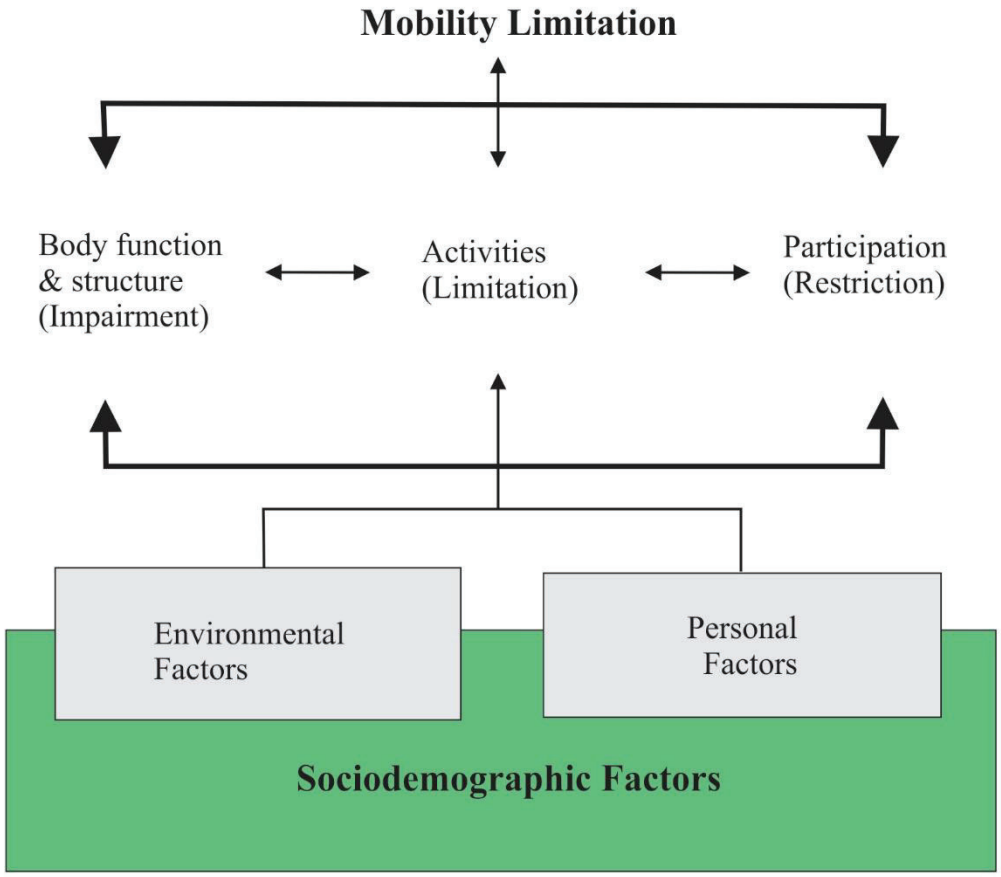


**Figure 2.1: The conceptual framework: Modified ICF model for sociodemographic determinants of mobility limitation in older adults.**

Source: WHO (2002), adapted by the author.

Body functions and structures.

This ICF framework component includes the body's physiological and anatomical aspects. In older adults, mobility limitation may be related to changes in body functions and structures, such as the musculoskeletal, cardiovascular, and nervous systems (Leonardi et al., 2009; McHugh & Gil, 2018; Rejeski et al., 2008). Age-related changes in the musculoskeletal system, such as osteoporosis, arthritis, and sarcopenia, can reduce muscle strength, joint stiffness, and bone fragility and limit mobility (Dunsky, 2019; Rejeski et al., 1995; Rejeski et al., 2008). Cardiovascular diseases such as heart failure and peripheral arterial disease can impair blood flow and oxygen supply to the muscles, reducing endurance and mobility. Similarly, neurological disorders, such as Parkinsonism and stroke, can increase the risk of falls and limited mobility due to decreased proprioception and balance control (Bouça-Machado et al., 2018; Dunsky, 2019; Rejeski et al., 2008).

Activities and participation.

This component of the ICF framework refers to the individual's ability to perform activities and participate in life situations. Mobility limitations occasioned by age-related decline in body structure and functions may affect older adults' activities and participation (Ayokunle et al., 2015; Dunsky, 2019; Goins et al., 2015). Mobility limitation can make it challenging to perform basic activities of daily living (BADLs), such as bathing, dressing, and toileting, which can negatively impact independence and quality of life (Bouça-Machado et al., 2018; Mlinac & Feng, 2016). Mobility limitation can also affect instrumental activities of daily living (IADLs), such as grocery shopping, housekeeping, and transportation, limiting participation in social and community activities (Bouça-Machado et al., 2018; Dunsky, 2019; Mlinac & Feng, 2016). Mobility limitation

can restrict leisure and social activities such as walking, dancing, and travelling, influencing social participation and quality of life (QOL) (Rantakokko et al., 2013).

Sociodemographic factors.

This component of the modified ICF framework (Figure 2.1) includes personal and environmental factors. The personal factors can be further categorized as demographic and socioeconomic determinants. Demographic determinants are modifiable and non-modifiable socially constructed factors such as age, gender, marital status, loneliness, social capital, social status, social isolation, race/tribe, religion, and culture (Latham-Mintus, 2020; Ruggero et al., 2013; Zaninotto et al., 2013). Socioeconomic factors include education, occupation, income, investments, physical assets, and ownership of a car, pet, and house (Busch et al., 2015; Plouvier et al., 2016; Russo et al., 2006; Welmer et al., 2013).

Demographic variables such as chronological age, gender, ethnicity/tribe, and social status have been used to order and discriminate against people, limiting their access to health and social support (Braveman, 2014; Bryant et al., 2011). Ageism, such as medicalization of ageing, sexism, racism, stereotyping, social exclusion, and other negative social constructs, may result in low self-esteem and lack of motivation among older adults, leading to physical inactivity and mobility limitations (Cruikshank, 2013; Fung, 2013; Rantakokko et al., 2013). Gendered cultural roles and marital status intersectionality may explain the feeling of loneliness, social isolation and the resultant mobility burden in older adults (Czaja et al., 2021). Aside from demographic factors, socioeconomic factors and physical environment can also account for mobility decline among older adults.

The most essential socioeconomic determinants of health are education, occupation, and income (Adler et al., 1994). Higher education minimizes the rate of functional decline in older

adults (Al Snih et al., 2008; Alexandre et al., 2014). Again, education is a foundational factor for holding skilled occupations and higher income (Avlund et al., 2000). There can be a bidirectional and cyclical relationship between income and mobility, whereby low-income individuals may have limited access to healthcare services and are more likely to acquire mobility-limiting disabilities (Marmot, 2002). Individuals with mobility limitations may experience greater difficulty maintaining jobs and earnings (Cattell, 2001). Lifetime occupation is associated with mobility outcomes in old age; people who engage in manual handling jobs are more exposed to musculoskeletal dysfunctions (Bishop et al., 2016; Oluka et al., 2020). Inherently, education is associated with occupation, which is associated with income (Darin-Mattsson et al., 2017), while the three factors are independently associated with mobility limitation in older adults.

Physical and socioenvironmental factors such as location, city plan, house type, unpaved walkways, community topography, city walkability, and lack of accessibility features can limit mobility in older adults (Barnett et al., 2017; Czaja et al., 2021; Nagel et al., 2008). Poorly planned urban communities affect the independent mobility of older persons (Clarke et al., 2008), while sparsely populated rural environments often lack good roads and recreational facilities (Tanyi et al., 2018). These community attributes affect outdoor mobility, physical activity, and community participation (Rosso et al., 2011). Furthermore, older adults' mobility and life satisfaction may be limited in communities with a high rate of social vices such as physical insecurity, ageism, sexism, and racism (Ani & Isiugo-Abanihe, 2017). Therefore, older adults residing in more secure neighbourhoods were more likely to have greater personal and community mobility (Umstattd Meyer et al., 2014). Three independent systematic reviews have shown an association between the physical environment, neighbourhood attributes, and older adults' outdoor walking behaviours (Barnett et al., 2017; Van Cauwenberg et al., 2018; Yun, 2019).

### *Study concept map*

The study concept map (Figure 2.2) shows a step-by-step approach to completing this study and documenting the findings. The map gives a snapshot of the introduction, literature review, methodology and four research manuscripts presenting a systematic review and meta-analysis, two secondary analyses, and a qualitative description study. Therefore, at least four research papers were expected from this study. The overarching hypothesis is that there would be a significant sociodemographic influence on the mobility trajectory of older adults in Canada and Nigeria. The philosophy underpinning the entire study hinged on the compatibility of qualitative and quantitative methods. Starting from ontology, Guba and Lincoln (1994) posited that objectivists (quantitative research) align with realist ontology, while constructivists (qualitative research) are inclined toward relativist ontology. However, Crotty advanced the assumption of epistemological intersections, stating that "realism in ontology and constructionism in epistemology turns out to be quite compatible" (Crotty, 2003, p. 11). Crotty's compatibility notion and Guba and Lincoln's commensurability of naturalistic paradigms allow mixed- and multi-methods research to straddle between objectivist and constructivist epistemologies (see Figure 3.1 and Appendix A).

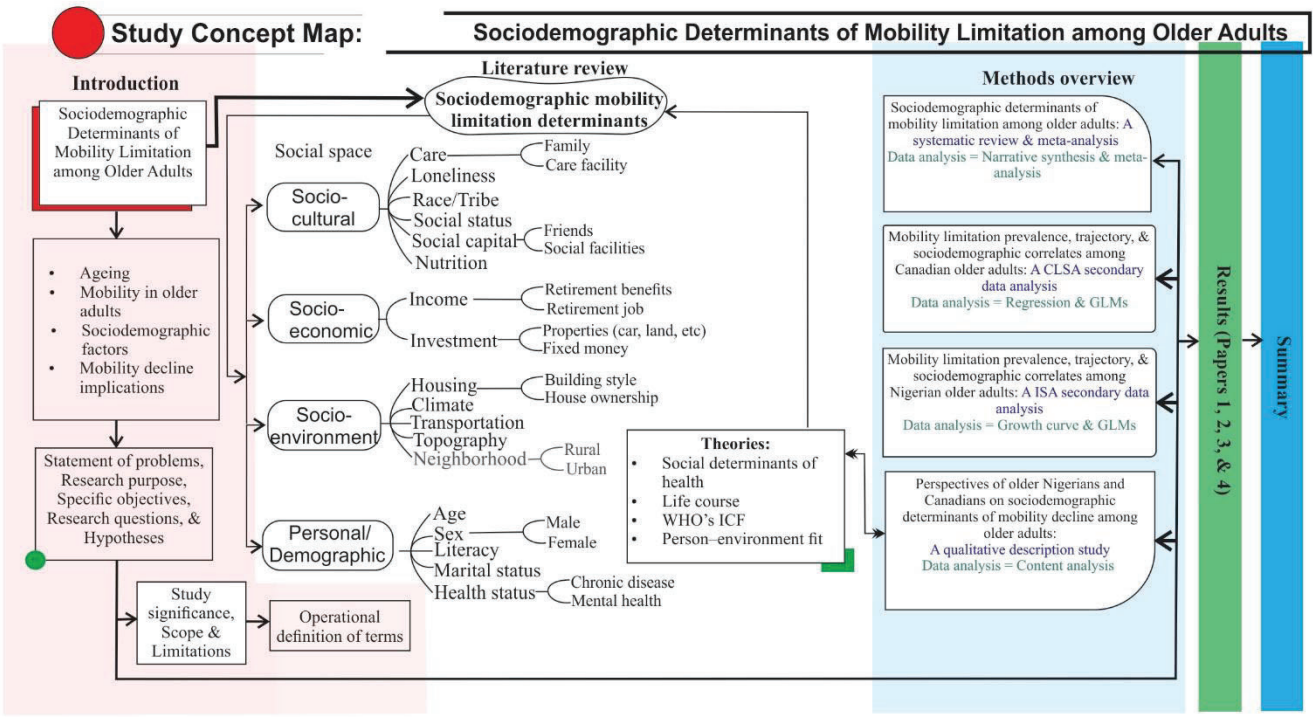


**Figure 2.2: The study concept map.**

### *Data analysis framework*

Qualitative and quantitative data curated in this study were analyzed from the perspective of the life course and social determinants of health theories (Marengoni & Calderon-Larrañaga, 2020). References were made to other relevant theories, such as the person-environment-fit theory of ageing (Lawton, 1982), preclinical disability theory (Fried et al., 1991), community mobility theory (Patla & Shumway-Cook, 1999), ICF model (WHO, 2002), theory of successful ageing (Flood, 2005), and comprehensive mobility model (Webber et al., 2010).

Life course and social determinants of health theories suggest that the accumulation of intersecting social disadvantages contributes to disparities in health outcomes later in life (Marengoni & Calderon-Larrañaga, 2020). Building on these frameworks, we hypothesized that mobility decline in older adults may be influenced by cumulative sociodemographic factors, including age, gender, marital status, residence, income, education, occupation, religion, social status, homeownership, and race or ethnicity (Onyeso et al., 2023).

The concept of person-environment fit shapes the perspectives on healthy and successful ageing (Lange & Grossman, 2006). Lawton (1982) person-environment-fit theory propounded that people's capability to function in their environment is an important aspect of successful ageing and that community functionality is affected by strength, mobility, physical health status, cognitive and sensory-perceptual capacities, and environmental factors. Similarly, Flood (2005) coined the theory of successful ageing from Roy's adaptation model (Roy & Andrews, 1999), stating that successful ageing is dependent on the extent to which older adults adapt to the cumulative physical and functional changes they experience within their community, which ultimately results in mobility limitations.

Mobility is necessary for people to adapt and exploit their environment to support their livelihood (Patla & Shumway-Cook, 1999; Rantakokko et al., 2013). The concept of mobility and its predictors are multifactorial and complex. This study examined the links between sociodemographic factors and mobility limitations. The qualitative data analysis was completed using a content analysis approach in qualitative description design (Bradshaw et al., 2017). Participants were interviewed on how specific sociodemographic variables have or have not influenced their mobility-lived experiences through the life-course perspective. Quantitative cross-sectional and longitudinal data analyses were completed via appropriate general linear models and regression equations to predict the contributions of sociodemographic factors to mobility trajectory – assessed through TUG, 4MWT, and HGS tests.

In line with the life-course perspective, age was recognized as a mediator in the overall analytic model. Figure 2.3 proposed that age would mediate the direct association between sociodemographic factors (exposure) and mobility (outcome), while health status and environment would mediate and confound the association, respectively. Chronological age is an arbitrary landmark of human senescence, health status is the presence or absence of chronic diseases, and environment includes both physical and sociocultural life spaces. A literature review on the impact of these factors on mobility outcomes was presented in the following sections.

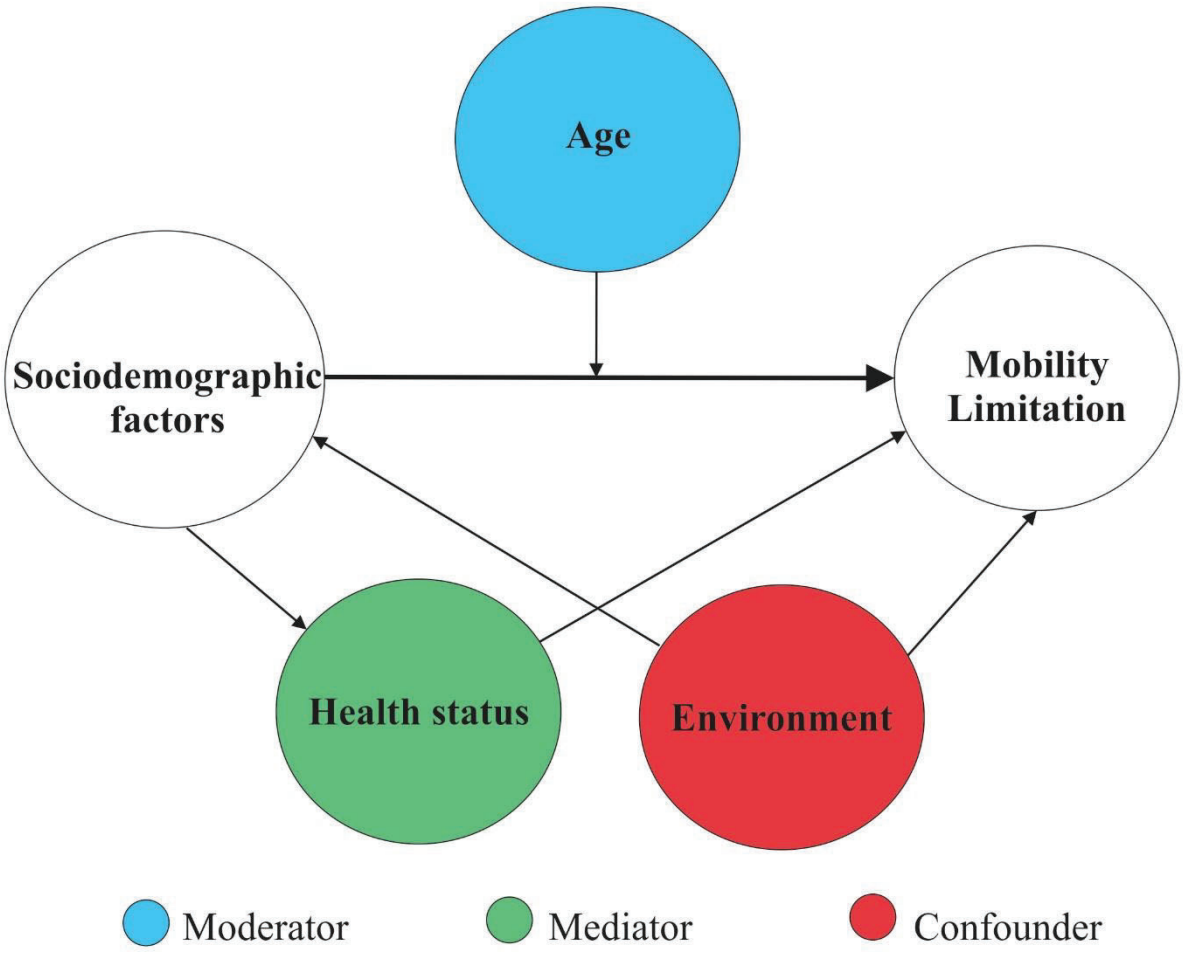


**Figure 2.3: The data analysis framework.**

## Theoretical Literature Review

### *Mobility as a concept*

The concept of mobility in older adults refers to the ability of older adults to move around independently and safely (NIA, 2020; Sheller & Urry, 2006; Webber et al., 2010). As people age, their mobility can become impaired due to various factors such as chronic diseases, physical limitations, and cognitive decline (Shumway-Cook et al., 2005). Mobility is indispensable to older adults because of its close link to their ability to engage in ADLs, maintain social connections, and overall quality of life (Groessl et al., 2007; Patla & Shumway-Cook, 1999; Rosso et al., 2013; Shafrin et al., 2017). Although healthy individuals and younger adults often take their ability to move around for granted, mobility is necessary for BADL (Gureje et al., 2007; Mlinac & Feng, 2016) and IADL (Albert et al., 2015). The inability to achieve full mobility potential is termed mobility limitation (Shumway-Cook et al., 2005).

The prevalence of mobility limitation among older adults ranged from 22.5% to 46.5% in developed countries (Musich et al., 2018). In Canada (2012), approximately 20.6% of community-dwelling people ≥ 65 years old had mobility limitations, and the trend increases with age (Bizier, 2016). There is a paucity of data on mobility limitations among older Nigerians. Mobility limitation can significantly impact an older adult's physical, psychological, and social life (Rantakokko et al., 2013; Umstattd Meyer et al., 2014). Mobility limitation can lead to reduced physical activity, contributing to the development of chronic diseases such as obesity, diabetes, and cardiovascular disease (Freiberger et al., 2020). It can also lead to a loss of independence, affecting an older adult's self-esteem and mental well-being (Iezzoni et al., 2001; Mlinac & Feng, 2016; Satariano et al., 2012). Socially, mobility impairments can limit an older adult's ability to

participate in social activities and maintain relationships with family and friends (Rosso et al., 2013).

Sociodemographic factor modifications may promote mobility in older adults through the implementation of various strategies, such as the provision of recreational facilities for regular physical activity, socioeconomic security to enable appropriate medical management of chronic conditions, and environmental modifications to reduce fall risks (Rosso et al., 2013; Yeom et al., 2008). Regular physical activity can improve strength, balance, and flexibility, which are essential for maintaining mobility in older adults (Avlund et al., 2000; Reid & Fielding, 2012). Appropriate medical management of chronic conditions such as stroke, Parkinsonism, arthritis, and osteoporosis can help prevent or slow down mobility impairments (Nagi, 1991). In addition to these interventions, environmental modifications can improve mobility in older adults. These modifications may include installing grab bars in the bathroom, removing tripping hazards in the home, ensuring adequate lighting, and enhancing neighbourhood walkability through the paving of walkways and older adult-friendly traffic regulations (Patla & Shumway-Cook, 1999; Sheller & Urry, 2006; Umstattd Meyer et al., 2014). Maintaining mobility in older adults is essential for their overall well-being. Interventions aimed at improving mobility can help older adults maintain their independence, social connections, and overall quality of life (NIA, 2020).

***Theoretical frameworks relevant to mobility in older adults***

Over the years, scholars have proposed some useful theories in conceptualizing mobility decline in older people. They include the ecological framework of adaption in older adults (Lawton & Nahemow, 1973), person-environment fit theory (Lawton, 1982), Carp's conceptual model on gerontological adaptation and emotional well-being (Carp, 1988), Roy's adaptation model (Roy & Andrews, 1999), the preclinical disability theory (Fried et al., 1991), community mobility theory

(Patla & Shumway-Cook, 1999), the ICF model (WHO, 2002), the theory of balance and mobility (Rose et al., 2005), the theory of successful ageing (Flood, 2005), public health framework for healthy ageing (Beard et al., 2016), and comprehensive mobility model (Webber et al., 2010). The current study was grounded on the life-course and social determinants of health theories with references to relevant aspects of preclinical disability theory, person-environment fit theory, community mobility theory, the comprehensive mobility model, and the ICF model.

Preclinical disability theory

The preclinical disability theory holds that there are identifiable stages of preclinical disability that would predict future disability and identify a focus for prevention (Fried et al., 1991). There are arbitrary stages between impairment and disability. The theory posits that as older adults continue to experience factors of mobility disability in their life course, their mobility abilities continue to decline until they reach a full clinical stage of severe disability, dysfunction, or complete immobility (Fried et al., 1991). The present study proposes that the progression from the preclinical or latent stage to complete disability can be influenced by sociodemographic factors such as age, gender, location, occupation, income, and education (Manini, 2011; Onyeso et al., 2023; Rantakokko et al., 2013; Rosso et al., 2013).

Person-environment fit theory

Person-environment fit shapes the perspectives on healthy and successful ageing (Lange & Grossman, 2006). Lawton's (1982) person-environment-fit theory suggested that people's capability to function in their environment is an essential aspect of successful ageing and that community functionality is affected by strength, mobility, physical health status, cognitive and sensory-perceptual capacities, and environmental factors. Similarly, the theory of successful ageing by Flood (2005) posited that successful ageing depends on the extent to which older adults

adapt to the cumulative physical and functional changes they experience within their community, ultimately resulting in mobility limitations (Lange & Grossman, 2006).

Community mobility theory

Patla and Shumway-Cook (1999) presented a mobility continuum that depicted a positive correlation between independent walking tolerance and the ability to access the community. They observed that most mobility assessment models were designed in a manner that can only be applied in controlled or experimental conditions, without regard to environmental effects such as ambience, visibility, traffic, topography, and change in weather conditions inherent in community mobility (Patla & Shumway-Cook, 1999). They argued that the path from disease to disability was not linear, as construed by most disablement models, such as Nagi (1991). Instead, older adults' pathway from disease to disability is obscured by the influence of many non-disease factors such as depression, social support, health behaviour, sociodemographics, and the environment (Patla & Shumway-Cook, 1999).

Patla and Shumway-Cook (1999) concept of mobility was anchored on the assumption that the degree of disability cannot be determined solely by levels of pathologies, impairments, or functional limitations as currently being measured by self-reported and performance-based mobility assessment tests (Bouça-Machado et al., 2020; Nielsen et al., 2016; Soubra et al., 2019) but must include the extent the environment constrains a particular disabling condition. Thus, the term community mobility was conceptualized by Patla and Shumway-Cook (1999) to integrate extrinsic (environmental) factors into the existing older adults' mobility frameworks. Therefore, community mobility includes walking in the parks, visiting family and friends, doctors' offices, and grocery stores. The community mobility continuum was categorized into four hierarchical ambulatory zones: (a) independent community ambulators are individuals who can meet the

demands of moving within their community, (b) limited community ambulators are individuals who can safely perform some but not all tasks associated with moving through the environment, (c) household ambulators are individuals who can perform the tasks that define mobility within the home environment but is incapable of meeting the demands of mobility outside the home, and (d) non-functional ambulators are individuals who cannot meet the requirements of ambulating within the home environment.

### Comprehensive mobility model

Webber et al. (2010) described a conical model of the theoretical framework for mobility in older adults. They illustrated seven life-space locations across five determinants of mobility: cognitive, psychosocial, physical, environmental, and financial factors. A spiral band around the cone depicts the influences of gender, culture, and biographical factors on all the mobility determinants. Webber and colleagues' model considered multiple mobility determinants spanning all the life spaces of independently living and dependent older adults. The theoretical framework assumed that mobility could take many forms, including, but not limited to, walking, driving, using a wheelchair, and using alternate forms of transportation (Webber et al., 2010). The framework illustrated concentric areas of expanding locations from home with increasing requirements for independent mobility. The mobility zones are the room where one sleeps, the home (house, apartment, institution), the outdoor area surrounding the home (yard, parking lot), the neighbourhood, the service areas in the community (grocery, bank, church, hospital), and geopolitical jurisdictions (Webber et al., 2010). The total cross-sectional area increases with expanding life spaces, suggesting that more factors contribute to each determinant category as one moves farther from home (Webber et al., 2010).

### The International Classification System of Functioning, Disability and Health model

The ICF model (Figure 2.1) demonstrated how environmental and personal factors can influence health outcomes by modifying three main components of human functioning: body functions and structures, task performance, and participation in daily life (Rejeski et al., 2008). The association between sociodemographic attributes and various levels of human functioning has been explained using the ICF model under the conceptual framework.

### *Perspectives on the Definition of Mobility*

Mobility is a broad term with diverse contextual meanings (Metz, 2000; Patla & Shumway-Cook, 1999; Webber et al., 2010). It was mainly conceptualized as individuals' ability to ambulate independently around their environment (Guralnik et al., 1993; Routhier et al., 2003; Sheller & Urry, 2006). Such mobility concepts could neither account for environmental factors such as topography and climatic conditions (Patla & Shumway-Cook, 1999) nor the transportation of individuals around their community (Oxley & Whelan, 2008). Therefore, Patla and Shumway-Cook (1999) proposed a community mobility framework including environmental contexts in which ADLs can be performed. Webber and colleagues published a broader framework for assessing mobility in older adults that took cognizance of the use of assistive devices or transportation within community environments that expand from one's home to the neighbourhood and regions beyond (Webber et al., 2010).

Generally, experts have conceptualized mobility from four perspectives: functionality, locomotion, transportation, and life space. The proponents of functionality define mobility as a means to meet ADL demands with minimal or no dependence (Albert et al., 2015; Bouça-Machado et al., 2018; Routhier et al., 2003). Locomotion scholars are more concerned about ambulation – the ability to walk unaided or with assistance (Patla & Shumway-Cook, 1999). For instance, the WHO's ICF model defines mobility as "movement by changing body position or location or by transferring from one place to another" (WHO, 2002). The idea of including transportation in mobility came from scholars opining that what matters is not the means but the ability to translocate, including the use of walking aids, motorized chairs, and vehicular transport (Routhier et al., 2003; Webber et al., 2010). The socio-ecological theorists conceptualized life space mobility as the ability for global exploration, starting from one's bedroom to worldwide (Baker et al., 2003;

Stalvey et al., 1999). Kuspinar et al. (2020) suggested that defining mobility in terms of life space is more operational than functionality definitions. Broadly, mobility is a functional movement within the home and socioeconomic activities beyond the house, including transportation (Beydoun & Popkin, 2005).

In a recent review paper, Reijnierse et al. (2023) summarized the definitions of mobility in the literature (Table 2.1). They recommended that in terms of the physical domain, mobility should be defined as the ability to move, with or without assistive devices.

**Table 2.1: Summary of mobility definition in the literature.**

| Mobility definition | Citation |
|---|---|
| Ability to walk some distance and climb stairs. | Guralnik et al. (1993) |
| The spatial extent of one's travel within the environment. | Stalvey et al. (1999) |
| Locomotion in the environments outside the home or residence. | Patla & Shumway-Cook (1999) |
| Moving by changing body position or location or transferring from one place to another, carrying, moving, or manipulating objects, walking, running, or climbing, and using various forms of transportation. | WHO ICF (2001) |
| Any movements that lead to a change in position or location by one's own means performed with or without technical assistance. | Routhier et al. (2003) |
| Ability to move oneself (e.g., by walking, using assistive devices, or using transportation) within community environments that expand from one's home to the neighbourhood and to regions beyond. | Webber et al. (2010) |
| The ability of individuals to meet the challenges of the environment given their capabilities associated with movement within and between environments. | Prohaska et al. (2011) |
| Movement in all its forms, including basic ambulation, transferring from a bed to a chair, walking for leisure and the completion of daily tasks, engaging in activities associated with work and play, exercising, driving a car, and using various forms of public transport. | Satariano et al. (2012) |
| The ability of an individual to move about the environment. | Rosso et al. (2013) |
| Personal mobility: the ability to perform activities of daily living, as measured through functional assessments (e.g., walking, standing, sitting, reaching, stooping, and so on), within a generic life space. Community mobility: recent driving history, limitations, and access to a vehicle, within a generic life space. | Umstattd Meyer et al. (2014) |
| The person's ability to change his position or location, or move from one place to another, by walking and basic ambulation. | Soubra et al. (2019) |

Adapted from Reijnierse et al. (2023).

### *Mobility, community, and quality of life*

Mobility can be used to predict the level of independence and quality of life of older adults (Rantakokko et al., 2013). The ability of older adults to remain mobile in their homes and community is an indicator of good health and successful ageing (Freiberger et al., 2020; NIA, 2020). Communities are platforms for human activities, including interactions between animate and inanimate components of the environment. Therefore, community attributes are essential in understanding the mobility decline trajectory throughout the life course (Patla & Shumway-Cook, 1999; Webber et al., 2010). Studies have explored socioecological correlates of the community mobility continuum to facilitate evidence-based individual and community interventions (Giannouli et al., 2019; Rantakokko et al., 2013; Umstattd Meyer et al., 2014; Zijlstra & Giannouli, 2021). Some of the previous studies on mobility correlates focused on biophysical determinants such as disease conditions, muscle strength and gait speed (Reid & Fielding, 2012; Studenski et al., 2011), while others investigated the cognitive (Peel et al., 2005), social (Rosso et al., 2013), psychological (Baker et al., 2003) and environmental determinants (McCormack, 2017; Shumway-Cook et al., 2005). The present study is on sociodemographic determinants.

A community is a group of people with diverse characteristics linked by social ties, governance, common perceptions, or culture interacting within a geographical location (MacQueen et al., 2001). This thesis conceptualizes community as a geographic and sociocultural entity. Comparative analysis was done at the international (Canada vs Nigeria) and local (urban vs rural) community levels. For instance, there are sociodemographic differences in ageing patterns across the international communities: the population proportion of people aged 65 years and older in Canada was 19.0%, and life expectancy was 82 years (Statistics Canada, 2022), while in Nigeria, it was 5%, and 55 years, respectively (Mbam et al., 2022). Nonetheless, ageing and community

attributes (geographic and cultural) have been associated with mobility in older adults (Freiberger et al., 2020; Rantakokko et al., 2013).

The term community is often conceptualized based on two key concepts: a sense of belonging or identity, and a communal context where space and life activities are shared (James et al., 2012). The mutual understanding of identity prompts community dwellers to build the social cohesion necessary for the collaborative development of their community in a manner that supports all members of the community, irrespective of their level of physical disabilities or decline, such as mobility-impaired older adults (Madrid, 2002). Bakar et al. (2012) described five community dimensions – political, economic, geographic, social, and cultural communities.

The political dimension of a community ensures that all citizens can participate freely in governance through effective democratic representation. Through policy interventions, older citizens should also enjoy equal rights, privileges, and benefits of community resources (Kembhavi, 2013; World Health Organization, 2021). Economic dimensions of the community ensure that older adults can engage in post-retirement socioeconomic and cultural activities such as trading, agro-allied businesses, and consultancy services, either in paid positions or volunteering (Cruikshank, 2013). The (Government of Canada, 2021) Action for Seniors Report stated that older adults who are active and engaged in the labour force and their communities contribute to the economy and society, as well as to their health and quality of life. The geographical dimension of the community includes non-modifiable environmental factors such as the geolocation of the community, ambience, topography, weather, and climatic conditions (Patla & Shumway-Cook, 1999), and modifiable factors including land use Law, building design, walkability, greenness, blueness, traffic control, public transportation system, and location of social amenities (Raphael et al., 2001). The sociocultural dimension includes community perception of ageing, societal

perception of physical activity in older adults, sociocultural roles for older persons, food, clothing, social support, family structure, security, and personal safety (Raphael et al., 2001; Tanyi et al., 2018). Tulchinsky and Varavikova (2014) suggested that a healthy community is a place where all people can meet their economic, social, physical, cultural, and spiritual needs and work together for the common good. Figure 2.4 shows the incorporation of the dimensions of a healthy community into the framework for community, mobility, and quality of life interactions.

Patla and Shumway-Cook (1999) presented a mobility continuum that positively correlated with independent walking tolerance and older adults' ability to access the community. They ingrained environmental dynamics such as ambience, visibility, traffic, topography, and weather conditions into their community mobility framework. Therefore, community mobility involves movement in all forms, including basic ambulation, completing daily tasks, transferring from a bed to a chair, engaging in economic and recreational activities, driving a car, and using public transportation. Putting together (Patla & Shumway-Cook, 1999) community mobility continuum, (Webber et al., 2010) mobility framework, and Bakar et al. (2012) community dimensions, *optimum community mobility* can be defined as the ability to safely access political, economic, social, cultural, and physical spaces within one's community using active ambulation, assistive devices, or motorized transportation. Optimum community mobility improves older adults' quality of life (Freiberger et al., 2020). The quality-of-life framework is based on three key concepts: functioning, capability, and subjective well-being (Round et al., 2014). Nonetheless, the three categories are not mutually exclusive; some instruments may include questions covering more than one concept.

Functionality or performance-based constructs are most suitable for assessing community mobility and quality of life interactions. For example, the EQ-5D *(the official name, not an*

*abbreviation)* (Brooks et al., 2020), Short-Form Six-Dimension (SF-6D), and the Health Utilities Index (HUI) are the three most used functionality or performance-based quality of life instruments (Brazier et al., 2017). The construct is based on the idea that individuals must explore their environment to survive. Mobility enables older adults to access shared community spaces and optimize their activities of daily living and quality of life (Rantakokko et al., 2013).

Some quality-of-life constructs were conceptualized to avoid imposing a particular idea of what a good life constitutes and to reflect the importance of freedom in rating personal capabilities. "This differs from the functionality theory, as the emphasis is placed on the capability of individuals to achieve an objective they so desire (Round et al., 2014). Examples are ICECAP (Al-Janabi et al., 2012) and ICEPOP instruments (Coast et al., 2008). The proponents of capability theory opined that a satisfactory quality of life hinged on freedom, safety, social justice, and equity.

Subjective well-being is an important quality-of-life construct that evaluates positive emotions, such as happiness and satisfaction, and negative emotions, such as pain or worry (Round et al., 2014). The key strengths of this approach lie in its conceptually simple questions that allow the respondents to decide for themselves whether their lives are good (Dolan & Metcalfe, 2012). The Personal Wellbeing Index (Cummins, 2020) and the WHO-5 Well-Being Index (Topp et al., 2015) are examples of subjective well-being assessments.

***Community, Mobility, and Quality of Life Interactions***

An in-depth literature review on elements of quality-of-life measures showed nine overarching dimensions of the quality-of-life framework. They are material living conditions (income, consumption, and residence), productive activity (employment and occupation), health status, education, leisure and social interactions, security and physical safety, governance and fundamental rights, natural living environment (community), and overall experience of life (Figure

2.4). These dimensions are interrelated and sometimes interwoven. A community encompasses the living space of a people, and their economic, political, and socio-cultural activities, which shape their identity, support their livelihood, and ultimately affect their quality of life (Bakar et al., 2012; Freiberger et al., 2020; National Institute on Aging, 2020). Therefore, older adults' life accomplishments and satisfaction depend on what their community can offer, what they are capable of harnessing from their community and what they can offer to their community (MacQueen et al., 2001; National Institute on Aging, 2020a; Raphael et al., 2001). Individuals' quality of life, life satisfaction, and accomplishments reflect their ability to explore various aspects of their community (Jaśkiewicz & Besta, 2014; Rantakokko et al., 2013; Raphael et al., 2001).

***Community and Mobility Interaction***

Figure 2.4 depicts a bidirectional relationship between community characteristics and the mobility potentials of older adult dwellers. The double-headed arrow connecting community and mobility implies that mobility among older adults would be supported by a healthy community where everyone can meet their life needs (Tulchinsky & Varavikova, 2014). On the other hand, optimum mobility enhances people's functionality in their community, leading to the development of healthy people in a healthy community (Gorman, 1999; James et al., 2012). Moreover, a good quality of life has a positive relationship with independent community mobility and vice versa (Azagba & Sharaf, 2014; Government of Canada, 2021; Raphael et al., 2001). Although geographical and climatic conditions inherent in a community can limit mobility in older dwellers (Patla & Shumway-Cook, 1999), sociocultural factors also affect mobility. For instance, Canada has an extreme climate but a society that imbibes physical activity as a way of life (Schmidt et al., 2016). In Nigeria, the weather is friendly all year round, but there is a lack of physical fitness culture, especially among the older population (Oyeyemi et al., 2013).

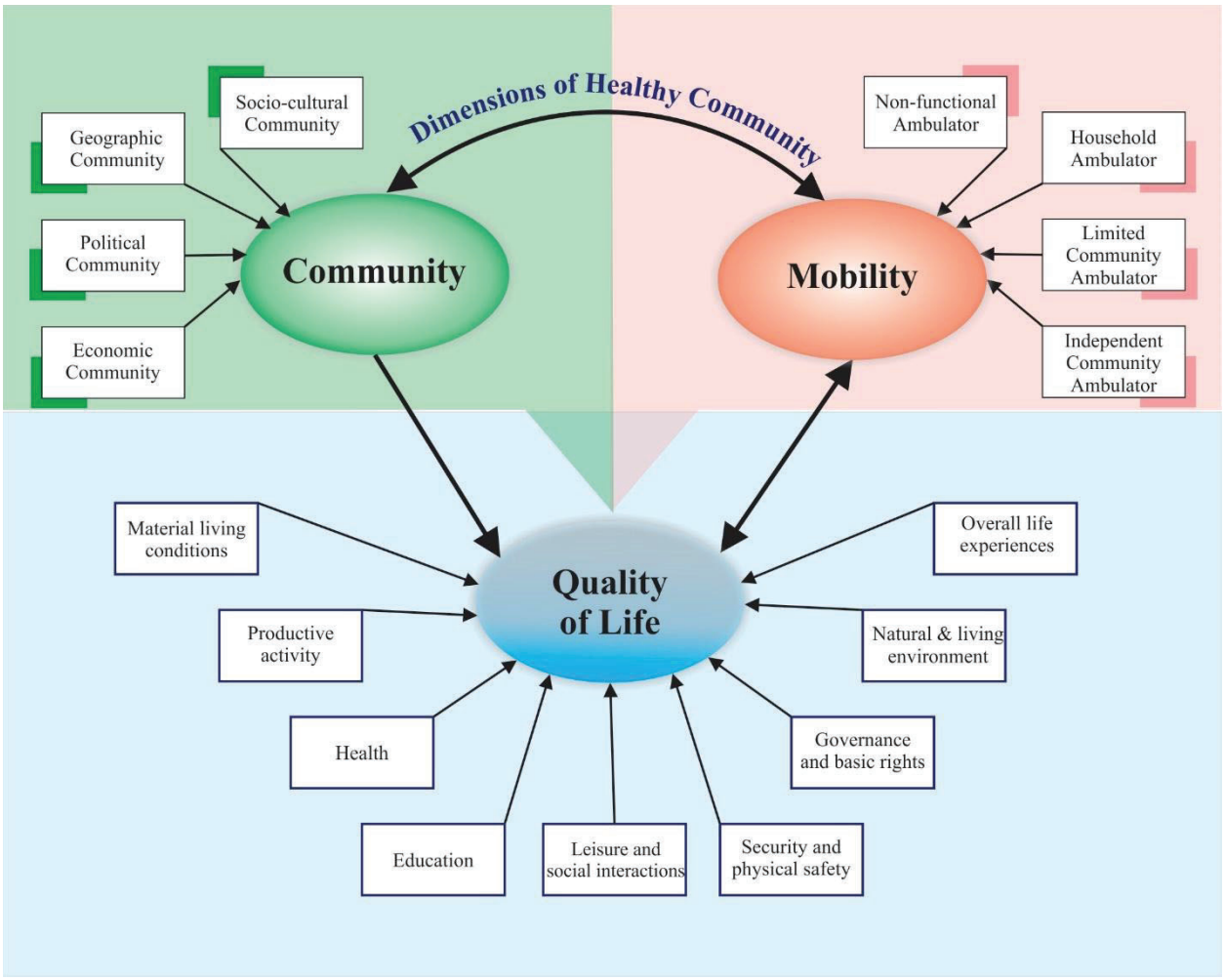


**Figure 2.4: Community, mobility, and quality of life interactions.**

### *Community and Quality of Life Interaction*

There could be a unidirectional relationship between community attributes, including sociodemographic characteristics and the quality of life of older adult dwellers (Figure 2.4). A closer look at Figure 2.1 shows that elements of the quality-of-life frameworks usually measure the levels of participation, capability to participate, or satisfaction with community dimensions (Round et al., 2014). There is a paucity of published literature on the proposed relationship. However, Datta et al. (2015) reported a significant role of community social interaction in improving the quality of life of the geriatric population. WHO floated the Healthy City Initiative in recognition of the community's role in the quality of life of individuals (World Health Organization, 2020). “A healthy city offers a physical and built environment that encourages, enables and supports health, recreation, well-being, safety, social interaction, accessibility and mobility, a sense of pride and cultural identity of all its citizens” (Tulchinsky & Varavikova, 2014, p. 81).

### *Mobility and Quality of Life Interaction*

I postulated a bidirectional relationship between mobility and quality of life (Figure 2.4**)**. Mobility predicts older adults' independence and quality of life (Rantakokko et al., 2013). Conversely, older adults with poor quality of life tend to have poorer socioeconomic status and mobility disabilities (Birnie et al., 2011; Groessl et al., 2007). An observational study of 183 older persons reported a significant positive correlation between mobility and higher quality of life among participants (Shafrin et al., 2017).

### *WHO Decade of Healthy Ageing (2021–2030) and Age-Friendly Community Initiatives*

The WHO’s Decade of Healthy Ageing initiative builds upon earlier frameworks, including the Global Strategy and Action Plan on Ageing and Health (2016–2020) and the Age-

Friendly Cities movement (2006) to create inclusive environments that empower older people to thrive (Rudnicka et al., 2020; van Hoof et al., 2021). These initiatives were launched in response to the United Nations' proclamation of 2021–2030 as the Decade of Healthy Ageing, aligning with the UN Sustainable Development Goals and commitment to ensuring older adults can lead dignified, healthy, and fulfilling lives (Rudnicka et al., 2020). The initiative was developed to address the growing global population of older adults and the challenges posed by ageing societies, particularly in terms of health, inclusion, and sustainable development.

The initiative's primary purpose is to improve the quality of life of older people by fostering collaboration across governments, civil society, academia, and the private sector (van Hoof & Marston, 2021). It focuses on four key areas: combating ageism and changing societal perceptions of ageing, enabling environments that support healthy ageing, such as age-friendly cities and communities, integrated care to address older adults' diverse health needs, and access to long-term care for those requiring assistance with daily living. The WHO Decade of Healthy Ageing (2021–2030) and age-friendly initiatives align closely with promoting community mobility among older adults (Rudnicka et al., 2020). Central to these efforts is the recognition that enabling older individuals to remain active, engaged, and mobile within their communities is essential for maintaining their health, autonomy, and quality of life (Beard et al., 2017).

The Decade of Healthy Ageing emphasizes creating supportive environments and fostering inclusive communities that address barriers to mobility, such as inaccessible infrastructure, transportation challenges, and safety concerns (Beard et al., 2017). Similarly, age-friendly initiatives advocate for urban and rural planning that prioritizes walkability, affordable and reliable public transport, and safe spaces for physical activity and social interaction (van Hoof et al., 2021).

### *Mobility outcome*

Mobility outcomes include gait, balance, transfer, and functional mobility (Dunsky, 2019). Gait is a person's walking pattern (Patterson et al., 2012), including gait speed, stride length, and cadence. Gait speed is one of the objective mobility outcomes that can predict health and functional statuses among older adults (Abellan Van Kan et al., 2009; Duan-Porter et al., 2019).

Balance is another mobility outcome and a key modifier of gait (Winter, 1991). Balance is the capacity to minimize and stabilize the movement of the center of gravity on a support base to maintain equilibrium under intrinsic and extrinsic perturbations (Matsumura & Ambrose, 2006). Human balance is a multidimensional concept, referring to the ability of a person not to fall during simple activities, such as quiet standing (static balance) and complex activities, such as changing directions while walking (dynamic balance) (Karimi & Solomonidis, 2011; Pollock et al., 2000).

Transfer is the process of changing positions, such as moving from bed to chair, wheelchair to toilet and vice versa (Alexandre et al., 2014). Sit-to-stand is the most complex part of transfer motion, yet it is vital for everyday functional tasks (Takahashi et al., 2011).

Functional mobility is the ability of a person to move independently and safely in various environments to accomplish functional tasks and perform ADLs (Bouça-Machado et al., 2018). Therefore, functional mobility encompasses gait, balance, and transfer, which are the building blocks of ADLs (Dunsky, 2019; Takahashi et al., 2011). A conceptual framework for the interactions between gait, balance, and transfer as components of functional mobility is shown in Figure 2.5.

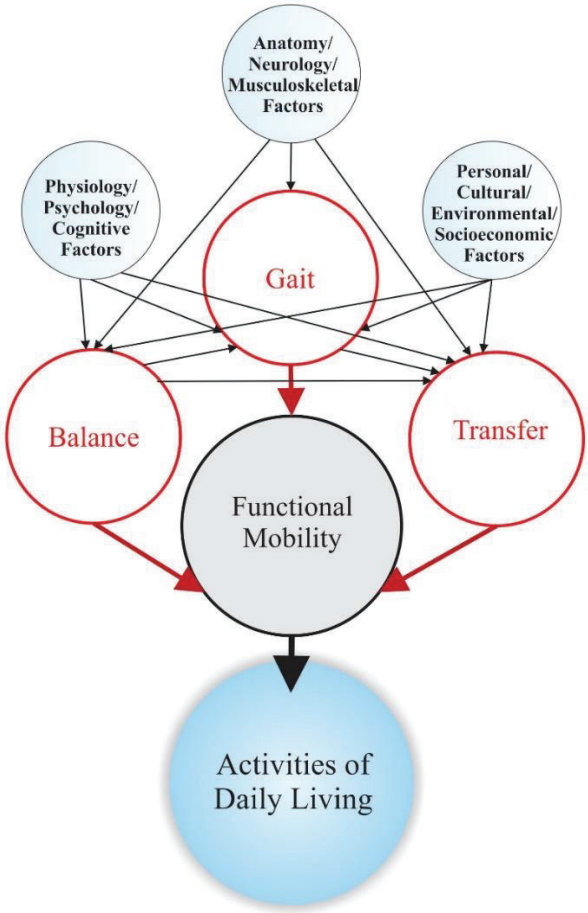


**Figure 2.5: Gait, balance, and transfer as components of functional mobility.**

### *Objective Measurement of Mobility in Older Adults*

Mobility assessment is part of older adults' health care management (VanSwearingen & Brach, 2001), especially when the aim is to improve or maintain physical functioning (National Institute on Aging, 2020). Appropriate mobility assessment tests can aid healthcare professionals in determining who has a problem, when and what interventions are necessary, relevant outcome measures, prognosis, and plan for the public health needs of older adults (Freiberger et al., 2020). Older adults' mobility assessment instruments are broadly classified as self-reported and performance-based tests (Nielsen et al., 2016). Examples of self-reported tests are Life Space Mobility Assessment, and Modified Gait Efficacy Scale (Soubra et al., 2019), while performance-based tests include Timed Up and Go, Short Physical Performance Battery, and Six-Minute Walk Test (Bouça-Machado et al., 2020; Soubra et al., 2019).

Some mobility assessment tests were designed to measure a single outcome, such as gait speed, walking endurance, balance, or perceived functional mobility, while others measure multiple outcomes concurrently (Bouça-Machado et al., 2020; VanSwearingen & Brach, 2001). Functional mobility (Figure 2.5) encompasses gait, balance, and transfer (Bouça-Machado et al., 2018). The suitability of a mobility assessment instrument depends on the outcome of interest, demographics, and clinical characteristics of the target population or individual. Usually, a critical appraisal is undertaken to determine the instruments' technical, technological, and cost implications, feasibility, suitability, and psychometric parameters, including validity, reliability, responsiveness, minimal detectable change, and ceiling and floor effects (VanSwearingen & Brach, 2001).

Studies have shown that self-reported and performance-based mobility tests could be useful depending on the setting and outcome of interest (Bean et al., 2011; Nielsen et al., 2016). However,

self-reported tests are less accurate in measuring simple mobility tasks such as gait speed or transfer (Roedersheimer et al., 2016). Furthermore, self-reported tests can be influenced by the respondent's perspective (culture), cognition, and literacy level (Gómez et al., 2013; Nielsen et al., 2016). On the other hand, performance-based measures can objectively evaluate discrete and specific components of the performance on specific tasks (Bouça-Machado et al., 2020; VanSwearingen & Brach, 2001). A recent systematic review identified 31 objective mobility assessment tests for older adults (Soubra et al., 2019). However, the ten most cited performance-based tests were discussed in this literature review.

Timed Up and Go (TUG).

The TUG is a modified version of the Get Up and Go test. It was developed by Podsiadlo and Richardson (1991) in Canada. According to Google Scholar, it is the most used older adults' mobility assessment test, with over 14,500 citations. It assesses older adults' sit-to-stand, balance, and walking abilities (Bohannon & Schaubert, 2005; Soubra et al., 2019). The participant is required to get up from a chair, walk three meters at a comfortable and safe pace, turn, and walk back to sit down on the chair (Podsiadlo & Richardson, 1991). The TUG is valid and reliable (Table 2.2 provides detailed psychometrics of the test), suitable for older adults, safe, and feasible in routine clinical practice (Bouça-Machado et al., 2020). For instance, it allows the patients to use their usual walking aids and footwear. The test takes less than 15 min; it is cheap – requires only a standard armchair, stopwatch, measuring tape, and marker. The instructor does not need a special technical skill or deployment of technology. A faster test completion time indicates better performance. The TUG is a highly recommended functional mobility test (Bouça-Machado et al., 2020). However, Rockwood et al. (2000) reported a floor effect in 35% of cognitively impaired older Canadians, implying that TUG cannot be used for non-ambulant people.

5-Time Sit-to-Stand Test (5-TSTS).

The 5-TSTS was developed in the USA by Csuka and McCarty (1985) to quantify the lower limb strength and muscle force, examine the functional status, and evaluate balance in older adults. The test measures the time needed to stand up and sit down five times from an unarmed chair while keeping one's arms folded across the chest and their back resting on the chair. The participants are asked to perform the task as quickly as possible without using their upper limbs (Duncan et al., 2011). The 5-TSTS is reliable and valid, and it is highly sensitive to fall risk and significantly correlated with the 6MWT (Bouça-Machado et al., 2020). Despite its apparent simplicity, the ability to go from sitting to standing reflects a vital skill in older adults, and the inability to perform the test suggests functional impairment (Reuben & Siu, 1990). The 5-STS is safe and feasible in clinical and research settings. It does not require costly equipment, technical skill, or technology. However, the potential use of compensatory strategies in the sit-to-stand movement may impair the test's validity. It does not measure static balance, balance limitations during walking, or gait speed (Bouça-Machado et al., 2020). Moreover, Janssen et al. (2002) observed that the chair type, height, foot positioning, and armrests may influence the test outcome. Taller participants may have an advantage while using a uniform chair height. Therefore, these factors need to be addressed to produce a reliable outcome (Soubra et al., 2019).

Short Physical Performance Battery (SPPB).

The SPPB test, developed in the USA by Guralnik et al. (1993), assesses older adults' physical functioning, including gait, balance, and transfer (strength and endurance). The test has three components: balance (ability to stand for three seconds with the feet together side by side, semi-tandem, and tandem), walking ability (two timed trials of three meters walked at a fast pace), and transfers (time to rise from a chair five times). The SPPB utilizes an ordinal ranking system,

from 0 to 12, where higher scores show better functional mobility. The SPPB is valid, reliable, safe, feasible, and suitable for routine geriatric assessment (Gómez et al., 2013). Although SPPB evaluates more constructs than TUG, it is more strenuous and requires great caution during tandem stance. Like the TUG, the SPPB test does not require costly equipment, technology, or technical skills. Gómez et al. (2013) affirmed that SPPB scores could predict a wide range of health consequences, such as disability in ADLs, mobility decline, and hospitalization.

Six-Minute Walk Test (6MWT).

The 6MWT was first described in the United Kingdom (UK) by Butland et al. (1982). It was initially a cardiopulmonary endurance test and has recently been considered a general indicator of overall physical performance and mobility in older adults (Chan & Pin, 2019; Lord & Menz, 2002). The scores are recorded as the maximum distance (m) walked in a flat hallway in six minutes (Butland et al., 1982). Participants are instructed to stand at the start mark and walk (in regular footwear) as far as they can without running or jogging and can use a walking aid if needed (Perera et al., 2006). The 6MWT is a valid, reliable, and responsive tool in geriatrics (Butland et al., 1982; Chan & Pin, 2019; Harada et al., 1999; Perera et al., 2006). The 6MWT is safe, feasible, and does not require special skills or technology. The equipment is very affordable and easy to set up. Armchairs can be placed in the hallway for intermittent rest during the test. The instructor might encourage a participant by only using the two standardized statements: “You are doing well” and “Keep up the good work.” The 6MWT can be limited by inadequate clinic space, leading to several laps around two cones set 30 meters apart (Soubra et al., 2019). Moreover, the test causes cardiopulmonary exertion and higher oxygen demand, leading to an emergency in people with underlying conditions (Paul, 2003). Therefore, pre-test screening and emergency

response capacity are needed for 6MWT. Absolute contraindication includes severe hypertension, unstable angina, and a recent heart attack.

8-Foot Up-and-Go (8FUG).

The 8FUG is a modified version of the TUG test, introduced by Rikli and Jones (1999) in the USA. It involves the same procedure as the TUG test with slight alterations: the walking distance changes from 9.84 feet (3 meters) to 8 feet (2.44 meters), and the turning phase must be done around a cone instead of a marked line on the floor. Soubra et al. (2019) posited that the main reasons for these changes were (1) to increase the test feasibility by administering it in areas with limited space and (2) to standardize the turning area dimensions. The 8FUG is a valid and reliable composite measurement of power, speed, ability, and dynamic balance (Rikli & Jones, 1999). Nonetheless, the 8FUG involves demonstration and practice sessions and two trials. The lowest of the two trial times is recorded as the final score. Although the 8FUG test does not provide a significant difference in feasibility relative to the TUG, it appears more sensitive in predicting fall risk among older adults than the TUG (Rolenz & Reneker, 2016). A study reported the sensitivity (and specificity) of TUG as 20% (94.6%) and 8FUG as 64% (75.7%) (Rolenz & Reneker, 2016).

Habitual Gait Speed (HGS).

Conventionally, walking speed has been widely used to measure mobility in research and clinical settings (Almeida et al., 2017). HGS is a person's usual walking pace (Soubra et al., 2019). The diagnostic and prognostic implications of HGS in community-dwelling older people were formally discussed in a 2-day expert panel (International Academy on Nutrition and Aging Task Force) held in Toulouse, France, and published by Abellan Van Kan et al. (2009). The HGS was recognized as a valid and reliable indicator of rehabilitation needs, future functional decline, and fall risk (Peters et al., 2013). Participants are instructed to walk a selected straight path at their

comfortable speed without verbal encouragement to perform the HGS test. Soubra et al. (2019) suggested that the instructor adopt various versions of HGS depending on the availability of walking distance (three, four, six, or ten meters walk test, with an additional distance of approximately five meters for acceleration and deceleration). The six-meter walk is the most used version for older adult studies (Almeida et al., 2017). However, Peters et al. (2013) suggested that a 10-meter walk was more sensitive than other versions of HGS. The HGS is reported as distance divided by time = speed (m/s). The HGS cannot be administered to non-ambulant patients.

De Morton Mobility Index (DEMMI).

The DEMMI was developed in Australia by De Morton and Lane (2010). It is a valid and reliable assessment instrument for measuring older adults' mobility in clinical settings. It consists of fifteen hierarchical items: bed mobility (three items), chair tasks (three items), static balance (four items), gait (two items), and dynamic balance (three items). Eleven items follow a dichotomous scale (0 or 1), and four items are scored from 0 to 2. The DEMMI score is calculated by converting the total raw score to an interval score of 0 to 100 through Rasch Analysis; higher scores represent better mobility (De Morton & Lane, 2010). The DEMMI is an 8-minute, safe, easy-to-administer, unidimensional instrument (Soubra et al., 2019). However, it requires a bed or plinth, an armchair of 45 cm seat height, a pen, and a stopwatch (De Morton & Lane, 2010). After critically evaluating the complete test protocol, I observed that the test is strenuous and may have a floor effect in older adults with ataxic neurological disorders. For instance, the test allows for a 50-meter walk, a power jump with both legs off the floor, four backward steps, and a forward flexion functional reach to pick up a pen on the floor. Moreover, raw scores must be converted to DEMMI scores before making a meaningful interpretation (De Morton & Lane, 2010).

The figure of 8 Walk Test (F8W).

The modified F8W was described in the USA by Hess et al. (2010). It is performed through combined straight and curved paths. Soubra et al. (2019) posited that F8W was the first assessment tool to provide curved-path walking consisting of clockwise and anticlockwise directions, with a straight path between them. While performing the F8W test, the participants are requested to walk a figure of eight around two cones five feet (1.524 m) apart. They must stand midway between the cones facing outward from the plane of the cones, select the direction of the F8W path, begin walking at their habitual gait speed, and stop once they return to the starting position.

As outcomes of this test, three skilled movement components are investigated: speed (time to complete the test), amplitude (number of steps taken), and accuracy – F8W completed within two feet of the cones or not. Accordingly, low walking speed, a higher number of steps, and being more than two feet away from the cones show poor performance. The two feet surrounding the test path should not be marked to avoid a visual cue. The tester estimates whether the test was completed within the boundary by their mental mapping of the testing space. The F8W is limited by the ambiguity of the walking path, which gives room for interrater bias. There were moderate to low criterion validity scores with standardized gait and balance instruments (Hess et al., 2010).

Hierarchical Assessment of Balance and Mobility (HABAM).

Macknight and Rockwood (1995) developed the HABAM instrument in Canada. The test aimed to graphically display the changes in transfer, balance, and mobility of hospitalized older adults. For each section, a hierarchical range of abilities is constructed. The patient is required to get up from the bed and walk to the best of his ability using his usual walking aid. HABAM's construct validity showed a correlation coefficient of 0.76 with the Barthel Index. In 2000, the developers suggested transforming the HABAM instrument from a graphic indicator into a

measurement index using Rasch Analysis to estimate dimensional intervals (Macknight & Rockwood, 1995). The major advantage of HABAM is that it does not have a floor effect, unlike TUG, Tinetti-POMA, and F8W. Thus, HABAM can be applied to a bedridden patient. However, it involves rigorous graphical presentation and calculations. Moreover, HABAM collects ordinal data, which might be subject to rater bias (Horton & Tennant, 2011).

Tinetti Performance-Oriented Mobility Assessment (Tinetti-POMA).

The Tinetti-POMA is a clinical test used to measure balance and gait in older adults. It was initially devised in the USA by Tinetti (1986). It contained 13 balance tasks and nine items for gait assessments and fall prediction among institutionalized older adults (Tinetti, 1986). To improve its feasibility, the original POMA was reduced to nine balance tasks (POMA-B: sitting, rising from a chair, attempting to rise, immediate standing, standing with eyes open and standing with eyes closed, sternal nudge, turning 360°, and sitting down. In addition, seven items to assess gait characteristics (POMA–G): initiation of gait, step length and height, step symmetry, step continuity, path, trunk stability, and walking stance, were added. Each task is scored on a two-point or three-point scale. Scores are combined, providing a maximum total score of 28 points, with a subtotal score of 16 and 12 points for POMA-B and POMA-G, respectively (Soubra et al., 2019). The total score is interpreted as a high (<19), medium (19 – 24), and low (25 – 28) risk of fall. POMA involves some technical measurements and requires a trained instructor with some expertise (VanSwearingen & Brach, 2001). Moreover, Pardasaney et al. (2012) reported the ceiling effect and limited responsiveness of POMA in community-dwelling older adults. Macknight and Rockwood (1995) suggested that one-third of hospitalized geriatric patients enrolled in their study could not complete the functional reach and Tinetti-POMA tests. Although the original Tinetti-

POMA was adjudged safe, valid, and reliable, it was not easily administered, and various modifications have emerged over the years to improve its feasibility (Soubra et al., 2019).

***Primary mobility outcome for this study***

Of the 12 commonly cited mobility tests, the TUG was recommended as the most suitable and feasible test for functional mobility, including gait, balance, and transfer (Bouça-Machado et al., 2020). *Description*: TUG is a single test that assesses gait (3m walk), balance (static and dynamic balance observed during standing, gait initiation phase, gait cycle, turning point, and sitting), and transfer (sitting-to-standing and standing-to-sitting) (Bouça-Machado et al., 2020). Takahashi et al. (2011) demonstrated that sit-to-stand is vital for transfer motion. *Purpose*: TUG is designed explicitly for functional mobility assessment (Bouça-Machado et al., 2020). *Applicability*: More than any other test, the TUG has been applied in diverse settings as a valid measure of mobility among older adults (Bohannon & Schaubert, 2005; Bouça-Machado et al., 2020; VanSwearingen & Brach, 2001). *Feasibility*: The TUG is suitable for the measurement of gait, balance, and transfer in older adults because it contains fewer items, has a shorter test time and does not require a skilled assessor or bulky equipment such as a bed (Alghadir et al., 2018; Bouça-Machado et al., 2020). *Objectivity*: Some performance-based assessment scores are judgmental (Berg Balance Scale) and collect ordinal data (HABAM), making them susceptible to rater bias (Soubra et al., 2019). The TUG gives an objective outcome and scale data (Podsiadlo & Richardson, 1991). *Clinimetric properties*: TUG is safe and has no ceiling effects, but floor effects exist at scores of 10 to 15 seconds (Bloem et al., 2016). There are several older adults' mobility tests, each with strengths and limitations (Table 2.2). In selecting mobility tests for older adults, the assessor should consider safety, objectivity, suitability, feasibility, and clinimetric properties in target populations. The TUG is apt for older adults' gait, mobility, and transfer assessment.

**Table 2.2: Psychometric Properties of Selected Older Adults' Mobility Assessment Tests**

| S/N | Instrument | Origin | Outcome | Psychometrics | Duration | Feasibility | Limitation |
|---|---|---|---|---|---|---|---|
| 1 | Timed Up and Go (TUG) | Podsiadlo & Richardson (1991) / Canada | Gait speed, power, balance, and transfer | Reliability (ICC) = 0.98, Criterion Validity (DGI) r = 0.48, and MDC = 3.2 s (Alghadir et al., 2018). | < 15 minutes | High | Cannot apply to a non-ambulant person |
| 2 | 5-Time Sit-to-Stand (5TSTS) | Csuka & McCarty (1985) / USA | Lower limb strengths, muscle forces, and balance | Reliability (ICC) = 0.95, Criterion Validity (TUG) r = 0.64, and MDC = 2.5 s (Goldberg et al., 2012). | < 5 minutes | High | Need for standardized chair measurement |
| 3 | Short Physical Performance Battery (SPPB) | Guralnik et al. (1994) / USA | Gait speed, balance, transfer. Strength and endurance | Reliability (test-retest) r= 0.87, Construct and Convergent Validity was good (Gómez et al., 2013). MDC = 0.99 to 1.34 (Perera et al., 2006). | 10 to 15 minutes | High | Can not apply to a non-ambulant person |
| 4 | Six-Minute Walk Test (6MWT) | Butland et al. (1982) / UK | Cardiopulmonary endurance and physical performance | Reliability (ICC) = 0.98, Criterion Validity (MBI) r = 0.48, and MDC = 28.1 m (Chang & Pin, 2019). | Up to 6 minutes | Moderate | May elicit cardiopulmonary distress. Require a long hallway. The patient must be ambulant. |
| 5 | 8 Foot-Up-and-Go (UG) | Rikli & Jones (1999) / USA | Gait speed, power, balance, and transfer | Reliability (ICC) = 0.95, Criterion Validity (TUG) r = 0.74 (Rikli & Jones, 1999). | < 15 minutes | High | Can not apply to a non-ambulant person |
| 6 | Habitual Gait Speed (HGS) | Van Kan et al. (2009) / France | Gait speed | Reliability (ICC) = 0.90-0.94, and Construct Validity (TUG) r = 0.82 (Muñoz-Mendoza et al., 2010). | Dependent on the specified walking distance | High | Can not apply to a non-ambulant person |

| | | | | | | | |
|---|---|---|---|---|---|---|---|
| 7 | De Morton Mobility Index (DEMMI) | De Morton et al. (2008) / Australia | Gait speed, transfer, and balance | Reliability (inter-rater) r = 0.87, Convergent Validity (TUG) r = -0.48, and MDC = 12.7 points (de Morton & Lane, 2010). | Average of 8.8 minutes | High | Floor effect |
| 8 | Figure of 8 Walk Test (F8W) | Hess et al. (2010) / USA | Complex walking abilities | Reliability (test-retest) Time r= 0.84, and Steps r= 0.82. Concurrent Validity (HGS) Time r= -0.57, Steps r= -0.50 (Hess et al., 2010). | < 3 minutes | Moderate | Ambiguous pathway. Rater bias. |
| 9 | Hierarchical Assessment of Balance & Mobility (HABAM) | Macknight & Rockwood (1995) / Canada | Mobility, transfer, and balance. | Reliability (ICC) r= 0.94. Construct Validity (BI) r= 0.76 (Macknight & Rockwood, 1995). | < 15 minutes | Moderate | The outcome is difficult to interpret |
| 10 | Tinetti Performance -Oriented Mobility Assessment (Tinetti-POMA) | Tinetti (1986) /USA | Transfer, balance, and gait cycle | Reliability (test-retest) r= 0.72 to 0.86. Fall sensitivity = 70% and specificity = 52% (Raîche et al., 2000). | 10 to 15 minutes | Moderate | The scores are difficult to compute. Ceiling effect and poor responsiveness. |

Note: MDC = Minimal detectable change (in community-dwelling older adults). DGI = Dynamic gait index. MBI = Modified Barthel Index. BI = Barthel Index. ICC = interclass correlation. High feasibility = affordable equipment, suitable for older adults, can be conducted in a limited space, has good clinimatic properties, is not too demanding on the patient, and scoring and interpretation are easy. Moderate feasibility = meet at least 3 of 6 criteria for high feasibility.

## Empirical Literature Review

### *Demographic factors*

#### Age

It is associated with a decline in physiological, psychological, and social functionality (National Institute on Aging, 2020a). Several studies have investigated the association between age and mobility in older adults. Billot et al. (2020) reviewed age-related pathological changes that impact mobility in old age and provided recommendations and procedures for physical activity interventions. Dunlap et al. (2022) conducted a cross-sectional analysis of 249 community-dwelling older adults to identify the association between mobility determinants and life space. They found that increasing age significantly predicted decreasing life-space mobility ($\beta = -0.43$, $p = 0.006$). Another cross-sectional study conducted by Wu and Zhao (2021) among 242 Chinese aged 60–80 years concluded that age was a significant predictor of usual walking speed ($B = -0.012$, $p < 0.001$) and maximum walking speed ($B = -0.014$, $p < 0.001$). The systematic review and meta-analysis by Boyer et al. (2017) aimed to determine how age alters walking mechanics. The study included 29 studies with 200 standardized effects. A subgroup analysis to compare the outcomes in young and older adults showed that age-related gait changes might play a critical role in the functional limitations of older adults. However, small sample sizes and heterogeneous outcome measures have precluded a conclusive understanding of the impact of age on lower extremity joint kinematics and kinetics.

#### Gender

There are gender differences in human structure and physiological functioning, so health outcomes can be gendered (Jackson & Short, 2018). For instance, musculoskeletal disorders are more prevalent in older women than their male counterparts (Overstreet et al., 2023). Similarly,

Wheaton and Crimmins (2016) reported that women had consistently worse self-reported and objectively measured disability and physical function among (n = 110,220) older adults aged 55-85 sampled from the USA, Taiwan, Korea, Mexico, China, Indonesia and among the Tsimane of Bolivia. It is well established that the intersectionality of age and gender worsens mobility decline in older women (Idland et al., 2013; Leveille et al., 2000). Mobility limitations in older adults are gender disproportionate, with women showing more significant limitations and a higher risk of mobility disability compared to men (Boyer et al., 2017; Leveille et al., 2000; Shumway-Cook et al., 2005; Wu & Zhao, 2021). A seven-year follow-up longitudinal study found a significant sex difference in the prevalence of mobility disability among 10,263 community-dwelling older adults in the United States (Leveille et al., 2000). The percentage of increase in mobility disability among women vs men was 22% vs 15% for those aged 70 years and 81% vs 57% for those aged 90 years during the baseline (Leveille et al., 2000). While Milanović et al. (2013) reported no significant gender difference in the levels of physical activities among 1,288 Serbian older adults, Wu and Zhao (2021) reported that among 242 Chinese older adults, men had a higher maximum walking speed than women.

Beyond biological factors, sociocultural constructed gender roles may affect mobility outcomes in older adults differently (Ahmed et al., 2016). Life course accumulation of these roles, including childbearing, childcare, homemaking, and other gendered economic activities such as food processing, may lead to earlier and more severe mobility disability in women relative to men. Webber et al. (2010) suggested that gender, culture, and biography (personal life history) acting independently and cumulatively influence individuals' experiences, opportunities, and behaviours, leading to disproportionate mobility outcomes. However, sociodemographic intersectionalities in mobility outcomes are rarely researched.

Marital status

There is a paucity of research on the effect of having a spouse on the mobility potential of older adults. However, Hossain et al. (2021) posited that married elderly had a lesser risk of mobility difficulty, whereas unmarried status was disadvantageous, particularly for women. Research has shown that older married adults have better mobility and functional status than unmarried (Perkins et al., 2016; Sengupta & Agree, 2002). One reason for this association may be that married individuals have more social support, which can help them maintain physical activity and engagement in daily activities. Social support can also help reduce stress and anxiety, which can have a negative impact on mobility and physical functioning (Hossain et al., 2021). Married individuals may also have better access to healthcare resources and receive more support from their spouses in managing chronic health conditions. This can result in better management of health conditions, positively impacting mobility and overall physical functioning (Perkins et al., 2016; Sengupta & Agree, 2002).

On the other hand, older adults who are widowed, divorced, or single may experience higher levels of social isolation and loneliness, which can negatively impact their mobility and physical functioning (Hossain et al., 2021). They may also have fewer resources and support to manage chronic health conditions, which can contribute to mobility limitations (Perkins et al., 2016; Sengupta & Agree, 2002). It is important to note that the associations between marital status and mobility in older adults may be influenced by other sociodemographic intersectionalities such as age, gender, socioeconomic status, health status, culture, and location.

### *Sociocultural factors*

Tribe/Ethnicity

Often, people of the same tribe or ethnicity share certain cultural values and norms, which culminate in a distinct culture that may influence health literacy, access, and adherence (Lie et al., 2012). Culture shapes mobility by impacting various aspects such as social connections, access to education and employment opportunities, and physical activity patterns (Webber et al., 2010). Research suggests that race, ethnicity, and tribe can be associated with mobility in older adults, with some studies showing disparities in mobility outcomes across different racial and ethnic groups (Vásquez et al., 2020). For example, findings from the Health, Aging, and Body Composition longitudinal cohort study in the United States have shown an association between race and decline in gait speed over five years of follow-up (Thorpe et al., 2011). The analysis of walking speed among 2,449 participants who had a clinic or home visit showed that, irrespective of gender, 33% of Black participants experienced a decline in walking speed relative to 27% of White participants ($p < 0.01$). When the data were adjusted for age, study site, and health status, Black women (OR = 1.24, 95% CI: 0.96, 1.61) and men (OR = 1.29, 95% CI: 0.99, 1.68) had similar odds of gait speed decline compared to White women and men (Thorpe et al., 2011).

Similarly, Vásquez et al. (2020) found older non-Hispanic Black (NHB) participants to have a higher mobility limitation (33.3%) than non-Hispanic White (NHW, 28.6%) and Hispanic participants (26.2%). The unadjusted multivariate logistic regression showed that Hispanics (POR: 0.88; 95% CI: 0.80, 0.98) and others (POR: 0.83; 95% CI: 0.71, 0.98) had lower odds of mobility limitations relative to NHW participants, while Blacks had higher odds of mobility limitations when compared with non-Hispanic Whites participants (POR: 1.25; 95% CI: 1.13, 1.37). After adjusting for age, gender, and education, Hispanics (POR: 0.86; 95% CI: 0.76, 0.97) retained their

lower odds, and NHB (POR: 1.30; 95% CI = 1.16, 1.43) remained with higher odds of having mobility limitation, compared with NHW participants.

Possible explanations for these disparities include differences in socioeconomic status, access to healthcare and health-related resources, and exposure to chronic stressors such as discrimination and racism (Kelley-Moore & Ferraro, 2004). Additionally, cultural factors may influence health literacy, access to health, diet and lifestyle, impacting mobility outcomes (Lie et al., 2012). Disparities in older adults' mobility outcomes across different racial and ethnic groups have been documented in research. However, after controlling for socioeconomic resources, social integration, demographic factors and other health indicators, the trajectories of disability by race are not significantly different (Dunlop et al., 2007; Kelley-Moore & Ferraro, 2004; Thorpe et al., 2011; Vásquez et al., 2020). More research is needed to understand the complex relationship between race, ethnicity, tribe, and mobility in older adults.

Religion

Religion is among sociocultural activities that engage older adults. Some people may walk a reasonable distance daily or weekly to perform retinue religious activities, which may involve dancing, procession, and other forms of physical participation. Although there is a paucity of how differences in religious denominations influence walking potentials in older adults, research suggests that religious participation, in general, may be associated with mobility in older adults, with some studies reporting that religion can have a positive impact on physical functioning and mobility (Hill et al., 2016; Park et al., 2008). A study conducted among older Mexican Americans using growth mixture modelling showed that respondents who attend religious services have lower odds of being classified as having low mobility compared to those who never attend (Hill et al., 2016). There was an association between mobility and the three identified latent classes of mobility

trajectories: high, moderate, and low, such that being classified as having low mobility as compared with high mobility is lower for respondents who attend religious services monthly (OR = 0.47), weekly (OR = 0.51), and more than once a week (OR = 0.36) than for respondents who never attend or rarely attend (Hill et al., 2016). Similarly, Berges et al. (2007) found that attending religious services was associated with better physical function post-stroke among older Mexican Americans.

Religion can provide a sense of social support and community, positively impacting physical functioning and mobility in older adults. Religious practices may promote healthy behaviours, such as regular exercise, contributing to better physical functioning and mobility (Koenig, 2012). However, a study among Taiwanese older adults found that participation in social activities had a more robust effect on health than religious attendance, even after controlling for prior health (Yeager et al., 2006). This finding led to the question of whether the purported health benefits of religious involvement are attributable to spiritualism or social activities inherent in religion and whether one religious denomination has advantages over the other.

***Socioenvironmental factors***

Area of residence

Urban and rural areas have peculiar neighbourhood characteristics that can influence mobility in older adults (Adebowale et al., 2012; Starke et al., 2015). Research suggests that location characteristics (urban and rural) can be associated with mobility in older adults, with some studies reporting that older adults residing in rural areas may have lower levels of mobility and physical functioning compared to those in urban areas (Smith et al., 2008; Umstattd Meyer et al., 2014). For example, Lunar et al. (2019) investigated the impact of residential settings on the mobility performance of community-dwelling older Filipinos living in urban and rural areas. The

study found that urban dwellers scored consistently better than their rural counterparts on commonly used mobility instruments. Specifically, urban dwellers had an average higher 6MWT scores (456.7 ± 69.0 metres) than rural dwellers (303.1 ± 54.4 metres), $p < 0.001$. The findings suggest that residential settings may contribute to differences in mobility performance among older adults.

One possible explanation for this association is that rural areas may have limited access to transportation and healthcare services, which can negatively impact mobility and physical functioning in older adults (Starke et al., 2015; Zhang et al., 2017). Moreover, Tilt et al., (2007) reported that having a grocery store or market and restaurants less than 440m and 262m from the residence encourages people to walk instead of taking vehicular transport. Similarly, a scoping review by Levasseur et al. (2015) has shown the importance of proximity to resources, social support, transportation and community security for older persons' mobility and social participation. Poorly planned urban communities affect the independent mobility of older persons (Clarke et al., 2008), while sparsely populated rural environments often lack good roads and recreational facilities (Tanyi et al., 2018). These community attributes affect outdoor mobility, physical activity, and community participation (Clarke et al., 2008; Tanyi et al., 2018).

The ability to connect with proximal and distal family and acquaintances and participate in socio-cultural activities such as community meetings influences the quality of life of older adults (Cruikshank, 2013). Furthermore, community-wide security and personal safety are crucial aspects of citizens' lives. Older adults' mobility and life satisfaction may be limited in communities with a high rate of social vices such as theft, kidnapping, or even racist attacks (Ani & Isiugo-Abanihe, 2017). Umstattd Meyer et al. (2014) reported that older adults residing in the more secure neighbourhoods were likelier to have greater personal and community mobility. Physical

community characteristics, walkability, and socioeconomic factors predict an area's quality of life (Jaśkiewicz & Besta, 2014). Three independent systematic reviews have shown an association between the physical environment, neighbourhood attributes, and older adults' outdoor walking behaviours (Barnett et al., 2017; Van Cauwenberg et al., 2018; Yun, 2019).

Rural areas may also have fewer opportunities for physical activity and recreation, which can contribute to lower levels of physical functioning in older adults (Levasseur et al., 2015). However, other studies have reported mixed findings and suggest that the association between urban and rural residence and mobility in older adults may be influenced by other factors, such as socioeconomic status and individual health status (Levasseur et al., 2015; Lunar et al., 2019). While some studies suggest an association between urban and rural residence and mobility in older adults, the evidence is inconclusive (Lunar et al., 2019). More research is needed to understand the complex relationship between these factors.

Housing

Several studies have investigated the association between housing-related factors, such as house type, compound size, house ownership, and mobility in older adults (Gitlin, 1998; Oswald et al., 2007). As individuals grow older, the need for housing modifications becomes crucial to help them cope with and adapt to declining physical abilities, ensuring a sense of well-being and autonomy in their daily lives (García-Esquinas et al., 2016; Gitlin, 1998). This relationship between housing and health becomes even more significant in advanced old age, as older adults are more vulnerable to environmental and housing challenges (Oswald et al., 2007). The type of home influences movement behaviour in older adults (García-Esquinas et al., 2016). For example, stairs and unpaved compounds impose higher tasks for someone using a walker device (García-Esquinas et al., 2016; Oswald et al., 2007). Change in one dimension may also alter the ability to meet specific demands in other determinant categories.

One study by Browne et al. (2021) explores the association between housing characteristics and objectively measured changes in movement behaviour among older adults with hypertension during the COVID-19 pandemic. The study included 35 older adults, and accelerometer-based movement behaviour was assessed. The study found that housing type was associated with changes in mobility. Specifically, individuals residing in an apartment showed a greater decrease in light physical activity on weekdays ($\beta$ = -65 min/day, $p = 0.035$) compared to detached houses. Residents of row houses took more steps/day ($\beta$ = -2064, $p = 0.010$) compared to those residing in a detached house.

There is a paucity of published work on the implications of compound size on the mobility of older adults. Another dimension is whether homeownership impacts older adults' mobility outcomes. A study by Do and Kim (2013) in South Korea investigated the association between home ownership, mobility and fall-related outcomes among older adults. The findings suggest that a lack of home ownership and unstable housing tenure are important risk factors for mobility-related outcomes among older adults in South Korea. This study highlights the potential influence of home ownership on mobility outcomes and the need for further research in different contexts to understand this relationship. Housing is often included in the measures of socioeconomic status, which is a critical determinant of mobility outcomes in older adults (Birnie et al., 2011; Plouvier et al., 2016). Overall, research suggests that housing-related factors, such as house type, compound size, and house ownership, can significantly impact mobility outcomes in older adults. These findings highlight the importance of considering housing-related factors in designing interventions to promote mobility and physical functioning in older adults.

### *Socioeconomic determinants*

The most important socioeconomic determinants of health are education, occupation, and income (Adler et al., 1994). Socioeconomic factors are strong predictors of health outcomes among older adults globally (Coppin et al., 2006; Gornick, 2002; Hatch et al., 2011; Plouvier et al., 2016). Figure 2.6 is an adapted Patla and Shumway-Cook (1999) community mobility model showing the association between the mobility continuum and socioeconomic status. Socially constructed risk factors may have a life-course implication for mobility in old age (Kuh et al., 2014; Meng & D'Arcy, 2013). Modifications of socioeconomic risk factors through policy action could lead to the postponement of chronic diseases, disability, and death among older adults (Freiberger et al., 2020; Hatch et al., 2011; Lai et al., 2022; Metz, 2000; National Institute on Aging, 2020a; Nwankwo et al., 2021; Patla & Shumway-Cook, 1999).

Adler et al. (1994) defined socioeconomic status as a multifactorial variable characterized by the intersectionality of income, education, and occupation. Wani (2019) put it as a cumulative measure of a person's level of education, occupation type, personal or family's economic access to resources and social position in relation to others. In 1976, Kuppuswamy devised a 5-level socioeconomic continuum concept to measure the socioeconomic status of persons or families through a cumulative range of scores: lower (1-4), upper-lower (5-10), lower-middle (11-15), upper-middle (16-25), and upper level (26-29) (Kuppuswamy, 1981). See Appendix B for the details of the scale. Kuppuswamy's socioeconomic continuum is commonly used to measure an individual's or family's socioeconomic status based on the education, occupation, and monthly income of the individual or the family head (Wani, 2019). Individuals' positions in the socioeconomic continuum could be indicative of the cumulative socioeconomic disparities over their life course (Marengoni & Calderon-Larrañaga, 2020). For instance, educated parents with

high-paying jobs often have children who live healthier lifestyles, have greater access to education and healthcare (Case et al., 2005), and grow up to be healthier older adults (Currie & Stabile, 2003). Low family income can contribute to an absence of these healthy lifestyles, depression, and mobility limitations in older age (Domènech-Abella et al., 2021; Yeom et al., 2008).

Education

Education, often acquired earlier in life (e.g., childhood, adolescence, and young adulthood), appears to be a foundational factor for holding a skilled occupation and higher income in the future (Avlund et al., 2000). Higher education protects against a functional decline in older adults (Al Snih et al., 2008; Alexandre et al., 2014). Although a few studies found no significant association between education and mobility potential in older age, they were of small sample size and had lower methodological rigour (Idland et al., 2013). A longitudinal study by Kyrönlahti et al. (2021) investigated the impact of education on Finnish 55-year and older adults' decline in maximum walking speed over 11 years. The result from 1128 participants showed that individuals with lower (0.24 m/s, 95% CI: 0.21, 0.26) and intermediate (0.24 m/s, 95% CI: 0.21, 0.28) levels of education experienced a greater decline in maximum gait speed compared to those with higher education (0.10 m/s, 95% CI: 0.07, 0.14). The findings suggest that education-based disparities in mobility increase with age, and physical workload among individuals with lower education levels contributes most to this disparity.

Access to education is among the dimensions of quality of life. Depending on their age, educational attainment, and life aspirations, older adults may not be seeking institutionalized formal education. However, nonformal education such as lived experiences, skill acquisition, access to information, town hall seminars, and workshops may improve health literacy, mobility strategies, and productive capacity among community-dwelling older adults (Rasi et al., 2020). In

contemporary knowledge-based economies, education plays a pivotal role in the lives of citizens and is a crucial factor in determining their general well-being (Weber, 2011). Hence, communities with poor education and information technology infrastructures may hamper the mobility of older dwellers. Moreover, people with poor quality of life or mobility disabilities are often associated with lower income and may have fewer choices of where to live.

Occupation

Lifetime occupation, often classified as unskilled non-manual, unskilled manual, skilled manual, and skilled non-manual (Latham-Mintus, 2020), is associated with mobility outcomes in old age (Bishop et al., 2016; Latham-Mintus, 2020). Inherently, education is associated with occupation, which in turn is associated with income (Beltrán-Sánchez et al., 2017; Darin-Mattsson et al., 2017). Mediation analyses revealed that lifetime exposure to physically demanding occupations was a significant factor contributing to the age-related decline in maximum gait speed, accounting for 11% of the overall effect (Kyrönlahti et al., 2021). In another study, Beltrán-Sánchez et al. (2017) examined the impact of physical work conditions on social disparities in mobility among older adults in Mexico using data from the Mexican Health and Aging Survey. They found that occupations with higher physical demands were associated with increased mobility limitations in older age, even after accounting for age and sex. The inclusion of job categories in the analysis reduced the effects of education and income, suggesting that physical work conditions contribute to socioeconomic disparities in mobility limitations.

Income

For older adults, income is typically a combination of personal income, pension, spousal, household/family income, and assets. There can be a bidirectional and cyclical relationship between income and health outcomes, whereby individuals with low income may have limited

access to health care services or are less likely to adopt healthy lifestyles (Marmot, 2002). In turn, individuals with poor health status may experience greater difficulty maintaining jobs and earnings (Cattell, 2001). Financial factors also directly influence mobility and interact with other vital determinants to affect overall mobility status. Research shows that lower-income individuals are at higher risk for mobility disability (Shumway-Cook et al., 2005).

Beydoun and Popkin (2005) posited that economic resources dictate activity options away from home, transportation mode, and time for social networking are also affected. In this way, financial factors can influence psychosocial factors (family and social relationships). It may also affect biophysical factors. For instance, in settings where out-of-pocket payment is required of older adults, the affordability of medical bills may hamper access to health services. Smith and Goldman (2007) examined whether physical functioning and health behaviours varied by socioeconomic status, comprising educational attainment, income, and wealth in later adulthood for Mexicans aged 50 and older. They found significant socioeconomic variation in mobility limitations and difficulty performing any activity of daily living.

People with lower economic resources tend to reside in insecure, unsafe, and unhealthy environments. Material living status significantly correlates with mobility and environment (Shumway-Cook et al., 2005). A study found that older adults below the poverty line are more likely to live in a community where access to health services is limited and are less likely to adopt healthy lifestyles (Marmot, 2002). If impaired, they are less likely to afford motorized mobility devices; if they do, they may reside in locations without paved walkways. Moudon et al. (2006) reported that residential density significantly correlates with walking frequency, life-space mobility, and moderate physical activity.

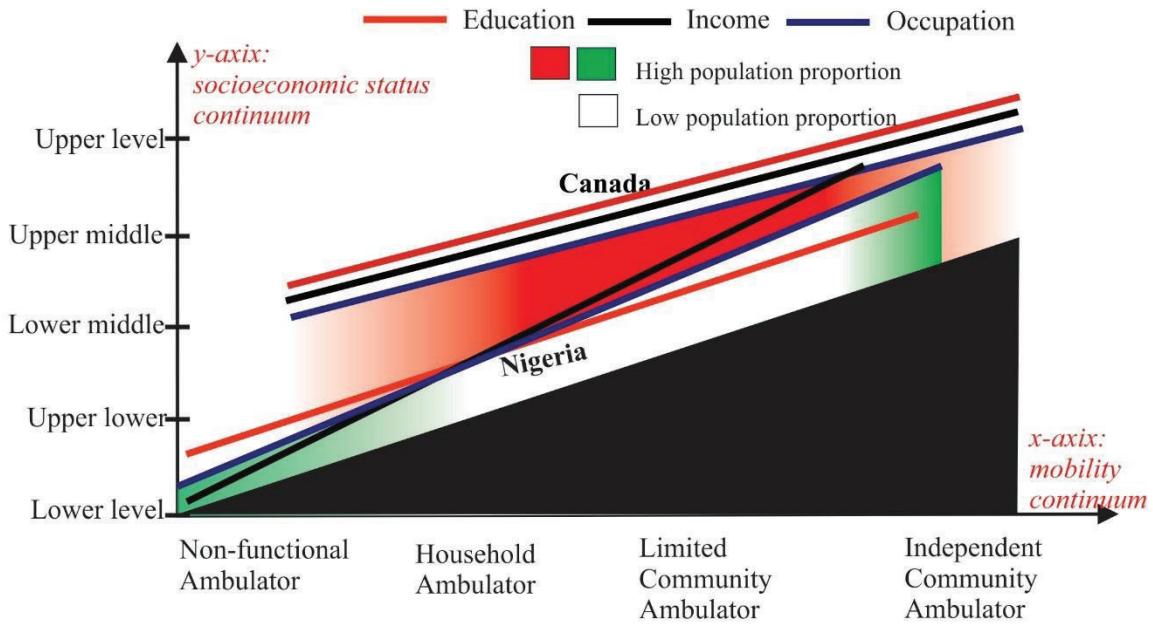


**Figure 2.6: Combined plot of community mobility and socioeconomic continua.**

## Summary and Gaps in Literature

The medical (biophysical and psycho-cognitive) aspects of older adults' mobility are more frequently researched, creating a literature gap on the implications of social factors. The mobility disability models under review appear to have provided a holistic framework for movement difficulties in older adults. However, the sociodemographic determinants of mobility disorders were conspicuously inadequate. For instance, Webber's model omitted the nuances of socioeconomic factors among the key determinants of mobility outcomes. Literature showed that socioenvironmental factors such as house ownership and house type influence older adults' mobility. It was interesting to know whether home type and ownership affect mobility in older adults, but there was a paucity of literature in that area. Participation in religious activities seems to enhance mobility opportunities among older adults. However, researchers have not yet unravelled the components of those activities that will benefit older adults' mobility. It was equally interesting to know whether differences in religious denominations make a difference. The perceived differences in ethnicity have not been decomposed to genetic and cultural factors such as food type and health beliefs. Although Webber et al. (2010) discussed financial and psychosocial factors in parts, it was not exhaustive. There is a need to identify sociodemographic correlates of mobility decline in older adults using data from both qualitative and quantitative procedures. It is also important to synthesize the findings of individual studies on various aspects of sociodemographic determinants of mobility outcomes among older adults. A systematic review and meta-analysis, secondary quantitative analysis, and qualitative inquiry completed in the current study bridge these gaps. The study also offered the opportunity for older adults' mobility trajectory comparison between a representative country of the global North and South.

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# CHAPTER 3: METHODOLOGY

## Overview of Methods

This study employed a multi-methods design comprising a systematic review, quantitative, and qualitative approaches. Multi-methods research involves conducting two or more research projects independently to address separate but related research questions (Morse, 2003). In contrast, mixed-methods research integrates quantitative and qualitative methodologies to answer a single research question (Nastasi, 2020). The overall approach adhered to Crotty's (2003) framework, which accommodates both objectivism and constructionism within a realist ontological perspective.

The study was conducted in four phases (Figure 3.1), corresponding to the manuscripts presented in Chapters Five through Eight. The first three phases aligned with objectivism, while the fourth aligned with constructionism. Chapters Five to Seven adhered to the post-positivist paradigm, whereas Chapter Eight followed the constructionist paradigm. All phases converge on the ethos of dialectic pluralism (Johnson, 2015; Johnson et al., 2014) as outlined in Appendix A.

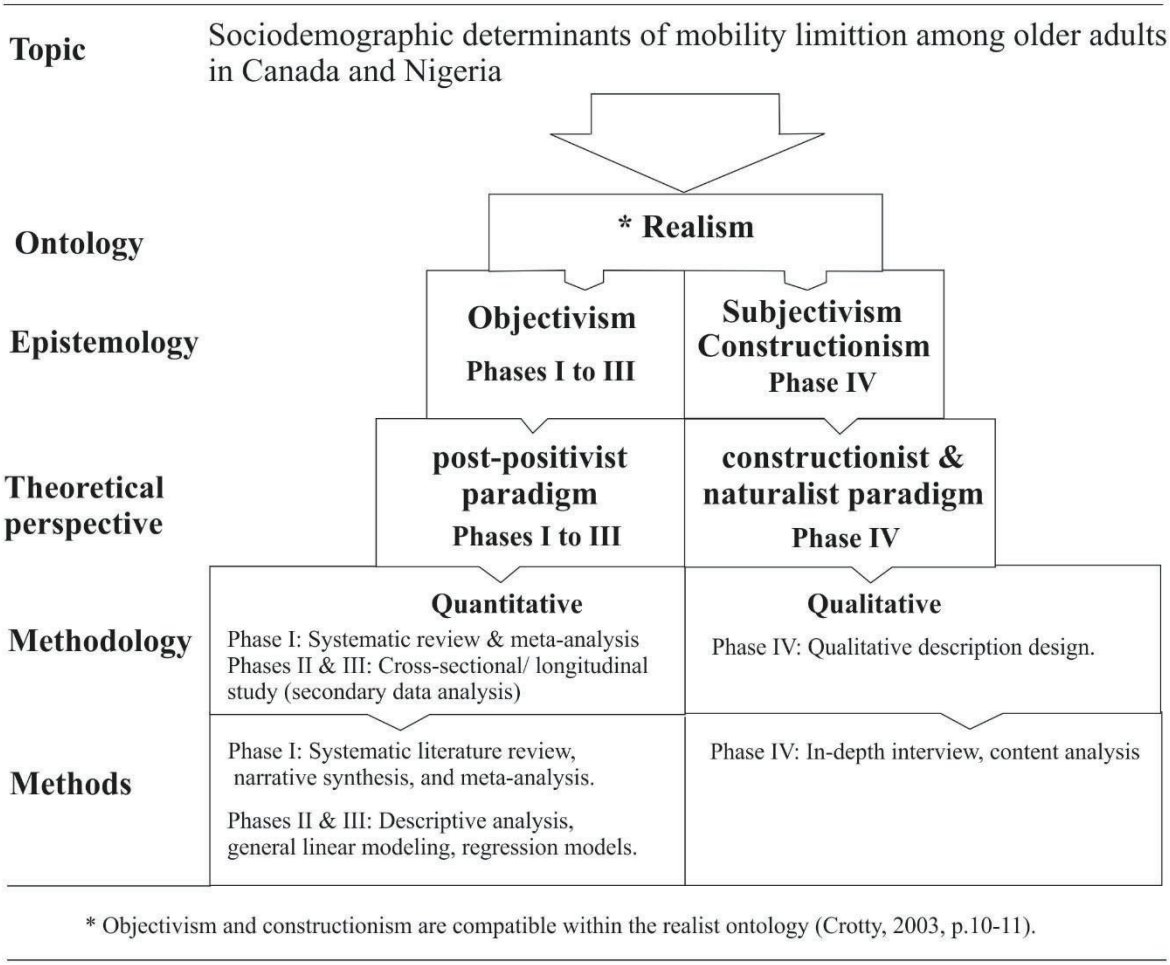


**Figure 3.1: Study phases and the philosophical underpinning.**

***Systematic review and meta-analysis***

Chapters Four and Five present a synthesis of quantitative studies examining sociodemographic factors and mobility limitations among older adults. The study utilized systematic review and meta-analysis methodologies. The included articles were observational studies with objective measures and quantitative analyses, situating the manuscript within the post-positivist theoretical framework. The review followed PRISMA and MOOSE guidelines (Moher et al., 2015; Stroup et al., 2000).

The methodology involved developing search terms based on the *Population Exposure Outcome Time* (PEOT) format, identification of literature, screening, eligibility, and inclusion of relevant studies. The coefficients of association between sociodemographic factors and mobility outcomes were meta-analyzed to generate summary estimates for each factor where relevant methodological assumptions were met.

***Secondary data analyses***

Chapters Six and Seven were secondary analyses of longitudinal observational studies comprising objectively measured mobility outcomes such as TUG and 4MWT, in the CLSA (Raina et al., 2009) and HGS in ISA (Gureje et al., 2007). The methodology of these studies, including sample frames, recruitment techniques, participant profiles, and ethical considerations, is detailed in their respective chapters.

Quantitative analyses were conducted by estimating mean differences in mobility outcomes across sociodemographic subcategories over follow-up periods. Statistical significance was assessed using an alpha level of $p < 0.05$. Furthermore, the participants' sociodemographic variables were regressed individually and collectively against the mobility outcomes. Chapter Six

incorporated gender-disaggregated analyses to address the observed wider gender gaps in mobility outcomes within the ISA cohort.

Figure 3.2 shows the overall quantitative analysis layout in a directed acyclic graph (DAG). Sociodemographic factors served as the exposure, while mobility decline was the outcome of interest. Health status was a mediator, capturing the pathway through which sociodemographic factors influence mobility decline. Ageing was a moderator, defining the path between sociodemographic factors and mobility decline, while environmental factors act as an antecedent of sociodemographic factors, health status, ageing, and mobility decline. Therefore, the environmental factor was considered an adjusted variable (or confounder), as it was associated with both exposure and the outcome but was not a direct cause of the exposure. Importantly, sociodemographic factors were both an exposure and an ancestor of exposure, as they influence ageing, which in turn affects the health and mobility of individuals. The adjusted DAG suggested that controlling for environmental factors might help isolate the effect of sociodemographic factors on mobility decline. A basic regression model for this system can be expressed as:

(i) Mobility Decline = $\beta_0$ + $\beta_1$Sociodemographic Factors + $\beta_2$Environmental Factors + $\beta_3$Health Status + $\beta_4$Ageing + $\epsilon$.

(ii) Where: $\epsilon$ (epsilon$\epsilon$) = the error term, and $\beta$ (beta) = standardized regression coefficients.

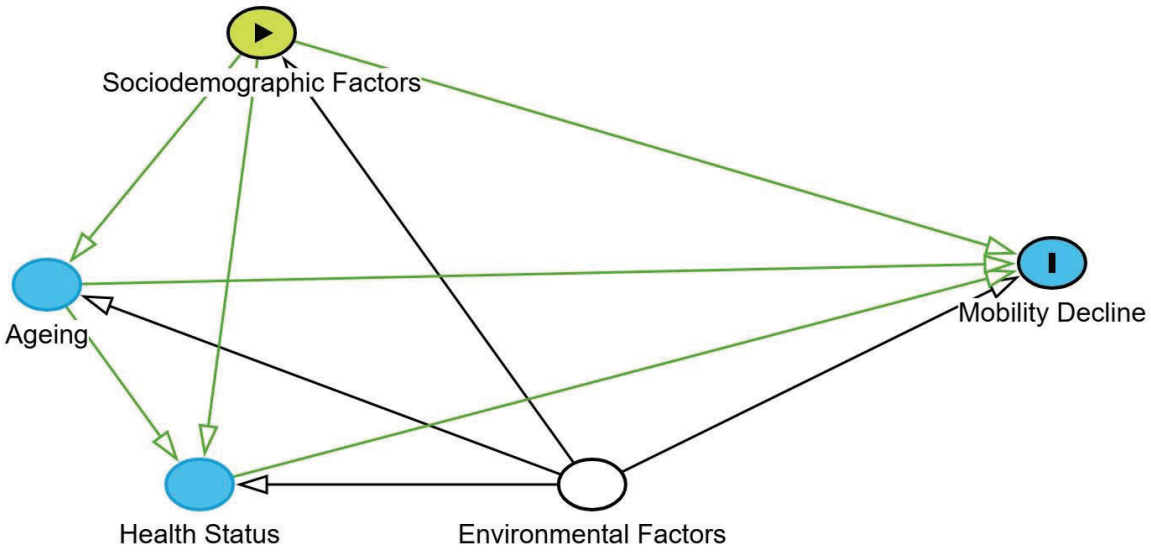


**Figure 3.2: Directed Acyclic Graph (DAG) for the association pathways between sociodemographic factors and mobility decline in older adults (**DAGitty v3.1 online**).**

***Qualitative study***

Despite the availability of quantitative research analyzing mobility and its sociodemographic determinants in older adults, qualitative studies exploring older adults' perspectives through sociodemographic lenses remain scarce (Goins et al., 2015). Therefore, Chapter Eight complements Chapters Four to Seven (Gough & Madill, 2012) by employing a qualitative descriptive approach to examine the perspectives of older Canadians and Nigerians on the sociodemographic determinants of mobility limitations.

Qualitative description is rooted in constructionist epistemology and adopts a naturalistic perspective (Bradshaw et al., 2017), aligning with social determinants of health and life-course theories (Elder et al., 2003). According to Bradshaw et al. (2017), qualitative description reconstructs the essence of a phenomenon through participants' lived experiences and researchers' contextual understanding. This approach is particularly suited to health research, as it connects participants' experiences to broader sociocultural contexts (Bradshaw et al., 2017; Parse, 2001).

The emphasis on in-depth, participant-driven descriptions provides valuable insights into their perceptions and informs intervention development (Sullivan-Bolyai et al., 2005). While qualitative description avoids the extensive abstraction typical of other qualitative methodologies (Lambert & Lambert, 2013), some interpretive analysis is necessary. Chapter Eight employed conventional qualitative content analysis, coding data, and constructing themes inductively (Hsieh & Shannon, 2005).

Maximum variation sampling was employed to recruit individuals from diverse sociodemographic strata until data saturation was achieved, at which point no new concepts emerged (Sutton & Austin, 2015). Participants were purposefully selected based on their relevant knowledge and familiarity with the subject under investigation (Caelli et al., 2003). Chapter Eight

provides a detailed description of the methodology, including study settings, context, interview procedure, data management and analysis, ethical considerations, and positionality.

***Summary***

Chapter Nine summarizes the research questions, presenting the key findings, conclusions, policy implications, and recommendations.

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# CHAPTER 4: MANUSCRIPT ONE

## Association between sociodemographic factors and mobility limitation among older adults: a systematic review and meta-analysis protocol.

**Citation:**

Onyeso, O. K., Odole, A. C., Scott, D. R., Akinrolie, O., Kalu, M. E., & Awosoga, O. A. (2023). Association between sociodemographic factors and mobility limitation among older adults: A systematic review and meta-analysis protocol. *Systematic Reviews*, *12*(1), 19. https://doi.org/10.1186/s13643-023-02190-9

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**Abstract**

**Background:** Mobility is an independent predictor of physical functionality, healthy aging, and quality of life. Various literatures have associated mobility limitation in older adulthood with demographic and socioeconomic factors. Hence, we propose a systematic review and meta-analysis to synthesize the association between sociodemographic factors and mobility limitations in older adults.

**Methods and analyses:** This protocol was written according to the Preferred Reporting Items for Systematic Review and Meta-Analysis Protocols (PRISMA-P) guidelines. We will perform a comprehensive search of all observational studies that assessed the relationship between age, gender, race, place, education, income, occupation, social status, and walking distance, time, or speed. Electronic databases (MEDLINE, Web of Science, EMBASE, CINAHL, AgeLine, and SPORTDiscus) will be searched from inception to 28 February 2023. We will supplement the database search by manually searching the reference lists of all identified and relevant full-text articles. Two independent reviewers will be responsible for screening of articles, data extraction, and assessment of bias. We will appraise the study quality and risk of bias using the Prediction Model Risk of Bias Assessment Tool (PROBAST). A meta-analysis will be considered if data from the selected studies are homogeneous; otherwise, a narrative synthesis of the extracted data will be presented.

**Discussion:** Mobility limitation leads to frequent falls, dependency, morbidity, and death among older adults. This review is necessary, to identify and prioritize important sociodemographic factors during older adults' clinical assessment and policy development. It is the first phase of a multi-methods study seeking to develop a prognostic mobility trajectory for community-dwelling older adults. **Systematic Review Registration:** PROSPERO CRD42022298570

## Background

Mobility is a broad term with diverse contextual meanings (Soubra et al., 2019; Webber et al., 2010). In this review protocol, we defined mobility as a person's ability to move around safely and independently with or without a walking aid (Carver et al., 2016). Mobility is fundamental to active ageing, health status, and quality of life (Freiberger et al., 2020; Soubra et al., 2019; Webber et al., 2010). Mobility limitation is an early predictor of physical disability (Hirvensalo et al., 2000), leading to frequent falls, dependency, and death among older adults (Carver et al., 2016; Freiberger et al., 2020; Hirvensalo et al., 2000). The prevalence of mobility limitation among older adults ranged from 22.5% to 46.5%, in developed countries (Musich et al., 2018). The World Health Organisation defined older adults as people aged 60 years and above (WHO, 2021). Older adults and researchers are keenly interested in understanding the factors that influence mobility and ways to maximize movement potential in older adulthood (Bennell et al., 2011; Soubra et al., 2019; Webber et al., 2010).

Webber and colleagues have conceptualized a comprehensive older adults' mobility model including cognitive, environmental, financial, personal, physical, psychological, and social factors (Webber et al., 2010). However, biophysical, and psycho-cognitive aspects of older adults' mobility are more frequently researched, creating a literature gap on the implications of the sociodemographic factors (Kalu et al., 2022). Exploring the influences of demographic and socioeconomic factors may further our understanding of the risks of mobility limitation in older adults. The demographic factors to be considered in this review are age, gender, race, and location (Ruggero et al., 2013; Zaninotto et al., 2013), while the socioeconomic determinants will be income, occupation, education, and social status (Busch et al., 2015; Plouvier et al., 2016; Russo et al., 2006; Wani, 2019; Welmer et al., 2013).

Knowledge of the impact of sociodemographic factors on older adults' mobility would assist clinicians and policymakers to develop strategies for the management of mobility decline among older adults. We propose to conduct the first systematic review of the association between sociodemographic factors and mobility in older adults. A recent scoping review (Kalu et al., 2022) examined the effect of social interactions, cognition, and psychological factors on older adults' mobility without emphasis on sociodemographic determinants. Therefore, we propose to conduct this review to synthesize the association between sociodemographic factors and performance-based walking outcomes including walking distance, time, and speed among community-dwelling older adults.

**Review Questions**

1. What is the direction of the association between sociodemographic factors and walking outcomes among community-dwelling older adults as reported in literature published from 1946 to 2023?
2. What is the size of the association between sociodemographic factors and walking outcomes among community-dwelling older adults as reported in literature published from 1946 to 2023?

**PEOT criteria**

The *population* of the review will include community-dwelling older adults aged 60 years and older. The *exposure* will include sociodemographic factors: age, gender, race, marital status, location, income, occupation, education, and social status (Wani, 2019). The *primary outcome* will include performance-based walking parameters such as walking distance, time, and speed. Outcome measures will include timed-up and go (TUG), short physical performance battery (SPPB), six-minute walk test (6MWT), ten-metre walk test (10MWT), habitual gait speed (HGS),

and backward walking (BW) (Soubra et al., 2019). The review will cover the time between the inception of the oldest database and 2023 (1946 to 28 February 2023).

**Systematic Review Team Members**

The primary investigator (OKO) will organize and coordinate this review process: development of the research questions, search strategies, screening of relevant articles, data extraction and analyses, and manuscript preparation. The content expert will include review authors OAA, ACO, and MEK (who are experts in older adults' mobility). Two review authors OKO and MEK will independently screen the citation for article and abstract inclusion and OKO and OA will perform the full-text screening and independently extract data from the included studies. A subject librarian (DRS) who is an expert in systematic review search methodology and OKO will develop the search strategies for all the included databases and conduct the literature search. Literature synthesis will be completed by OKO, OA, and MEK who are knowledgeable in systematic and scoping reviews. Statistical analysis will be done by OAA and ACO who are experts in meta-analysis.

**Methods**

**Protocol and registration**

This protocol has been registered within the International Prospective Register of Systematic Reviews (PROSPERO; registration number: CRD42022298570) (Onyeso et al., 2022). This protocol was written according to the guidelines of the Preferred Reporting Items for Systematic Reviews and Meta-Analyses Protocols (PRISMA-P) (Moher et al., 2015). We also adhered to the recommendations of Meta-analysis of Observational Studies in Epidemiology (MOOSE) (Stroup et al., 2000). Any amendments to this protocol will be documented and published alongside the results of the systematic review.

**Eligibility criteria**

**Inclusion criteria**

Studies will be included if they (1) were observational studies evaluating mobility in apparently healthy community-dwelling older adults (≥ 60 years), (2) described an association between any of the sociodemographic variables and walking parameters identified in this study, (3) were published between 1946 and 28 February 2023, and (4) were published in the English language only. (5) There will be no restriction regarding publication country, race, and gender. To be included in the meta-analysis part of the study, a study should provide the zero-order associations between sociodemographic factors and walking parameters or provide sufficient information for these associations (effect sizes) to be calculated and transformed into odds ratios (Bramer et al., 2017).

**Exclusion criteria**

Studies will be excluded if focused on older adults (1) that non-ambulatory, (2) with cognitive or neuromuscular diseases such as disabling stroke, parkinsonism, Alzheimer's disease, or dementia, (3) residing in an institutionalized or continuing care facility, and (4) the data is overlapping or a duplicate of an already included study (we will choose the most recent publication).

**Outcome measures**

The outcomes will be walking distance, time, and speed measured with performance-based tests (PBTs) such as TUG, SPPB, 6MWT, UG, HGS, 10MWT, and BW (Soubra et al., 2019). Walking distance is defined as the distance (metres) covered during a timed walking test (e.g.,6MWT); walking time is the time taken (seconds) to complete a specific distance (e.g., 10MWT); and walking speed is defined as walk distance divide by walk time (m/s, e.g., HGS test).

**Information sources**

Following the Bramer et al. (2017) recommendation on electronic search databases combination, we intend to search Ovid MEDLINE, Web of Science, Ovid EMBASE, EBSCO CINAHL, EBSCO AgeLine, and EBSCO SPORTDiscus from inception to 28 February 2023. A draft MEDLINE search strategy developed by the subject librarian and the primary investigator was provided in Appendix D.

**Search strategy development**

Search terms were identified through consultations between the primary investigator, content experts, and the librarian, and a review of the titles and abstracts of six seed articles gathered by the primary investigator (Busch et al., 2015; Plouvier et al., 2016; Ruggero et al., 2013; Russo et al., 2006; Welmer et al., 2013; Zaninotto et al., 2013). Elements of search strings developed for previously published reviews also informed the search strategy development (Allen et al., 2020; Chastin et al., 2021; Green et al., 2021).

The draft MEDLINE search strategy will be peer-reviewed by another librarian who is not part of this review and comments will be addressed. Afterward, the search strategy will be translated into different syntax recognized by each database. Subject headings (e.g., MeSH), Boolean operators, proximity operators, truncation and phrase searching will be used appropriately as shown in Appendix D.

**Data management**

The results of the search from the different databases will be exported to EndNote 20 (a citation manager) and duplicates will be removed. After removing duplicates, the articles will be exported to Rayyan – a web-based systematic review management tool (Ouzzani et al., 2016) that will be used for the title, abstract, and full-text screening. Included and excluded articles will be

exported to and organized in EndNote 20 for the generation of the PRISMA flow chart and in-text citations.

**Study selection and data extraction**

We will adopt a two-stage screening (title and abstract screening, and full-text screening) to select eligible studies. At the two stages of screening, two review authors will independently screen for studies that are relevant to the objectives of this review using the selection criteria. There will be a pilot screening before the full-text screening. Two review authors (OKO and OA) will independently screen 50 studies; their results will be compared and resolved to maximize inter-reviewer agreement ahead of the full-text screening process. Similarly, data extraction will be done independently by two review authors (OKO and OA) and piloted on a small sample of selected studies using a standardized data extraction form set up on a Microsoft Excel spreadsheet (Appendix H). Conflict arising through this process will be resolved by a third review author (OAA). Following the description by Lipsey and Wilson (2001), and Khaliq et al. (2022), we will extract the following information from each study: citation details such as first author, year and country of publication, study design (cohort, case control, cross-sectional, or longitudinal study), sample size, participants' demographic (age, sex/gender, race, location), socioeconomic factors studied (income, occupation, education, and social status), all the names of PBTs and other mobility assessment instruments used, the measured outcomes, and the statistical methods implemented including the descriptive summary of the outcomes and inferential results such correlation coefficients, odd ratios, relative risks, their effect sizes and p-values (Appendix H).

**Risk of bias and quality assessment**

The Prediction Model Risk of Bias Assessment Tool (PROBAST) (Wolff et al., 2019) will be used to assess the internal validity of the included studies. The study participation, attrition, risk

factor measurement, outcome measurement, confounding factor, statistical analysis, and report completeness can be assessed and rated as low, moderate, or high risk of bias. Two review authors (OKO and OA) will complete the assessment independently and discrepancies will be resolved by another review author (OAA). The quality of evidence for the main outcome across the studies will be assessed using the GRADE approach (Huguet et al., 2013), and rated high, moderate, low, or very low based on the confidence in the effect estimate, a summary of the risk of bias assessment, imprecision, and indirectness.

## Data Analysis

### *Narrative synthesis*

A narrative synthesis will be used to analyze the results of all included studies, and the association between socioeconomic factors and walking parameters will be classified by direction and strength: correlation coefficients <0.3 were interpreted as a weak association, 0.4 to 0.6 as a moderate association, and >0.6 as a strong association (Akoglu, 2018). Studies will be categorized according to the PBTs that were assessed (Soubra et al., 2019), and the association between each primary outcome and any of the sociodemographic factors under review will be compared between studies that used the same PBT (Rooney et al., 2019).

### *Meta-analysis*

Studies will be grouped according to their designs, such that, case-control, cohort, cross-sectional, and longitudinal studies will be analyzed and reported separately. Due to anticipated sociodemographic changes over time, both aggregate (1946 to 2023) and separate analyses (20 years intervals; 1946 to 1966, 1967 to 1987, 1988 to 2008, 2009 to 2023) will be conducted for studies based on time-lagged data to determine the direction of associations over time. Comprehensive Meta-Analysis (CMA, version 3) software will be used to conduct the meta-

analysis (Borenstein et al., 2014). The overall synthesized measure of effect size will be reported with odd ratios (95% CI). The mean of the combined effect sizes will be calculated in studies where several effect sizes were reported from the same sample (e.g., models with different control variables) (Nielsen et al., 2018). An overall estimate will be calculated for studies with overlapping samples. In studies reporting effect sizes from independent subgroups (e.g., moderators), each subgroup will be included as a unique sample in the meta-analysis. Moderation analyses will also be used to compare associations from cross-sectional and prospective data. The CMA weights studies by inverse variance (Borenstein et al., 2014), which is a method of aggregating multiple random variables where each random variable is weighted in inverse proportion to its variance to minimize the variance of the weighted average (Nielsen et al., 2018). The inverse variance is approximately proportional to sample size, but it is a more nuanced measure and serves to minimize the variance of the combined effect (Borenstein et al., 2007).

As the individual studies included cannot be expected to come from the same population of studies, the pooled mean effect size will be calculated using the random-effects model (Nielsen et al., 2018). Such effects models are thus recommended when accumulating data from a series of studies where the effect size is assumed to vary from one study to the next and where it is unlikely that studies are functionally equivalent (Borenstein et al., 2007). Random effects models allow statistical inferences to be made to a population of studies beyond those included in the meta-analysis (Berkeljon & Baldwin, 2009).

An $I^2$ statistic will be computed as an indicator of heterogeneity in terms of percentages. Increasing values show increasing heterogeneity, with values of 0% indicating no heterogeneity, 50% indicating moderate heterogeneity, and 75% indicating high heterogeneity (Berkeljon & Baldwin, 2009). The “one-study-removed” procedure will be used as a sensitivity analysis to

determine whether the overall estimates between sociodemographic factors and mobility limitations are influenced by outlier studies. Using this approach, effect sizes that fall outside the 95th confidence interval of the average effect size will be considered outliers (Borenstein et al., 2021). Three indicators of publication bias are to be examined: funnel plot, Rosenthal's Fail-Safe N, and Egger's regression intercept. A Forest plot will be constructed for the included studies.

**Discussion**

The proposed systematic review will be impactful in the field of ageing research, clinical practice, policy formulation, and for the entire society. Gerontology has become a spotlight area due to the increase in population ageing, life expectancy, and age-related chronic diseases. By the next three decades, the global population of older adults will rise from eight hundred million to two billion people (Bloom et al., 2015). Thus, it can be predicted that age-related mobility limitations will increase the burden on social, economic, and healthcare systems (Freiberger et al., 2020; Webber et al., 2010). Most importantly, studies on older adults' mobility have been biased towards the biophysical factors, yet sociodemographic determinant is a significant factor in access to health and healthy ageing (Kalu et al., 2022). This study will quantify and synthesize the various sociodemographic determinants of mobility in older adults as available in the literature so far and proffer recommendations on the critical directions for future research.

Mobility limitation is an early predictor of physical disability, leading to frequent falls, dependency, morbidity, and death among older adults (Freiberger et al., 2020; Webber et al., 2010). Geriatricians need this type of review to know the magnitude and direction of associations between sociodemographic factors and mobility decline. The outcome of this review will be necessary to develop prognostic models for geriatric care. Knowing the modifiable and non-

modifiable determinants of mobility decline as envisaged in this study is fundamental for policy design and implementation (Freiberger et al., 2020).

The implication for society and policymakers is that all of us are ageing by the day, and the health of our aged dependents is our collective responsibility as a society. Social justice, equity, and fairness demand that our policies should be formed and implemented in cognizance of sociodemographic inequalities. National resources, infrastructures, basic amenities, and social welfare should be distributed in consideration of the real, perceived, and potential impacts of the mobility decline in the ageing population.

**Limitations**

The meta-analysis will include studies with cross-sectional designs, and the aggregated effect sizes will therefore not account for the cause-and-effect relationship between the included variables (Nielsen et al., 2018).

**Declarations**

**Ethics and consent to participate**

Ethical approval is not required for this systematic review because we are not planning to collect any new data, we intend to analyze secondary data already available in scientific databases (Nielsen et al., 2018).

**Consent for publication**

Not applicable.

**Availability of data and materials**

Not applicable.

**Competing interests**

The authors declare that they have no competing interests.

**Funding**

There was no external funding for this study.

**Authors' contributions**

OKO and OAA conceived this study. OKO, ACO, OA, and MEK designed the study. OKO, OAA, ACO, DRS, OA, and MEK drafted the manuscript. OKO and DRS developed the search strategy. All authors contributed to the refinement of the study protocol, reviewed, and provided feedback on the manuscript and approved the final manuscript. OKO serves as the guarantor of the manuscript. The authors read and approved the final manuscript.

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## CHAPTER 5: MANUSCRIPT TWO

# Association between sociodemographic factors and mobility among older adults: a systematic review and meta-analysis

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**Abstract**

**Background:** Mobility limitation is associated with poor quality of life, morbidity, and mortality among older adults. This pre-registered systematic review [PROSPERO CRD42022298570] synthesized the coefficients of association between sociodemographic factors and performance-based mobility outcomes in older adults (≥ 60 years).

**Methods:** Electronic databases MEDLINE, WoS, EMBASE, CINAHL, AgeLine, and SPORTDiscus were searched from inception to 27 November 2023 for observational studies reporting an association between sociodemographic factors and performance-based mobility outcomes among older adults. Pairs of reviewers independently conducted title, abstract, and full-text screening, narrative synthesis, and meta-analysis following the PRISMA and MOOSE guidelines. The effect sizes, heterogeneity, dominance, and publication bias were analyzed using R-studio (version 4.3.2) and CMA (version 4).

**Results:** Of the 9,328 studies screened, 57 were included (*n* = 130,060 participants); the pooled mean age was 69.81 ± 7.21years, habitual gait speed (HGS) = 1.01 ± 0.28m/s, and time-up and go score = 7.67 ± 3.56s. The narrative synthesis showed that the majority of the studies found older age (92.2%), women (62.9%), non-Caucasian (75.0%), and lower education (64.5%) associated with significant mobility outcomes. There was a paucity of studies on marital status, area of residence, income, occupation, religion, homeownership, and social status. Meta-analysis showed that older age r = -0.37 [-0.42, -0.32] and female gender r = -0.13 [-0.22, -0.03] were moderately associated with slower HGS.

**Conclusion:** Various sociodemographic factors, including age, gender, race, and education, were found to influence mobility outcomes in older adults. However, there is a need for broader studies

covering income, occupation, homeownership, area of residence, marital status, religion, and social status and their implications for mobility.

**Keywords:** Ageing, Community-dwelling, Gait speed, Mobility decline, Social determinants of health, Social gerontology, Socioeconomic

**Systematic review registration:** PROSPERO CRD42022298570

## Background

Mobility is the ability of an individual to ambulate safely and independently, with or without a walking aid (Maresova et al., 2023; Reijnierse et al., 2023). Mobility is crucial for performing activities of daily living and impacts an individual's independence and overall health (Freiberger et al., 2020; Hirvensalo et al., 2000; Maresova et al., 2023). Mobility limitation has dire consequences for older adults, including physical disability and institutionalization (Hirvensalo et al., 2000), frequent falls and injuries (Webber et al., 2010), sedentary behaviour and dependency (Freiberger et al., 2020; Satariano et al., 2012), depression (Iezzoni et al., 2001), social isolation (Mezuk & Rebok, 2008), reduced quality of life (Shafrin et al., 2017), and death (Hirvensalo et al., 2000).

This review focuses on older adults aged 60 years and older (World Health Organization, 2021). The review is timely given that the projected increase in the global population of older adults between now and 2050 will place an unprecedented strain on the health, economic, and social systems of countries (World Health Organization, 2021). There is a paucity of systematic literature reviews and meta-analyses on the broader sociodemographic determinants of mobility in older adults. Recent scoping reviews focused on cognitive, psychological, and environmental factors with little emphasis on social behaviour (Kalu et al., 2023; Kalu et al., 2022). Understanding the sociodemographic factors contributing to mobility decline among older adults is essential for formulating policies on ageing, allocating resources, and implementing geriatric interventions (National Institute on Aging, 2020).

Life course and social determinants of health theories propounded that the accumulation of intersecting social disadvantages leads to disparity in health outcomes in later life (Marengoni & Calderon-Larrañaga, 2020). Grounded on these theories, we conceptualized that mobility decline

in older adults may be associated with cumulative sociodemographic influences, such as age, gender, marital status, area of residence, income, education, occupation, religion, social status, house ownership, and race or ethnicity (Onyeso et al., 2023). Hence, we conducted a systematic review and meta-analysis of the association between sociodemographic factors and performance-based walking outcomes among community-dwelling older adults. The performance-based mobility outcomes included walk speed, time, and distance, measured through timed-up and go (TUG), habitual/usual gait speed (HGS), and time- and distance-specified walk tests (Soubra et al., 2019).

The research questions were as follows: (1) What is the direction of the association between sociodemographic factors and performance-based walking outcomes among community-dwelling older adults as reported in literature published from 1947 to 2023? and (2) What is the pooled effect size of the association between sociodemographic factors and performance-based walking outcomes among community-dwelling older adults?

## Methods

### Protocol and registration

The protocol (Onyeso et al., 2023) was registered within the International Prospective Register of Systematic Reviews (PROSPERO, CRD42022298570). The review was conducted and reported in adherence to the updated Preferred Reporting Items for Systematic Reviews and Meta-Analyses (PRISMA-2020) (Page et al., 2021), the PRISMA-2020 checklist is provided in Appendix C, and the Meta-analysis of Observational Studies in Epidemiology (MOOSE) guidelines (Stroup et al., 2000).

Due to the nature of the extracted data, we deviated from the published protocol as follows: (1) the pooled effect size was correlation coefficient (r) instead of odds ratio, (2) the risk of bias

(ROB) assessment tool was changed from Prediction Model Risk of Bias Assessment Tool (PROBAST) to Joanna Briggs Institute's (JBI) ROB appraisal checklist for analytic cross-sectional studies, (3) we conducted meta-analysis regardless of $I^2$ statistics > 75%, (4) subgroup analysis of studies within 20-year intervals from 1947 to 2023 was not feasible because of limited number of included studies before 2009, (5) to facilitate the interpretation of the effect size (r), only zero-order and not partial correlation were included in the meta-analysis, and (6) the review timeline was amended and the search end date was extended from 28 February to 27 November 2023.

**Population, exposure, outcome, and timeline (PEOT) criteria**

The study *population* was community-dwelling older adults aged 60 years and older. The *exposure* was sociodemographic factors: age, gender, marital status, area of residence, income, education, occupation, religion, social status, house ownership, and race or ethnicity. The *outcome* was performance-based walking outcomes: walking distance (m), time (s), and speed (m/s) obtained through timed-up and go test (TUG – 3 m and 8 ft), short physical performance battery (SPPB – gait speed component), timed walk test e.g. six-minute walk test (6MinWT), distance walk test e.g. ten-metre walk test (10MWT), and habitual gait speed (HGS) (Soubra et al., 2019). The review *timeline* was from the inception of the oldest included database (EMBASE,1947) to 27 November 2023.

**Eligibility criteria**

*Inclusion criteria*

Studies were included if they (1) described an association between any of the sociodemographic variables and walking distance, time, or speed, (2) included older adults with a mean age ≥ 60 years, and (3) were observational studies published in the English language between 1947 and 27 November 2023.

*Exclusion criteria*

Studies were excluded if (1) the target population were non-ambulatory, hospitalized, institutionalized, or continuing care facility residents, (2) conducted among older adults with specific disease conditions, including cancer, stroke, parkinsonism, Alzheimer's disease, dementia, arthritis, sarcopenia, diabetes, chronic obstructive pulmonary disease, and organ failures, such as kidney or heart failure, and (3) the data were overlapping or a duplicate of an already included study.

**Information sources**

Following Bramer and colleagues' recommendation on electronic databases combination (Bramer et al., 2017), MEDLINE (Ovid), EMBASE (Ovid), Web of Science, AgeLine (EBSCO), SPORTDiscus (EBSCO), and CINAHL (EBSCO) were searched from inception to 27 November 2023 by a health sciences librarian (DRS).

**Search strategy**

Search terms were identified through consultations between the primary investigator (OKO), content experts (OAA, ACO, OA, MEK, VJ and JD), and the librarian (DRS), and a review of the titles and abstracts of six seed articles gathered by the primary investigator (Brunner et al., 2009; Busch et al., 2015; Granic et al., 2018; Plouvier et al., 2016; Ruggero et al., 2013; Welmer et al., 2013). Elements of search strings developed for previously published reviews also informed the search strategy (Allen et al., 2020; Chastin et al., 2021; Green et al., 2021). Following the publication of the review protocol, the search strategy was reviewed by another librarian using the Peer Review of Electronic Search Strategies (PRESS) checklist (McGowan et al., 2016), and several minor revisions were made based on the feedback provided. The search strategy was first developed for MEDLINE (Figure 5.1) and then adapted for the other five databases (Appendix D).

When possible, subject headings from controlled vocabularies (e.g., MeSH) were used in the search. The search sensitivity was enhanced by entering concepts in the search string as keywords with truncation (e.g., ethnic*) and proximity operators (e.g., adj5) used when appropriate. Boolean operators connected subject headings and keywords, as shown in Figure 5.1.

**Data management and Study selection**

The retrieved articles' bibliographic information, including title, abstract, authors, publication metadata, and subject headings, was imported into EndNote 20 for deduplication (Bramer et al., 2017). After removing duplicate records, the articles were exported to Covidence, a systematic review management software (Kellermeyer et al., 2018), and screened in two phases: title/abstract and full-text screening. Two independent reviewers from the authorship list, randomly assigned by Covidence, completed the screening, with the software automatically assigning a third independent reviewer (OKO, CJA, IIA, or KMO) to resolve conflicts. Similarly, a pair of independent reviewers (OKO, CJA, or MEK) simultaneously completed the data extraction and risk of bias (ROB) assessment within Covidence using customized templates (Moola et al., 2020; Onyeso et al., 2023). The authors (OKO, CJA, IIA, and OA) hand-searched the reference lists of the included articles.

**MEDLINE Search Strategy for the Systematic Review**

1. exp Aged/ [MeSH]
2. (elderly or senior or seniors or "older adult" or "older adults" or geriatric or geriatrics or "old people" or older-age or "old age" or "older people").ti,ab.
3. or/1-2
4. Mobility Limitation/ [MeSH]
5. Walking Speed/ [MeSH]
6. ((walk* or gait* or ambulat* or locomot*) adj5 (speed* or pace* or difficult*)).ti,ab.
7. (mobilit* adj5 limit*).ti,ab.
8. or/4-7
9. Social Determinants of Health/ [MeSH]
10. exp Socioeconomic Factors/ [MeSH]
11. ((social or socioeconomic or economic or population*) adj3 (determinant* or factor* or risk* or equity or equities or inequit* or inequal* or equality or equalities or disparit*)).ti,ab.
12. (health adj3 (determinant* or equity or equities or inequit* or inequal* or equality or equalities or disparit*)).ti,ab.
13. "determinants of health".ti,ab.
14. exp Ethnic Groups/ [MeSH]
15. exp Continental Population Groups/ [MeSH]
16. (ethnic* or race or racial* or immigrant*).ti,ab.
17. exp Gender Identity/ [MeSH]
18. Sex/ [MeSH]
19. (gender* or sex).ti,ab.
20. exp Income/ [MeSH]
21. (((social or socioeconomic or economic) adj3 (status* or class*)) or income or poverty).ti,ab.
22. exp Employment/ [MeSH]
23. (employ* or unemploy* or occupation*).ti,ab.
24. or/9-23
25. 3 and 8 and 24
26. limit 25 to English language

Note: MeSH = medical subject heading; exp = used with a MeSH term to include all narrower MeSH terms; .ab, .ti = field codes for abstract and title, respectively; adj# = search for records with terms within # words of each other; * after keyword indicates truncation (e.g., ethnic* will retrieve “ethnic”, “ethnicity”, “ethnicities”, etc.)

**Figure 5.1: MEDLINE search strategy for the systematic review**

**Data Items**

A data extraction sheet, as outlined in the protocol by Onyeso et al. (2023), was set up in Covidence and tested on a small sample of selected studies. The setup allowed two randomly paired reviewers (OKO, CJA, IIA, or MEK) to independently extract data, with OKO and CJA adjudicating any discrepancies. Consistent with the methodologies described by Lipsey and Wilson (2001) and Khaliq et al. (2022), we extracted key information from each study, including the first author's surname, the year and country of publication, the study design (e.g., cohort, case-control, cross-sectional, or longitudinal), the sample size, the sociodemographic characteristics of participants, the mobility assessment tests used, and a descriptive summary of the outcomes. Additionally, we collected inferential statistical results, such as correlation and regression coefficients, effect sizes, standard errors, standard deviations, confidence intervals, and p-values.

**Risk of bias quality assessment**

Two reviewers (OKO and CJA) independently evaluated the Risk of Bias (ROB) using the 8-item Joanna Briggs Institute's (JBI) ROB appraisal checklist for analytic cross-sectional studies (Moola et al., 2020) and met to resolve any conflict. This checklist helped in assessing the internal validity of the studies, examining aspects such as the clarity of inclusion criteria, descriptions of participants and settings, measures of exposure, conditions and outcomes, confounding factors, and statistical analysis. Each item was rated as "Yes = 1", "Unclear = 0", or "No = 0". The overall risk assessment was conducted by assigning each study a score from 0 to 8, with the total scores used to classify the studies into three ROB categories: High (0–3), Medium (4–5), and Low (6–8).

**Data Analysis**

The units of analysis were sociodemographic factors, mobility test, study design (cross-sectional and longitudinal studies), and type of inferential statistics (test of differences, bivariate,

and multivariate association). A narrative synthesis was conducted to illustrate the direction of effects across all included studies. The synthesis for each sociodemographic factor was reported under the headings: bivariate analyses (including simple linear regression, Pearson correlation, and test of differences, such as t-test and analysis of variance) and multivariate analyses.

The meta-analysis included only studies that reported a bivariate association (zero-order correlation) between a sociodemographic factor and walking parameter or provided sufficient information to calculate these associations (Bramer et al., 2017). The Comprehensive Meta-Analysis (version 4) (Borenstein et al., 2021) and R software (version 4.3.2, 'metafor' and 'robumeta' packages) (Quintana, 2015) were used for quantitative synthesis. The overall estimate was computed for studies with overlapping samples. In cases where studies reported effect sizes from independent subgroups, each subgroup was treated as a separate sample in the meta-analysis (Nielsen et al., 2018). The effect sizes (correlation coefficients) were transformed to Fisher's z-scores to adjust for normal distribution (Quintana, 2015). The inverse variance method was employed, which reduces the variance of the weighted average of effect sizes (Borenstein et al., 2007; Nielsen et al., 2018). The pooled mean effect size was then calculated using a random-effects model (Nielsen et al., 2018), which is suitable for drawing statistical inferences from studies of a heterogeneous population and generalizing beyond the included studies (Berkeljon & Baldwin, 2009). The pooled estimates were presented using Forest plots.

Heterogeneity was evaluated by visually examining the Forest plots, the p-value of Cochran's Q test ($p < 0.05$), and the $I^2$-statistic value. An $I^2$ statistic of 0% indicates no heterogeneity, 50% indicates moderate heterogeneity, and 75% indicates high heterogeneity (Higgins et al., 2003). The influence analysis, Cook's distance ($D$), was calculated to identify studies with overt dominance in the meta-estimates; a threshold of $D > 0.5$ was used to qualify a

study as influential (Quintana, 2015). Where necessary, "one-study-removed" sensitivity analysis was applied to reduce subgroup heterogeneity, considering effect sizes outside the 95% confidence interval of the mean effect size as outliers (Borenstein et al., 2021). Publication bias was assessed using three indicators: funnel plot, Rosenthal's Fail-Safe N, and Egger's regression intercept.

## Results

### Study characteristics

The search across six databases yielded 17,170 results, of which 7,842 duplicates were removed. The PRISMA flowchart (Figure 5.2) details the screening process of 9,328 abstracts, leading to the exclusion of 8,910 studies that did not meet the inclusion criteria. Seven of the remaining 428 articles could not be retrieved through the library's collection or interlibrary loan. The 421 retrieved full texts were assessed, and 57 were selected for analysis. No additional articles were found through hand-searching their references.

The studies were conducted across 25 countries between 1989 to 2023 (Figure 5.3). The studies' characteristics (Appendix E) showed that 50 employed cross-sectional analyses, five were longitudinal, and two employed both designs. The review involved a total sample of 130,060 participants with a pooled mean ± SD age of 69.81 ± 7.21 years (95% CI: 69.77 - 69.85), ranging from 60.25 to 80.90 years. The sample was 58.2% women, 60.1% married, and 72.7% identified as Caucasian. The pooled average HGS = 1.01 ± 0.28 m/s (95% CI: 1.01, 1.05), range 0.52 to 1.37 and TUG = 7.67 ± 3.56 s (95% CI: 7.61, 7.73) range 5.71 to 12.6 reflected the general mobility status of the study populations. Table 5.1 summarized the narrative synthesis, indicating that 92.1% of the unique analyses found older age associated with mobility limitations. Other significant factors included being female (64.7%), non-Caucasian (62.5%), and having lower educational attainment (64.5%). Studies on marital status, area of residence, income, occupation,

religion, homeownership, and social status were few and presented inconsistent results (Appendix H). Only some studies addressing age and gender met the criteria for meta-analysis, as highlighted in the data analysis section.

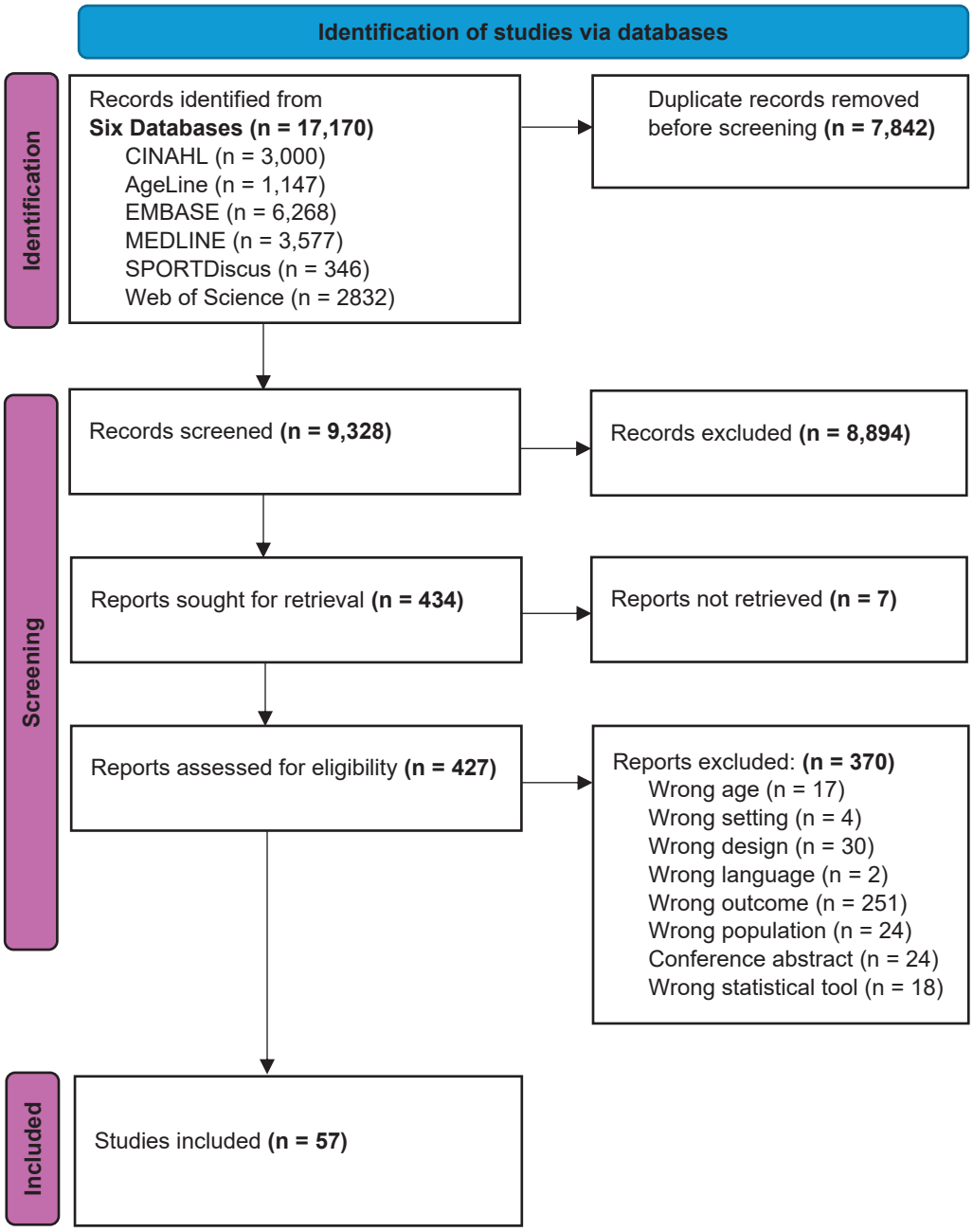


**Figure 5.2: PRISMA flowchart.**

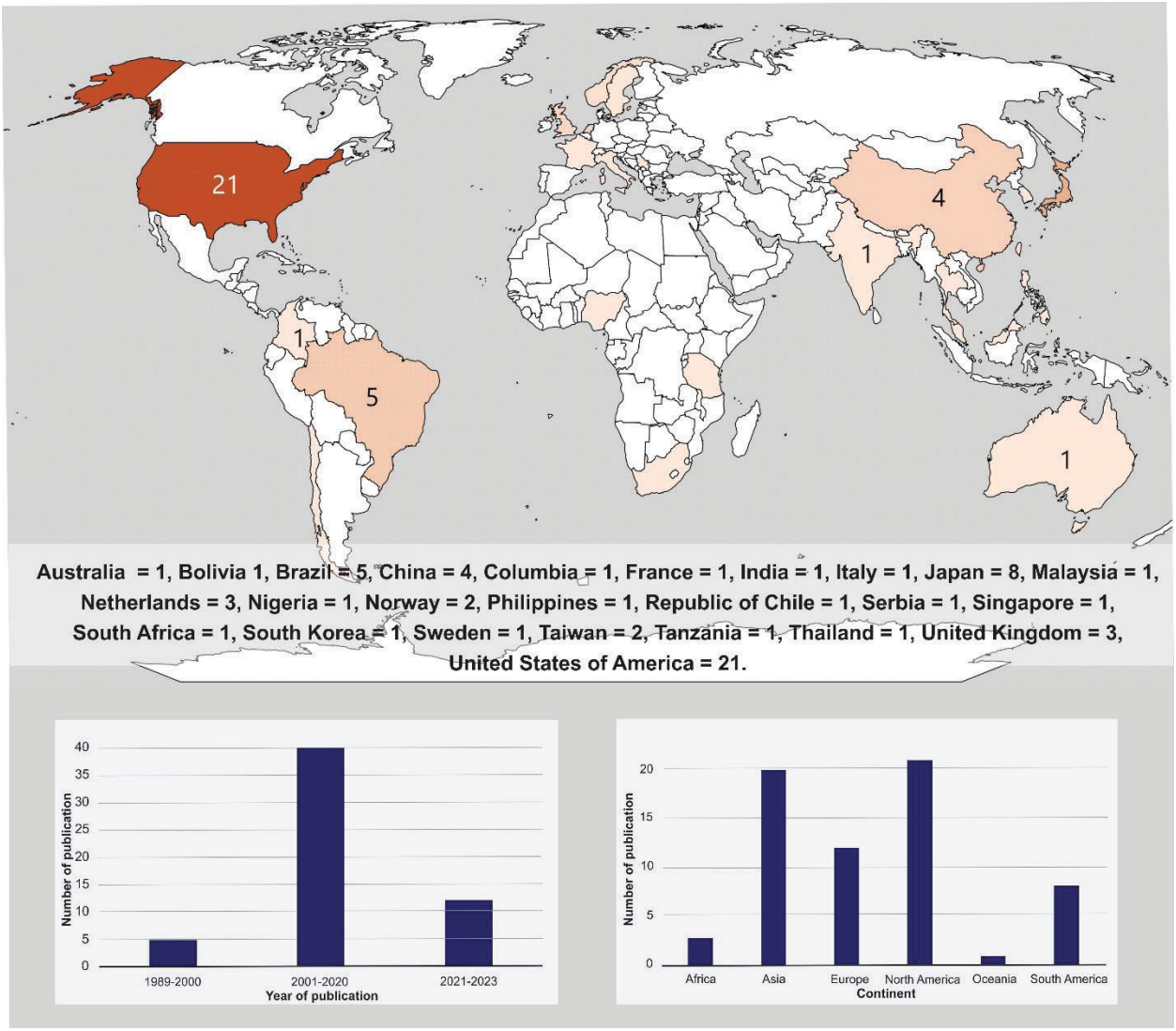


**Figure 5.3: Periods and countries where included studies were conducted.**

**Table 5.1: Summary of the narrative synthesis of the association between sociodemographic factors and mobility outcome**

| Result | Cross-sectional analysis *f*(%) | | Longitudinal analysis *f*(%) | | Total *f*(%) |
|---|---|---|---|---|---|
| | Bivariate | Multivariate | Bivariate | Multivariate | |
| **Age** | | | | | |
| Older age → significantly lower mobility | 39 (92.9) | 26 (92.9) | 2 (66.7) | 4 (100.0) | 71 (92.2) |
| Younger age → significantly lower mobility | - | - | - | - | - |
| Result was not statistically significant. | 3 (7.3) | 2 (7.1) | 1 (33.3) | - | 6 (7.8) |
| **Gender** | | | | | |
| Men → significantly higher mobility | 24 (63.2) | 18 (66.7) | 1 (33.4) | 1 (50.0) | 44 (62.9) |
| Women → significantly higher mobility | 1 (2.6) | - | 1 (33.3) | - | 2 (2.9) |
| Result was not statistically significant. | 13 (34.2) | 9 (33.3) | 1 (33.3) | 1 (50.0) | 24 (34.2) |
| **Marital status** | | | | | |
| Married/has partner → significantly higher mobility | 1 (100.0) | 1 (50.0) | 1 (100.0) | - | 3 (75.0) |
| Has no partner → significantly higher mobility | - | - | - | - | 0 (0.0) |
| Result was not statistically significant. | - | 1 (50.0) | - | - | 1 (25.0) |
| **Race** | | | | | |
| Caucasians → significantly higher mobility | 7 (77.8) | 4 (100) | 1 (33.3) | - | 12 (75.0) |
| Non-Caucasians → significantly higher mobility | 1 (11.1) | - | - | - | 1 (6.2) |
| Result was not statistically significant. | 1 (11.1) | - | 2 (66.7) | - | 3 (18.8) |
| **Education level** | | | | | |
| High education → significantly higher mobility | 14 (93.3) | 6 (60.0) | - | - | 20 (64.5) |
| Low education → significantly higher mobility | - | 1 (10.0) | 1 (33.3) | 1 (33.3) | 3 (9.7) |
| Result was not statistically significant. | 1 (6.7) | 3 (30.0) | 2 (66.7) | 2 (66.7) | 8 (25.8) |
| **Income level** | | | | | |
| High income → significantly higher mobility | 1 (50.0) | 2 (100.0) | - | 1 (100.0) | 4 (80.0) |
| Low income → significantly higher mobility | - | - | - | - | - |
| Result was not statistically significant. | 1 (50.0) | - | - | - | 1 (20.0) |
| **Occupation type** | | | | | |
| Manual job → significantly higher mobility | - | - | - | - | - |
| Non-manual job → significantly higher mobility | 2 (66.7) | - | - | - | 2 (66.7) |
| Result was not statistically significant. | 1 (33.3) | - | - | - | 1 (33.3) |
| **Area of residence** | | | | | |
| Urban residents → significantly higher mobility | 1 (100.0) | - | - | - | 1 (50.0) |
| Rural residents → significantly higher mobility | - | 1 (100.0) | - | - | 1 (50.0) |
| Result was not statistically significant. | - | - | - | - | - |
| **Homeownership** | | | | | |
| Homeowners → significantly higher mobility | - | - | - | 1 (100.0) | 1 (100.0) |
| Non-homeowners → significantly higher mobility | - | - | - | - | - |
| Result was not statistically significant. | - | - | - | - | - |
| **Social status** | | | | | |
| High social status → significantly higher mobility | - | 1 (100.0) | 1 (100.0) | - | 2 (66.7) |
| Low social status → significantly higher mobility | - | - | - | - | - |
| Result was not statistically significant. | 1 (100.0) | - | - | - | 1 (33.3) |
| **Religious participation** | - | - | - | - | |

NB: The total number of studies included was 57, but some analyzed multiple independent datasets.

## Age

*Bivariate analysis*

Forty-nine of the 57 studies reported the influence of age on older adults' mobility. Older age was significantly associated with slower HGS, as reported in 96.4% of the cross-sectional bivariate analyses (Asher et al., 2012; Bendall et al., 1989; Bohannon, 2008; Boulifard et al., 2019; Brunner et al., 2009; Buchner et al., 1996; Busch et al., 2015; Butler et al., 2009; Coelho-Junior et al., 2021; Dommershuijsen et al., 2022; Fang & Jiang, 2020; Kamiya et al., 2019; Lin et al., 2021; Lunar et al., 2019; Makizako et al., 2017; Mantel et al., 2019; Payne et al., 2017; Ramírez-Vélez et al., 2020; Ruggero et al., 2013; Seino et al., 2014; Sprague et al., 2023; Staples et al., 2020; Tanaka et al., 2022; Tangen & Robinson, 2020; Thaweewannakij et al., 2013; Watson et al., 2010; Welmer et al., 2013). Similarly, poorer TUG performance (Coelho-Junior et al., 2021; Ibrahim et al., 2017; Milanović et al., 2013; Mohammed et al., 2021; Rikli & Jones, 1999; Staples et al., 2020; Tangen & Robinson, 2020; Thaweewannakij et al., 2013; Yaoxin et al., 2022) and 6MinWT performance (Kamiya et al., 2019; Rikli & Jones, 1999; Thaweewannakij et al., 2013) were significantly associated with older age. However, three studies found no significant age-group difference in HGS (Bohannon et al., 1996) and TUG scores (Tangen & Robinson, 2020; Thompson & Medley, 1995). Two longitudinal bivariate analyses reported a significant decline in TUG among the older age groups after six (Gomes et al., 2023) and nine-year follow-ups (Idland et al., 2013), and no significant difference in HGS was found (Gomes et al., 2023).

*Multivariate analysis*

Cross-sectional multivariate analyses showed that older age was significantly associated with slower HGS (Asher et al., 2012; Binotto et al., 2019; Bohannon, 2008; Boulifard et al., 2019; Busch et al., 2015; Chiles Shaffer et al., 2020; Granic et al., 2018; Lin et al., 2021; Makizako et

al., 2017; Payne et al., 2017; Ramírez-Vélez et al., 2020; Ruggero et al., 2013; Schrack et al., 2012; Seino et al., 2014; Shubert et al., 2006; Sialino et al., 2019; Smolar et al., 2012; Staples et al., 2020; Thaweewannakij et al., 2013; Wu & Zhao, 2021), poorer TUG (Al Snih et al., 2008; Ibrahim et al., 2017; Iwakura et al., 2022; Staples et al., 2020; Thaweewannakij et al., 2013), and 6minWT performances (Kamiya et al., 2019). Two cross-sectional studies found no significant multivariate association between HGS and age (Fiser et al., 2010; Mantel et al., 2019). However, longitudinal multivariate analyses showed a significant association between age and mobility (HGS and TUG) decline after a three-year (Jerome et al., 2015; Vasunilashorn et al., 2009), five-year (Thorpe et al., 2011), and nine-year (Idland et al., 2013) follow-up.

*Meta-analysis*

The meta-analysis of 22 cross-sectional bivariate analyses (Figure 5.4) showed that older age correlated significantly with slower gait speed. The pooled effect size ($r$) = -0.37 (95% CI: -0.42, -0.32), $p < 0.001$. Cochran's $Q = 253.68$, $p < 0.001$, $I^2 = 92.1\%$ suggests substantial heterogeneity among the studies. Rosenthal's Fail-Safe ($N$) = 35.14 and Egger's Regression Intercept ($b$) = -0.388, $p = 0.763$, show no evidence of publication bias. None of the studies overtly influenced the pooled estimate ($D < 0.5$).

The "one-study-removed" sensitivity analyses produced no significant difference in the heterogeneity indices. However, the simultaneous removal of seven studies (Bendall et al., 1989; Bohannon et al., 1996; Butler et al., 2009; Coelho-Junior et al., 2021; Ramírez-Vélez et al., 2020; Sprague et al., 2023; Staples et al., 2020) whose estimate fell outside the 95% CI, yielded a remarkable difference in heterogeneity, $Q = 159.54$, $p < 0.001$, $I^2 = 71.7\%$ and effect estimate $r$ = -0.42 (95% CI: -0.49, -0.38), $p < 0.001$. There was no statistical evidence of publication bias; Rosenthal's $N = 80.55$ and Egger's $b = -0.448$, $p = 0.554$.

The meta-analysis of six studies reporting the effect of age on TUG (Figure 5.5) showed a pooled effect size $r = 0.31$ (95% CI: 0.28, 0.34), $p < 0.001$, with a low heterogeneity $Q = 5.73$, p = 0.333, $I^2 = 0.1\%$ and no statistical evidence of publication bias (Rosenthal's $N = 85.64$ and Egger's $b = 0.292$, $p = 0.459$). One study (Mohammed et al., 2021) with a high correlation coefficient ($r = 0.81$, $n = 100$) was excluded from the analysis as a severe outlier. The longitudinal analysis subgroups for HGS and TUG did not meet the criteria for meta-analysis.

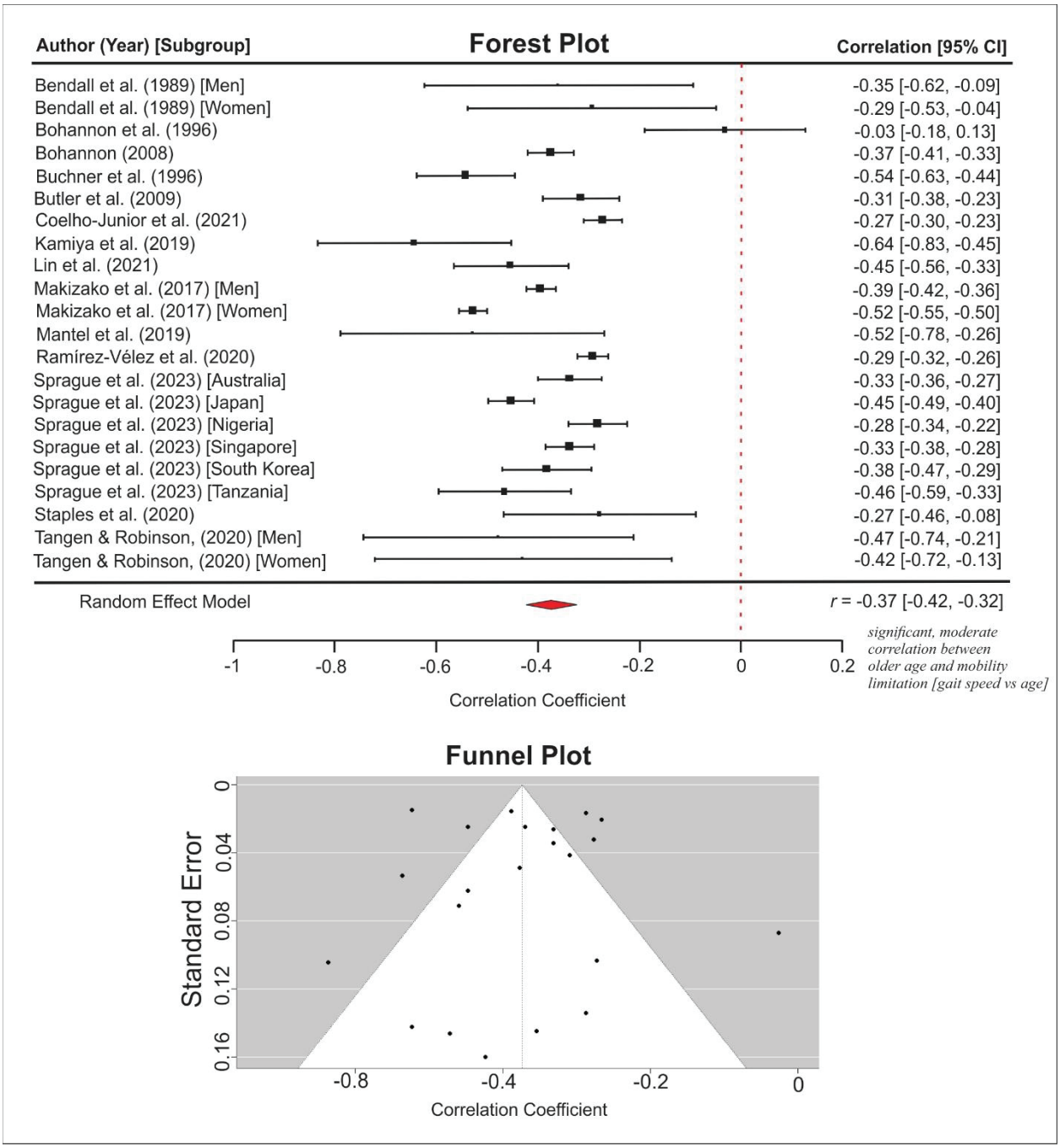


**Figure 5.4: Meta-analysis of the association between age and habitual gait speed.**

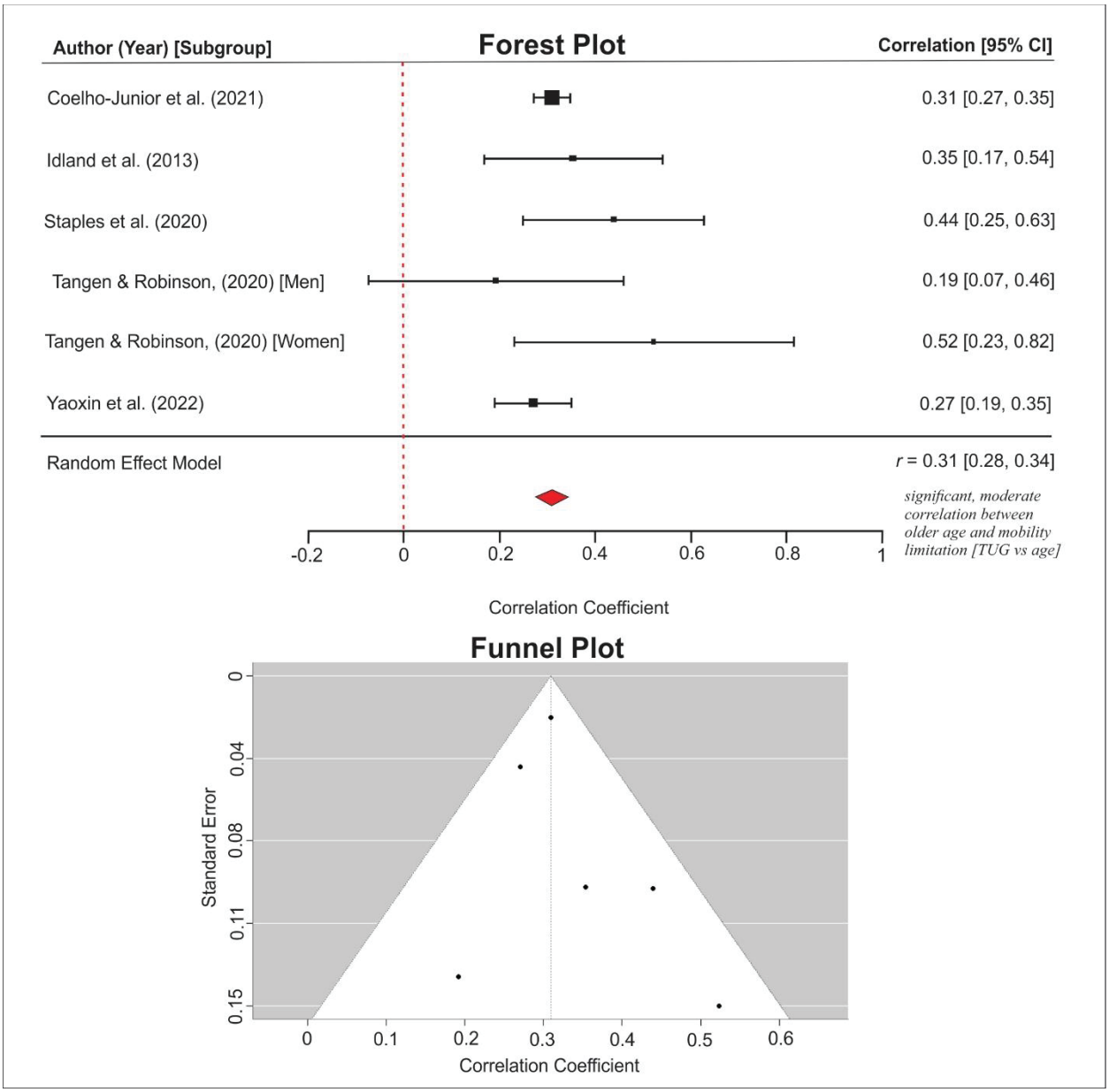


**Figure 5.5: Meta-analysis of the association between age and timed-up and go score.**

## Gender and sex at birth

*Bivariate analysis*

Forty-five of the 57 studies reported the effect of gender or sex at birth on older adults' mobility. Most cross-sectional bivariate analyses reported significantly faster HGS for men compared with women (Asher et al., 2012; Bendall et al., 1989; Bohannon, 2008; Bohannon et al., 1996; Boulifard et al., 2019; Brunner et al., 2009; Buchner et al., 1996; Butler et al., 2009; Fiser et al., 2010; Lin et al., 2021; Payne et al., 2017; Ramírez-Vélez et al., 2020; Seino et al., 2014; Sialino et al., 2019; Sprague et al., 2023; Thaweewannakij et al., 2013; Watson et al., 2010; Welmer et al., 2013). However, Sprague et al. (2023) found the reverse in a Japanese dataset. The rest of the studies found no significant difference (Blanco et al., 2012; Busch et al., 2015; Carvalho de Abreu et al., 2021; Dommershuijsen et al., 2022; Fang & Jiang, 2020; Makizako et al., 2017; Mantel et al., 2019; Ruggero et al., 2013; Sprague et al., 2023; Tanaka et al., 2022). For walk distance, three studies reported that men covered longer distances during 6MinWT (Kamiya et al., 2019; Rikli & Jones, 1999; Thaweewannakij et al., 2013), but Kamiya et al. (2019) result was not significant. Cross-sectional bivariate analyses showed that men had better TUG scores than women (Ibrahim et al., 2017; Rikli & Jones, 1999; Thaweewannakij et al., 2013; Thompson & Medley, 1995), but two studies found the outcome not statistically significant (Mohammed et al., 2021; Yaoxin et al., 2022). Two longitudinal bivariate analyses of HGS decline gave contrasting results. Gomes et al. (2023) six-year follow-up found women, but Sialino et al. (2021) 15-year follow-up found men to have more HGS decline. However, Gomes et al. (2023) found no statistically significant gender differences in TUG decline.

*Multivariate analysis*

Most of the multivariate analyses showed that being a man was significantly associated with faster HGS (Asher et al., 2012; Binotto et al., 2019; Bohannon, 2008; Bohannon et al., 1996; Boulifard et al., 2019; Carvalho de Abreu et al., 2021; Granic et al., 2018; Lin et al., 2021; Payne et al., 2017; Ramírez-Vélez et al., 2020; Schrack et al., 2012; Seino et al., 2014; Thaweewannakij et al., 2013; Wheaton & Crimmins, 2016). The remaining studies found no statistically significant gender effect (Fiser et al., 2010; Makizako et al., 2017; Mantel et al., 2019; Shubert et al., 2006; Smolar et al., 2012; Tangen & Robinson, 2020). In terms of the time of completion of walking tasks, three cross-sectional analyses showed that being a man was significantly associated with a shorter time (Al Snih et al., 2008; Ibrahim et al., 2017; Thaweewannakij et al., 2013), while two studies found no significant gender association (Iwakura et al., 2022; Tangen & Robinson, 2020). Similarly, Thaweewannakij et al. (2013) cross-sectional analyses found male gender as a significant predictor of a longer walking distance among older adults, while Kamiya et al. (2019) found the same effect direction but not statistically significant. In a 15-year longitudinal multivariate model, Sialino et al. (2021) found a significant association between HGS decline and woman gender. Vasunilashorn et al. (2009) reported no statistical significance after a three-year follow-up.

*Meta-analysis*

The meta-analysis of four cross-sectional bivariate studies suggested that being a woman was associated with slower HGS. The pooled effect size $r = -0.13$ (95% CI: -0.22, -0.03), $p = 0.007$ (Figure 5.6). There was a moderate heterogeneity $Q = 7.03$, $p = 0.071$, $I^2 = 62.6\%$, and no statistical evidence of publication bias; Rosenthal's $N = 2.12$ and Egger's $b = -0.011$, $p = 0.095$. Only the cross-sectional bivariate HGS subgroup met the criteria for meta-analysis.

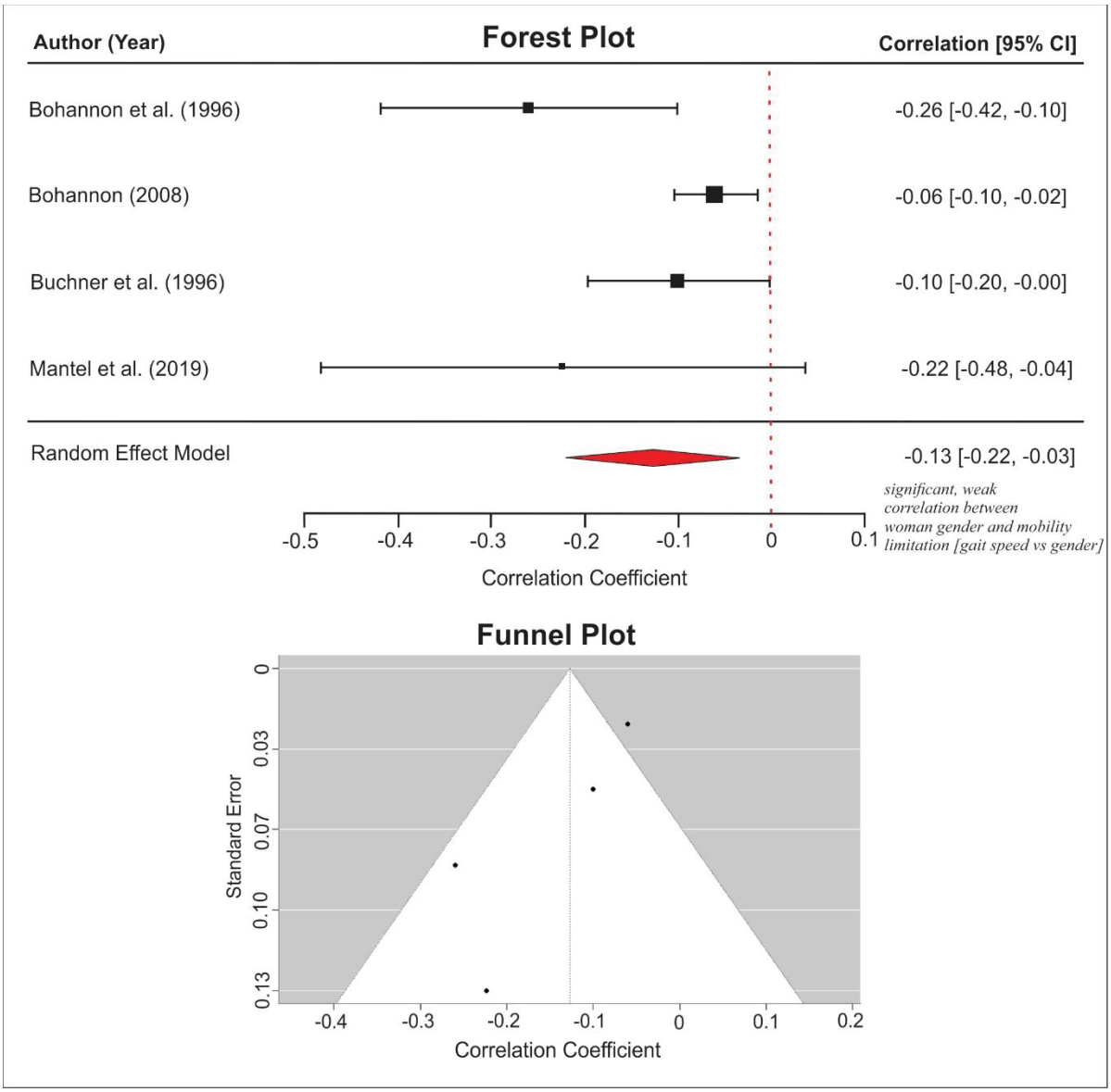


**Figure 5.6: Meta-analysis of the association between gender and habitual gait speed.**

**Marital status**

*Bivariate analysis*

Four of the 57 included studies reported the influence of marital status on mobility among older adults. A cross-sectional (Brunner et al., 2009) and longitudinal (Gomes et al., 2023) bivariate analysis reported that those who were married or with partners had significantly better HGS than those without partners or unmarried. Furthermore, Gomes et al. (2023) reported that people with no partner had a more significant decline in TUG scores.

*Multivariate analysis*

Cross-sectional multivariate analyses conducted by Payne et al. (2017) and Al Snih et al. (2008) showed a positive influence of having a partner or being married on the HGS and 8ft walk test, respectively. Payne et al. (2017) result was statistically significant, but Al Snih et al. (2008) was not.

**Race**

*Bivariate analysis*

Twelve studies conducted a race-based analysis of mobility in older adults. Five bivariate cross-sectional analyses showed that Caucasians had significantly better HGS (Blanco et al., 2012; Boulifard et al., 2019; Brunner et al., 2009; Granic et al., 2018; Smolar et al., 2012; Watson et al., 2010), but a study reported no significant results (Busch et al., 2015). Conversely, a study reported that the Japanese had better HGS than Caucasians (Aoyagi et al., 2001). Regarding timed walk tests, a cross-sectional bivariate analysis by Al Snih et al. (2008) showed that Caucasians had significantly better 8ft WT scores than non-Caucasians. A six-year longitudinal analysis by Gomes et al. (2023) showed that Caucasians had a lesser but not statistically significant HGS and TUG

decline. However, Thorpe et al. (2011), in a five-year longitudinal analysis, showed that Caucasians had significantly less HGS decline.

*Multivariate analysis*

All the cross-sectional multivariate analyses – four studies reported that being Caucasian was significantly associated with better HGS relative to other races, especially Blacks (Blanco et al., 2012; Boulifard et al., 2019; Chiles Shaffer et al., 2020; Smolar et al., 2012). No study reported a race-based longitudinal multivariate analysis.

**Education**

*Bivariate analysis*

Twenty-two of the 57 studies reported the impact of education on mobility in older adults. About 93% of the cross-sectional bivariate analyses showed that higher education attainment was significantly associated with better HGS (Asher et al., 2012; Busch et al., 2015; Dommershuijsen et al., 2022; Lin et al., 2021; Ruggero et al., 2013; Watson et al., 2010; Welmer et al., 2013) and TUG scores (Barrera et al., 2017; Yaoxin et al., 2022). Additionally, Sprague et al. (2023) analyzed six datasets and found higher education associated with better HGS, except for a Nigerian dataset that showed no significant result. A six-year follow-up longitudinal bivariate analysis reported that people with higher education had a significantly high HGS decline, but less and non-significant TUG decline (Gomes et al., 2023). Similarly, Idland et al. (2013) reported that people with lower education had a lower TUG decline, but this was not statistically significant.

*Multivariate analysis*

Six cross-sectional multivariate analyses showed that higher education was significantly associated with better HGS (Boulifard et al., 2019; Busch et al., 2015; Granic et al., 2018; Lin et al., 2021; Welmer et al., 2013) and TUG scores (Al Snih et al., 2008), but three studies found no

significant association between education attainment and HGS (Chiles Shaffer et al., 2020; Payne et al., 2017; Smolar et al., 2012). Conversely, Staples et al. (2020) reported that higher education was associated with poorer TUG performance. A five-year longitudinal multivariate analysis showed that higher education was significantly associated with less HGS decline (Thorpe et al., 2011), while Vasunilashorn et al. (2009) three-year and Sialino et al. (2021) 15-year follow-up found no significant association.

**Income**

*Bivariate analysis*

Five studies reported the influence of income on the mobility of older adults. One cross-sectional bivariate analysis reported that high-income earners had significantly better HGS than low-income earners (Brunner et al., 2009), while another study found no significant association between income and HGS (Ruggero et al., 2013).

*Multivariate analysis*

Two cross-sectional multivariate analyses showed that high-income earners had significantly better HGS than low-income earners (Boulifard et al., 2019; Chiles Shaffer et al., 2020). A five-year longitudinal multivariate analysis showed that low income significantly predicted HGS decline (Thorpe et al., 2011).

**Occupation**

Three cross-sectional studies reported the association of manual (unskilled) and non-manual (skilled) jobs with mobility in older adults. Welmer et al. (2013) (bivariate) and Plouvier et al. (2016) (multivariate) reported significantly higher HGS in older adults with non-manual than manual occupations. However, bivariate analysis by Yaoxin et al. (2022) found no significant job-type-related differences in TUG scores.

### Area of residence

Two cross-sectional studies reported contrasting findings on the implications of urban and rural residence on older adults' mobility. Compared to rural residents, urban residents had significantly higher HGS and 6MinWT scores in bivariate analyses (Lunar et al., 2019) or slower gait speed within a multivariate-adjusted model (Boulifard et al., 2019).

### Homeownership

One study reported a five-year follow-up longitudinal multivariate analysis showing that not owning one's home was significantly associated with HGS decline (Thorpe et al., 2011).

### Social status

Only three of the included studies reported the impact of social status on mobility. A cross-sectional bivariate analysis showed that people with higher social status had better HGS, though the outcome was not statistically significant (Brunner et al., 2009). However, a six-year follow-up longitudinal bivariate analysis reported a significant decline in HGS and TUG performances of older adults with low relative to high socioeconomic status (Gomes et al., 2023). Similarly, a 15-year follow-up longitudinal multivariate analysis showed that lower social participation was associated with significant HGS decline (Sialino et al., 2021).

### Study Risk of Bias

The overall ROB of the included studies is presented in Figure 5.7. Detailed ROB evaluations for each study are presented in Appendix G. Among the 57 included studies, 51 (89.5%) exhibited a low ROB, while six (10.5%) demonstrated a moderate ROB, with none categorized under high risk of bias. The average ROB score was 7.

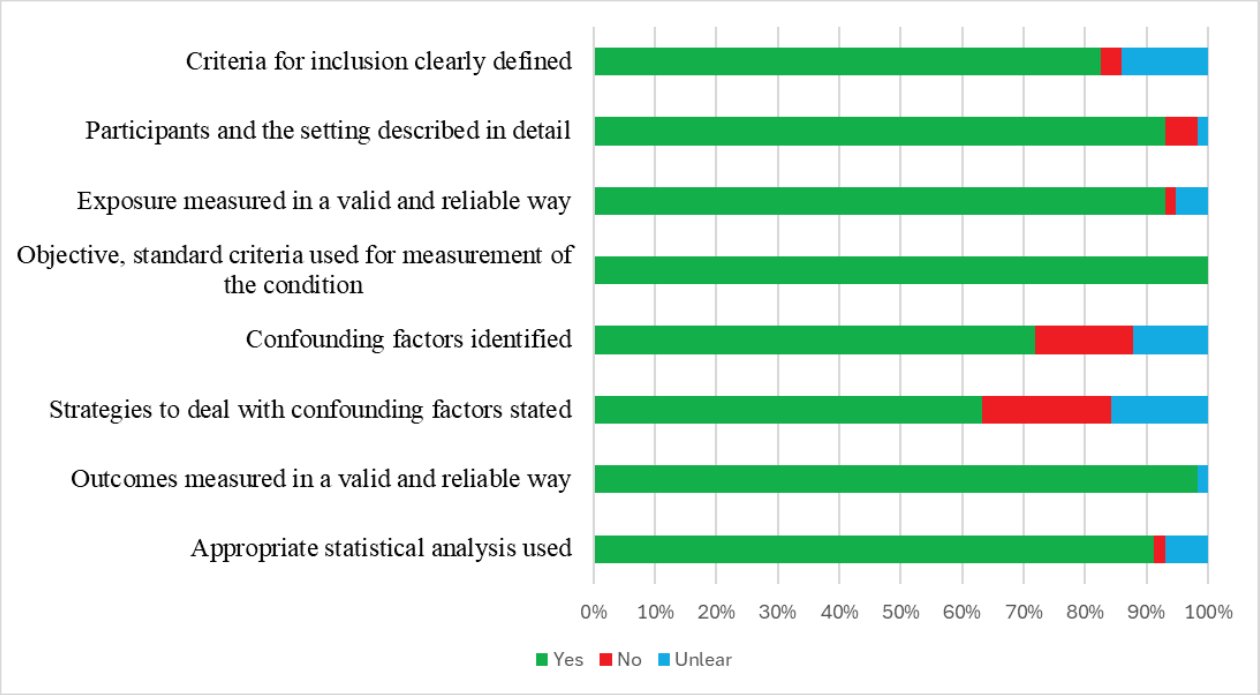


**Figure 5.7: Joanna Briggs Institute's checklist for risk of bias of all included studies.**

## Discussion

The review aimed to determine the direction and magnitude of the association between sociodemographic factors and performance-based mobility outcomes among older adults from studies published in English up to 27 November 2023. Concerning the direction of the association, the majority of studies suggest that older age, being female/woman, single or without a partner, non-Caucasian race, lower level of formal education, and lower income were significantly associated with lower mobility scores. Three or fewer studies examined the effects of occupation type, area of residence, homeownership, and social status; these studies were inconsistent, thus limiting our ability to draw reliable conclusions. Additionally, no studies on religious participation met the inclusion criteria. Regarding effect magnitude, meta-analyses of cross-sectional bivariate results showed that older age and being female/woman were moderately correlated with lower mobility scores. No other subgroup met the set inclusion criteria for meta-analysis.

The review was grounded in the life course and socio-determinant of health theories (Allen et al., 2020; Elder et al., 2003; Marengoni & Calderon-Larrañaga, 2020). From these theoretical frameworks, we conceptualized that accumulated sociodemographic disadvantages could differentially affect mobility experiences among older adults (Mohd Talmizi et al., 2021). The findings were interpreted through the lens of the socio-determinants of health, providing an alternative perspective to the biophysical models. It is essential to note that three of the eleven sociodemographic factors in this review: age, sex, and race, can be explained through socially constructed and biophysical mechanisms. The physiological implications of old age, sex, and race have been well-established within the biophysical models; however, social scientists argue for a social perspective that addresses how the cumulative effects of ageism, sexism, and racism can be superimposed on the biophysical model.

Human ageing naturally leads to biological decline, including mobility limitation. However, ageist actions, including the medicalization of old age, older adult abuse and neglect, forced retirement, institutionalization, and systematic exclusion during policymaking, can negatively impact the mobility potentials of older adults (Criss et al., 2022; National Institute on Ageing, 2024). Governments should develop national policies for healthy ageing, including social security, rights protection and caregiving support for older adults (World Health Organization, 2020).

Sex differences in anatomy and physiology are evident, with biophysical impacts often emerging at older age (Tibaek et al., 2015; Valentine et al., 2009; Wheaton & Crimmins, 2016). However, some socioculturally constructed gender roles, including unpaid and unrecognized labour relating to childbirth, childrearing, housekeeping, and discriminatory practices, may predispose women to earlier mobility decline than men (Sialino et al., 2021; Yavorsky et al., 2015). To mitigate the life course impact of some socially constructed women's work overload, we concur with Yavorsky et al. (2015) on the spousal division of labour.

Race is another social construct with biological intricacies. Some racial differences may have a genetic basis in human senescence, but racism creates systematic disadvantages that can affect older adults' mobility, as seen between American Blacks and Caucasians (Thorpe et al., 2011). In a multiracial society, Caucasians, especially males, occupy positions of privilege with better access to health, financial resources, social status and quality of life (Dixon, 2019; Hobbs, 2018). Beyond racism, racial identity aligns with cultural practices, such as dietary patterns (Parsons et al., 2019), health-seeking behaviours (Lie et al., 2012) and beliefs on healthy ageing (Löckenhoff et al., 2009), which may influence older adults' mobility. However, investment in

education can mitigate the impacts of racism and culture through its effect on socioeconomic status and health literacy (Lie et al., 2012).

Socioeconomic factors, including education (Kyrönlahti et al., 2021; Welmer et al., 2013), occupation (Beltrán-Sánchez et al., 2017; Plouvier et al., 2016), and income (Shumway-Cook et al., 2005), affect mobility independently and collectively (Coppin et al., 2006; Rautio et al., 2005). Though socioeconomic factors may not have a direct biophysical effect, they influence mobility indirectly through psychological and sociobehavioural mediation on healthy ageing (Coppin et al., 2006). Education determines occupation type and income, which in turn influences mobility in older adults (Beltrán-Sánchez et al., 2017). Beltrán-Sánchez et al. (2017) reported a significant influence of job type, education, and wealth on mobility in older adults, with emphasis on the negative impact of physically demanding jobs, even after controlling for age and sex. A conducive sociopolitical environment, including formal education, employment opportunities, and social insurance, will enable healthy ageing, including mobility in later life (World Health Organization, 2020).

There was a paucity of studies to make inferences on marital status, area of residence, homeownership, and social status. However, related literature reviews have shown the benefits of marriage for older adults, including companionship, co-caregiving, higher household incomes, life satisfaction, social participation, and better health (Lambert, 2004) and mixed results on the association between marital status and physical activities (Mohd Talmizi et al., 2021). Specifically, studies reported that married older adults had lesser mobility difficulties compared to unmarried (Hossain et al., 2021; Umstattd Meyer et al., 2014) and people who lost their spouses, especially widows (Perkins et al., 2016; Sengupta & Agree, 2002). Widowed older adults may be encouraged to have a partner as a way of maintaining mobility and healthy ageing.

Home type and ownership affect mobility; homeowners are generally more active due to home maintenance, while tenants in shared apartment buildings and institutionalized older adults tend to be less mobile (García-Esquinas et al., 2016; Oswald et al., 2007; Thorpe et al., 2011). Rural and urban areas offer different benefits; rural areas provide natural environments (vegetation, water bodies, social and food security, quality air, and traffic safety) conducive to healthy ageing, while urban areas offer better access to healthcare and recreational services (Lunar et al., 2019). Government ageing policies should prioritize housing security and amenities to support healthy ageing in the community (Wilson et al., 2012).

Our review made obvious the paucity of studies on the association between performance-based mobility outcomes and religious participation. Few studies suggest that religious older adults have better mobility outcomes (Berges et al., 2010; Hill et al., 2016) but none met the inclusion criteria for this review. Similarly, a systematic review of six studies (Amorim et al., 2017) suggests a positive relationship between religiosity and better functional capacity in older adults, possibly due to social support, coping mechanisms, and a sense of purpose provided by religious beliefs and practices.

**Implications for future studies**

This study reveals significant gaps in the literature, including the paucity of studies with a specific objective of examining the sociodemographic factors in mobility trajectory across the life course. Standardizing sociodemographic categories in observational studies, such as consistent categorization of education by years of schooling or levels of educational attainment, would facilitate cross-study comparisons and meta-synthesis of research findings. Reporting both bivariate and multivariate outcomes would allow a better understanding of the crude and adjusted effects of the factors. Longitudinal studies are encouraged, where feasible, to establish modifiable

sociodemographic determinants of performance-based mobility outcomes. Longitudinal studies can also facilitate analysis of sociodemographic interactions in mobility decline trajectory and identify the effect of changes in sociodemographic statuses, such as moving from widowed to married and vice versa.

**Policy implications**

The ageing process affects everyone, making the health of older adults a societal and policy issue. Ageism and other forms of discrimination and inequity can be addressed through cultural reorientation. Social justice and equity require that policies consider sociodemographic inequalities to ensure a fair distribution of national resources, infrastructure, basic amenities, and social welfare, aiming to mitigate mobility decline in the ageing population and to support those with mobility limitations.

**Limitations**

The strength of our study lies in its methodological rigour. However, its limitations include the restriction to English-language articles. The paucity of studies and variations in mobility outcomes and statistical analyses prevented a meta-analysis on marital status, education, income, occupation, homeownership, religion, social status, area of residence, and race. We aggregated correlation coefficients, which do not imply causality (Nielsen et al., 2018).

**Conclusion**

This review elucidates the multifaceted determinants of mobility limitation in older adults, highlighting the significant roles of age, gender, race, and education. While biological ageing inherently affects mobility, social factors such as age, gender, race, and socioeconomic disparities profoundly influence mobility trajectories. The limited research on the impact of marital status, homeownership, religion, income, occupation, social status, and area of residence underscores the

need for comprehensive studies that consider the broad spectrum of sociodemographic factors. Addressing these gaps will enrich our understanding of the sociodemographic influences on mobility in older adults and guide the development of targeted interventions and policies to support active ageing.

## Declarations

### Ethics approval and consent to participate

Not applicable.

### Consent for publication

Not applicable.

### Availability of data and material

The datasets used and/or analyzed during the current study are available from the corresponding author on reasonable request.

### Competing interests

The authors declare that they have no competing interests.

### Funding

There was no external funding for this study.

### Authors' contributions

OKO and OAA conceived this study. OKO, DRS, CJA, MEK, IIA, OA, KMO, ACO, JV, JD, and OAA designed the study. OKO and DRS developed the search strategy. DRS completed the literature search and deduplication. Each author participated in article screening, data extraction, or risk of bias assessment. OKO, CJA, DRS, MKO, and OAA drafted the manuscript.

All authors gave critical input to the final manuscript and approved it for publication. OKO serves as the guarantor of the manuscript.

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# CHAPTER 6: MANUSCRIPT THREE

## Sociodemographic determinants of mobility decline among community-dwelling older adults: findings from the Canadian Longitudinal Study on Ageing.

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**Running Head:** Sociodemographic determinants of mobility decline

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**Abstract**

**Background**: Mobility is fundamental to healthy ageing and quality of life. Mobility decline has been associated with functional impairment, falls, disability, dependency, and death among older adults. We explored the sociodemographic determinants of mobility decline among community-dwelling older Canadians.

**Methods:** This study was a secondary analysis of a six-year follow-up of the Canadian Longitudinal Study on Ageing (CLSA). Our analysis was based on 3882 community-dwelling older adults 65 years or older whose mobility was measured using timed-up and go (TUG) and 4-meter walk (4MWT) tests at baseline and follow-ups 1 and 2 after three- and six-year intervals, respectively. We analyzed the cross-sectional and longitudinal association, main and interaction effects of the participants' sociodemographic characteristics on mobility decline using chi-square, Pearson's correlation, mixed-design repeated measures ANOVA, and bivariate and multivariate linear regression tests.

**Results:** At baseline, 52% of the participants were female, 70.4% were married, and the average age was 68.82 ± 2.78 years. Mean TUG and 4MWT scores were 9.59 ± 1.98 s and 4.29 ± 0.95 s, respectively. There was a strong positive longitudinal correlation between TUG and 4MWT ($r$ = 0.65 to 0.75, $p < 0.001$), indicating concurrent validity of 4MWT. The multivariate linear regression (for TUG) showed that older age (β = 0.088, $p < 0.001$), being a female (β = -0.035, $p < 0.001$), retired (β = -0.058, $p < 0.001$), Canadian born (β = -0.046, $p < 0.001$), non-Caucasian (β = -0.063, $p < 0.001$), tenant (β = 0.050, $p < 0.001$), having no spouse/partner (β = -0.057, $p < 0.001$), household income of $50,000-$99,999 (β = 0.039, $p < 0.001$), wealth/investment lower than $50,000 (β = -0.089, $p < 0.001$), lower social status (β = -0.018, $p = 0.025$), secondary

education and below ($\beta = 0.043$, $p < 0.001$), and living in certain provinces compared to others, were significant predictors of a six-year mobility decline.

**Conclusion:** Our study underscored the impact of modifiable and non-modifiable sociodemographic determinants of mobility trajectory. There is a need for nuanced ageing policies that support mobility in older adults, considering sociodemographic inequalities through equitable resource distribution, including people of lower socioeconomic backgrounds.

**Keywords**: CLSA, Four-meter walk test, Gerontology, Healthy ageing, Independent living, Life course, Mobility limitation, Social determinants of health, Timed-up and go test

## Background

Mobility has been defined in various ways and contexts (Reijnierse et al., 2023), typically emphasizing an individual's ability to move around safely and independently, with or without the use of an assistive device (Carver et al., 2016; Patla & Shumway-Cook, 1999; Soubra et al., 2019; Umstattd Meyer et al., 2014; Webber et al., 2010). In this paper, mobility is conceptualized as an objective measure of ambulation, specifically an individual's movement from one point to another, with or without a walking aid. Maintaining mobility is crucial for older adults as it promotes healthy and successful ageing by enhancing physical health, social engagement, and overall well-being (Chua et al., 2023; Maresova et al., 2023).

Conversely, mobility limitations – the inability to achieve full mobility potential have far-reaching consequences (Shumway-Cook et al., 2005). These include early physical disability and institutionalization (Hirvensalo et al., 2000), frequent falls and injuries (Webber et al., 2010), sedentary behaviour and dependency (Freiberger et al., 2020; Satariano et al., 2012), depression (Iezzoni et al., 2001), social isolation (Mezuk & Rebok, 2008), reduced quality of life (Shafrin et al., 2017), and death among older adults (Hirvensalo et al., 2000). As the global population of older adults continues to rise (World Health Organization, 2021), age-related mobility decline has become a relevant subject worldwide (National Institute on Aging, 2020). In Canada, approximately 20.6% of community-dwelling older adults (65 years and older) have mobility limitations, a trend that increases with age (Bizier et al., 2016). The Canadian older adult population, which was 7.3 million in 2022 (Statistics Canada, 2023), is projected to reach 10.9 million by 2036 (Statistics Canada, 2014). Consequently, mobility decline can be predicted to exert a significant burden on Canadian social, economic, and healthcare systems (Freiberger et al., 2020).

The dire implications of mobility limitations in the ageing population have prompted stakeholders including older adults, caregivers, geriatricians, researchers, and policymakers, to explore modifiable sociodemographic determinants of mobility decline (National Institute on Aging, 2020). While many studies have focused on biomedical factors affecting mobility in older adults, the role of sociodemographic determinants is equally crucial for promoting healthy ageing (Chua et al., 2023; Satariano et al., 2012; Shumway-Cook et al., 2005; Statistics Canada, 2014). However, there is a paucity of research explicitly aimed at estimating the influence of multiple sociodemographic factors on mobility decline among older adults (Kalu et al., 2022; Onyeso et al., 2023). For instance, the influence of marital status, area of residence, income, occupation, religion, homeownership, and social status on mobility trajectories remains understudied.

Understanding the modifiable sociodemographic determinants of mobility decline is essential for preventing total disability in the ageing population (National Institute on Aging, 2020). Such knowledge can inform advocacy efforts for personal characteristic modifications, guide clinical practices, and shape policy design and implementation (Maresova et al., 2023). To gain insights into these determinants, we analyzed the Canadian Longitudinal Study on Aging (CLSA) dataset (Raina et al., 2019). The CLSA contains objective mobility measures, such as the 4-metre walk (4MWT) and timed-up and go (TUG) tests (Bennell et al., 2011; Soubra et al., 2019), and sociodemographic variables, including age, sex, education, rural/urban residence, marital status, religion, ethnicity, culture, income, employment type, retirement, house type and ownership, and wealth (Raina et al., 2019). The longitudinal design and large sample size of the CLSA also enabled the concurrent validation of the normal-paced 4MWT using the TUG test as a criterion. This addresses a critical gap in the literature, as the few existing validation studies on

non-disease-specific, community-dwelling older adult populations have been limited by cross-sectional designs and small sample sizes (Maggio et al., 2016; Peters et al., 2013).

The overarching aim of our study was to estimate the longitudinal association between older Canadians' mobility decline and their sociodemographic characteristics using the CLSA's baseline, follow-up 1 (FU1), and follow-up 2 (FU2) data cycles. We hypothesized that there would be a significant (i) difference in the sociodemographic distribution of the participants at baseline, FU1, and FU2, (ii) correlation between TUG and 4MWT scores at baseline, FU1, and FU2, (iii) mean differences in the participants' TUG and 4MWT scores at baseline, FU1, and FU2 across categories of sociodemographic factors, (iv) zero-order association between TUG and 4MWT scores and sociodemographic factors at baseline, FU1, and FU2, and (v) multivariate longitudinal association between TUG and 4MWT scores and sociodemographic factors.

## Methods

### Data source

The study was a secondary data analysis of CLSA's comprehensive cohort baseline, FU1 and FU2. The CLSA is an ongoing large national bilingual (English and French) longitudinal study that commenced in 2011 with a comprehensive cohort of 30,097 aged 45 to 85 years (Raina et al., 2019). Sociodemographic interviews, biospecimen sampling, and physical measures, including the 4MWT and TUG, were collected in person from this comprehensive cohort at designated data collection centres in their respective cities. The CLSA participants will be followed up in three-year cycles for at least 20 years (Raina et al., 2009).

We selected 3,882 participants who were 65 years and older at baseline, participated in the three data cycles (baseline, FU1 and FU2) at three-year intervals, and never lived in a long-term care facility throughout the study period. Therefore, 113 persons who transitioned to long-term

care facilities during the follow-ups were excluded. The overall CLSA's participant inclusion and exclusion criteria, study protocol, procedures, consent, and ethics approval have been extensively discussed in previous publications (Raina et al., 2019; Raina et al., 2009). The original CLSA protocol was reviewed and approved by 13 university-based ethics committees across Canada (Raina et al., 2009). Furthermore, the Health Research Ethics Board of the University of Alberta approved the study protocol for this CLSA secondary analysis (reference number: Pro00129371). More information about the CLSA can be found at www.clsa-elcv.ca.

**Mobility outcomes**

The outcomes in this study were time (s) of completion of TUG and 4MWT measured with a stopwatch and meter rule (Raina et al., 2009). The TUG, developed in Canada by Podsiadlo and Richardson (1991), has become the most popular comprehensive mobility assessment tool for older adults because it measures functional mobility comprising of gait, balance, and transfer (Soubra et al., 2019). Moreover, it has good psychometric and clinimetric properties among community-dwelling older adults, including a high interclass correlation reliability ($r$ = 0.99) (Podsiadlo & Richardson, 1991) and strong construct validity with gait speed test ($r$ = 0.75) (Steffen et al., 2002). Similarly, the 4MWT has a high interclass correlation reliability ($r$ = 0.96 to 0.98) and strong concurrent validity with the 10-meter walk test ($r$ = 0.93) (Peters et al., 2013).

**Explanatory variables**

The explanatory variables were sociodemographic variables identified in the CLSA, including age, sex, marital status, country of birth, ethnic and cultural identities, province, area of residence, education, occupation, total household income (THI), wealth (value of total savings and investments), homeownership, home type, religious affiliation, retirement status, and social status. Social status was measured using the MacArthur Scale of Subjective Social Status (Adler et al.,

2000), by asking individuals to rank themselves on a 10-rung ladder, indicating where they stand in relation to others in their community.

**Covariates**

The regression models were controlled for covariates, such as smoking, alcoholism, chronic disease status, and self-reported general health (Shumway-Cook et al., 2005).

**Variable description**

Age (years), TUG (s), and 4-MWT (s) were scale variables. The ordinal continuous variables were social status ladder (1-10) and alcohol frequency (1 = never, 2 = less than once monthly, 3 = once monthly, 4 = twice or thrice monthly, 5 = once weekly, 6 = twice or thrice weekly, 7 = four to five times weekly, and 8 = almost daily). The categorical variables were sex (male/ female), marital status (have partner/ do not have a partner), cultural identities (Caucasian/ non-Caucasian), country of birth (Canada/ OECD excluding Canada/ non-OECD), ethnicity (Canada/ French/ English/ Others), area of residence (rural/ urban), province (Alberta/ British Columbia/ Manitoba/ Newfoundland & Labrador/ Nova Scotia/ Ontario/ Quebec), education (secondary and below/ above secondary), occupation (manual/ non-manual), THI (< $50,000/ $50,000 to $99,999/ $100,000 and above), wealth (< $50,000/ $50,000 to < $100,000/ $100,000–< $1M/ $1M and above), home ownership (own/ rent or not own), home type (house/ apartment), religious affiliation (no/ yes), retirement (retired/ partly or not retired), social status (≤3-low/ 4 to 6-middle/ ≥7-high), smoked 100 cigarettes ever (no/ yes), and chronic disease status (no/ yes), general health rating (poor/ good).

**Data analysis**

The data were analyzed using the Statistical Package for Social Sciences (SPSS) version 28. All analysis was completed using the weighted dataset. Participants' sociodemographic and

mobility outcomes were summarized using descriptive statistics: frequency, percentage, mean, and standard deviation.

Before the inferential analysis, the data were tested for the assumptions of the statistical tool. Continuous variables were tested for univariate and multivariate outliers using a standardized Z-score > ±3.29 and Mahalanobis distance approaches (Garson, 2012; Tabachnick & Fidell, 2013). Normality, sphericity, homogeneity of variance, and linearity were determined through Kolmogorov–Smirnov, Mauchly's, and Levene's tests and Q-Q plot, respectively (Garson, 2012; Tabachnick & Fidell, 2013). Multicollinearity was read off the regression output via the variance inflation factor < 4. When multicollinearity occurred, the least important of the affected variables were dropped from the model (Tabachnick & Fidell, 2013). The TUG and 4MWT scores were log-transformed to achieve normality.

Hypothesis I was tested using Pearson's chi-square test ($\chi^2$). Hypothesis II was tested using repeated measures mixed-design ANOVA ($F$), with Greenhouse-Geisser correction reported where Mauchly's test of sphericity was violated. The post hoc pairwise comparisons were Bonferroni adjusted, and the Games-Howell test was applied where Levene's test of homogeneity of variance was violated. Hypothesis III was tested using a bivariate linear regression, with the standardized regression coefficient (β) reported. Hypothesis IV was tested using simultaneous entry multivariate linear regression, with the standardized coefficient (β) reported. Hypothesis V was tested using Pearson's product-moment correlation coefficient ($r$). The alpha level was set at 0.05 for all the inferential statistics.

## Results

### Sociodemographic characteristics

A total of 3882 participants were included in the analyses, and 52.4% were females. The participants' mean age (years) ± SD was 68.88 ± 2.80 at baseline, 71.81 ± 2.81 at FU1, and 74.65 ± 2.83 at FU2. The TUG scores were 9.70 ± 2.01s at baseline, 10.26 ± 2.25s at FU1, and 10.90 ± 2.50s at FU2. The 4MWT scores were 4.37 ± 1.05s at baseline, 4.50 ± 1.06s at FU1, and 4.63±1.03s at FU2.

At baseline, 0.3% could not walk without aid, 0.3% at FU1, and 0.8% at FU2. On a ten-step social status ladder (1 to 10), participants' mean self-rating was 6.17 ± 1.88 at baseline and 6.53 ± 1.87 at FU1; the data were not collected at FU2. Other sociodemographic characteristics collected at baseline were language of data collection (English = 75.6%, French = 24.4%), cultural identity (Caucasian = 96.8%, non-Caucasian = 3.2%), ethnicity (Canada = 34.4%, French = 10.5%, English = 26.9%, others = 28.2%), country of birth (Canada = 79.7%, OECD excluding Canada = 16.8%, non-OECD = 3.5%), religious affiliation (no = 19.2%, yes = 80.8%), and education level (secondary or less = 33.7%, above secondary 66.3%). Between baseline and FU1, 3.9% of the participants gained education, 12.9% became more religious, 6.7% less religious, 5.9% changed marital status, while between FU1 and FU2, 2.0% gained education, 11.2% became more religious, 7.2% less religious, 6.1% changed marital status. Table 6.1 shows no significant difference in participant distribution across the province of residence, occupation type, sex, wealth, and household income categories across the cycles.

**Table 6.1: Participants' sociodemographic characteristics (n = 3882)**

| Parameters | Percentage (%) | | | df | $\chi 2$-statistic | *p*-value |
|---|---|---|---|---|---|---|
| | Baseline | FU1 | FU2 | | | |
| Sex | | | | 4 | 8.047 | 0.090 |
| Female | 52.4 | 52.4 | 52.2 | | | |
| Male | 47.6 | 47.6 | 47.7 | | | |
| Others | 0.0 | 0.0 | 0.1 | | | |
| Marital Status | | | | 8 | 30.122 | <0.001* |
| Single | 4.5 | 4.7 | 4.5 | | | |
| Married/ Common law | 76.5 | 74.7 | 71.5 | | | |
| Widowed | 8.9 | 11.2 | 14.5 | | | |
| Divorced/ Separated | 10.1 | 9.4 | 9.5 | | | |
| Province | | | | 12 | 0.236 | 1.000 |
| Alberta | 5.7 | 5.7 | 5.7 | | | |
| British Columbia | 24.0 | 24.1 | 24.1 | | | |
| Manitoba | 8.9 | 8.9 | 8.9 | | | |
| Newfoundland/ Labrador | 3.1 | 3.1 | 3.1 | | | |
| Nova Scotia | 7.6 | 7.6 | 7.6 | | | |
| Ontario | 25.4 | 25.3 | 25.3 | | | |
| Quebec | 25.3 | 25.3 | 25.3 | | | |
| Area of residence | | | | 2 | 26.867 | <0.001* |
| Rural | 10.0 | 6.4 | 6.2 | | | |
| Non-rural | 90.0 | 93.6 | 93.8 | | | |
| Occupation | | | | 2 | 1.663 | 0.435 |
| Manual | 16.2 | 13.7 | 17.6 | | | |
| Non-manual | 83.8 | 86.3 | 82.4 | | | |
| Retirement status | | | | 2 | 358.740 | <0.001* |
| Retired | 72.3 | 83.0 | 88.5 | | | |
| Partly retried/ Not retired | 27.7 | 17.0 | 11.5 | | | |
| Home | | | | 4 | 43.254 | <0.001* |
| House (semi-/detached) | 81.4 | 78.5 | 75.5 | | | |
| Apartment or condominium | 18.3 | 20.4 | 23.1 | | | |
| Others | 0.4 | 1.1 | 1.4 | | | |
| House ownership | | | | 2 | 25.173 | <0.001* |
| Own | 86.6 | 85.3 | 82.3 | | | |
| Rent/ Not own | 13.4 | 14.7 | 17.7 | | | |
| Total Household Income | | | | 8 | 5.926 | 0.655 |
| Less than $20,000 | 5.9 | 5.2 | 5.2 | | | |
| $20,000 - $49,999 | 33.2 | 34.7 | 34.5 | | | |
| $50,000 - $99,999 | 42.0 | 41.4 | 40.5 | | | |
| $100,000 - $149,999 | 12.2 | 12.3 | 13.3 | | | |
| $150,000 and above | 6.7 | 6.4 | 6.5 | | | |
| Wealth (investments) | | | | 6 | 7.614 | 0.268 |
| Less than $50,000 | 23.6 | 24.9 | 25.7 | | | |
| $50,000 - <$99,999 | 16.1 | 16.7 | 15.6 | | | |
| $100,000 - <$999,99 | 49.9 | 49.2 | 48.2 | | | |
| $1M and above | 10.4 | 9.2 | 10.5 | | | |

Source: weighted Canadian Longitudinal Study on Ageing dataset. * = Chi-square is significant at $p < 0.05$. FU1 = follow-up 1. FU2 = follow-up 2. N ≠ 3882 in variables with missing data. The percentage was calculated with valid cases.

**Bivariate analysis**

Pearson correlation analysis was used to determine the concurrent validity of TUG and 4MWT. The coefficient showed a strong positive correlation between TUG and 4MWT scores at baseline ($r = 0.65$, $p < 0.001$), FU1 ($r = 0.74$, $p < 0.001$), and FU2 ($r = 0.75$, $p < 0.001$).

For the regression analyses, it is important to note that TUG and 4MWT scores were time (seconds) taken to complete a fixed distance; therefore, a lower score implies better mobility. The data was coded such that when a reference category has a negative coefficient, the non-referenced category has better mobility. The bivariate regression analysis showed a significant association between mobility outcomes and non-modifiable sociodemographic variables, such that increasing age led to significant mobility decline at baseline (TUG $\beta = 0.12$, $p < 0.001$; 4MWT $\beta = 0.09$, $p < 0.001$) and all follow-ups (Table 6.2). Sex at birth correlated significantly with mobility decline, such that males have lower TUG ($\beta = -0.04$, $p = 0.021$) and 4MWT scores ($\beta = -0.11$, $p < 0.001$) than women at baseline and better mobility in all the cycles. Moreover, country of birth, ethnicity, and cultural identity had a significant association with TUG and 4MWT scores at baseline (Table 6.2).

Table 6.2 shows the detailed cycle-wise bivariate association between mobility outcomes and modifiable sociodemographic factors. Specifically, marital status, type of home, home ownership, and total household income had a significant bivariate association with both TUG and 4MWT. Being married was associated with better performance on both tests (TUG $\beta = -0.08$, $p < 0.001$; 4MWT $\beta = -0.09$, $p < 0.001$). Living in an apartment compared to a detached house (TUG $\beta = 0.09$, $p < 0.001$; 4MWT $\beta = 0.07$, $p < 0.001$) and tenancy compared to being the owner of the house (TUG $\beta = 0.11$, $p < 0.001$; 4MWT $\beta = 0.10$, $p < 0.001$) were linked to higher mobility decline.

**Table 6.2: Bivariate regression (zero-order correlation) between sociodemographic factors and mobility at baseline and follow-ups.**

| Variable | Baseline TUG | | Baseline 4MWT | | FU1 TUG | | FU1 4MWT | | FU2 TUG | | FU2 4MWT | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | β-statistic | *p*-value | β-statistic | *p*-value | β-statistic | *p*-value | β-statistic | *p*-value | β-statistic | *p*-value | β-statistic | *p*-value |
| *Non-modifiable factors* | | | | | | | | | | | | |
| Age (ref: increase in years) | 0.12 | <0.001* | 0.09 | <0.001* | 0.18 | <0.001* | 0.14 | <0.001* | 0.17 | <0.001* | 0.16 | <0.001* |
| Sex at birth (ref: female) | -0.04 | 0.021* | -0.11 | <0.001* | -0.05 | 0.003* | -0.13 | <0.001* | -0.06 | 0.006* | -0.12 | <0.001* |
| Country of birth‡ | | | | | | | | | | | | |
| Canada | 0.07 | <0.001* | 0.06 | 0.003* | 0.04 | 0.021 | 0.03 | 0.082 | 0.03 | 0.273 | 0.06 | 0.010* |
| OECD excluding Canada | -0.07 | <0.001* | -0.06 | 0.001* | -0.05 | 0.014* | -0.04 | 0.057 | -0.03 | 0.164 | -0.06 | 0.006* |
| Non-OECD | -0.01 | 0.819 | 0.00 | 0.986 | -0.01 | 0.942 | 0.01 | 0.951 | 0.01 | 0.674 | -0.01 | 0.912 |
| Ethnicity‡ | | | | | | | | | | | | |
| Canada | 0.05 | 0.005* | 0.04 | 0.032* | -0.01 | 0.510 | -0.01 | 0.913 | -0.03 | 0.152 | -0.01 | 0.580 |
| French | 0.02 | 0.267 | 0.03 | 0.098 | 0.03 | 0.167 | 0.03 | 0.181 | 0.03 | 0.279 | 0.02 | 0.365 |
| English | -0.07 | <0.001* | -0.07 | <0.001* | -0.04 | 0.027* | -0.06 | 0.002* | -0.02 | 0.332 | -0.04 | 0.127 |
| Others | -0.01 | 0.814 | 0.01 | 0.958 | 0.04 | 0.053 | 0.04 | 0.027* | 0.04 | 0.077 | 0.04 | 0.134 |
| Cultural identity‡ (ref: non-Caucasian) | -0.04 | 0.036* | -0.03 | 0.139 | -0.04 | 0.038* | -0.05 | 0.008* | -0.01 | 0.852 | -0.03 | 0.183 |
| *Modifiable factors* | | | | | | | | | | | | |
| Marital status (ref: has no partner) | -0.08 | <0.001* | -0.09 | <0.001* | -0.10 | <0.001* | -0.10 | <0.001* | -0.11 | <0.001* | -0.13 | <0.001* |
| Residence (ref: rural) | 0.02 | 0.157 | 0.01 | 0.579 | 0.05 | 0.003* | 0.05 | 0.002* | 0.03 | 0.108 | 0.05 | 0.021* |
| Home type (ref: detached house) | 0.09 | <0.001* | 0.07 | <0.001* | 0.08 | <0.001* | 0.06 | <0.001* | 0.08 | <0.001* | 0.05 | 0.009* |
| Homeownership (ref: owner) | 0.11 | <0.001* | 0.10 | <0.001* | 0.11 | <0.001* | 0.10 | <0.001* | 0.10 | <0.001* | 0.11 | <0.001* |
| Province | | | | | | | | | | | | |
| Alberta | -0.05 | 0.012* | 0.01 | 0.474 | 0.03 | 0.082 | 0.11 | <0.001* | -0.06 | 0.019* | 0.04 | 0.115 |
| British Columbia | -0.12 | 0.316 | -0.13 | <0.001* | 0.12 | 0.334 | -0.12 | <0.001* | 0.15 | <0.001* | -0.03 | 0.167 |
| Manitoba | 0.03 | 0.074 | 0.06 | 0.001* | 0.05 | 0.007* | 0.08 | <0.001* | 0.05 | 0.020* | 0.05 | 0.041* |
| Newfoundland/ Labrador | 0.05 | 0.006* | 0.08 | <0.001* | 0.02 | 0.249 | 0.03 | 0.104 | -0.04 | 0.136 | -0.06 | 0.010* |

| | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| Nova Scotia | -0.09 | <0.001* | -0.08 | <0.001* | -0.12 | <0.001* | -0.08 | <0.001* | -0.06 | 0.014* | 0.01 | 0.828 |
| Ontario | -0.01 | 0.841 | 0.06 | <0.001* | 0.01 | 0.946 | 0.02 | 0.362 | -0.05 | 0.012* | 0.04 | 0.085 |
| Quebec | 0.06 | 0.001* | 0.04 | 0.040* | -0.01 | 0.526 | 0.02 | 0.228 | -0.05 | 0.030* | -0.04 | 0.080 |
| Education‡ (ref: below secondary) | -0.08 | <0.001* | -0.08 | 0.001* | -0.06 | 0.011* | -0.09 | <0.001* | -0.05 | 0.081 | -0.08 | 0.005* |
| Occupation (ref: manual) | -0.03 | 0.089 | -0.04 | 0.040* | -0.03 | 0.367 | -0.06 | 0.121 | -0.003 | 0.935 | -0.03 | 0.384 |
| Retirement (ref: retired) | -0.06 | <0.001* | -0.06 | <0.001* | -0.06 | 0.001* | -0.05 | 0.004* | -0.07 | <0.001* | -0.06 | 0.002 |
| Total Household Income | | | | | | | | | | | | |
| Below $50,000 | 0.14 | <0.001* | 0.15 | <0.001* | 0.16 | <0.001* | 0.19 | <0.001* | 0.15 | <0.001* | 0.12 | <0.001* |
| $50,000 - $99,999 | -0.11 | <0.001* | -0.11 | <0.001* | -0.14 | <0.001* | -0.16 | <0.001* | -0.12 | <0.001* | -0.09 | <0.001* |
| $100,000 and above | -0.04 | 0.075 | -0.07 | 0.001* | -0.04 | 0.067 | -0.05 | 0.006* | -0.06 | 0.020* | -0.05 | 0.045* |
| Wealth (Investments) | | | | | | | | | | | | |
| < $50,000 | 0.16 | <0.001* | 0.14 | <0.001* | 0.16 | <0.001* | 0.17 | <0.001* | 0.17 | <0.001* | 0.15 | <0.001* |
| $50,000 - <$100,000 | 0.03 | 0.201 | 0.02 | 0.226 | 0.01 | 0.557 | 0.04 | 0.038* | 0.01 | 0.676 | 0.03 | 0.211 |
| $100,000 - <$1M | -0.13 | <0.001* | -0.09 | <0.001* | -0.11 | <0.001* | -0.14 | <0.001* | -0.09 | <0.001* | -0.10 | <0.001* |
| $1M and above | -0.03 | 0.118 | -0.08 | <0.001* | -0.06 | 0.001* | -0.07 | <0.001* | -0.11 | <0.001* | -0.09 | 0.001* |
| Social status† (ref: unit increase) | -0.03 | 0.089 | -0.09 | <0.001* | -0.04 | 0.055 | -0.07 | 0.001* | -0.08 | 0.002* | -0.09 | <0.001* |
| Religious affiliation (ref: no) | 0.04 | 0.051 | 0.07 | <0.001* | 0.03 | 0.097 | 0.05 | 0.011* | 0.02 | 0.355 | 0.03 | 0.221 |

Source: weighted Canadian Longitudinal Study on Ageing dataset. Standardized regression coefficient (β) = zero-order correlation coefficient (r). * = β was significant at $p <$ 0.05. OECD = Organisation for Economic Cooperation and Development. FU1 = follow up 1. FU2 = follow up 2. TUG = timed-up and go test score (sec). 4MWT = four-meter walk test score (sec). † = FU2 analysis was completed with FU1 demographic variable. ‡ = FU1 and FU2 analysis was completed with baseline demographic variable.

**Table 6.3: Mixed-design ANOVA for the effects of sociodemographic factors and study cycle on mobility decline.**

| Parameter | TUG | | | 4MWT | | |
|---|---|---|---|---|---|---|
| | Partial Eta Squared ($\eta^2_p$) | *F*-statistic (df) | *p*-value | Partial Eta Squared ($\eta^2_p$) | *F*-statistic (df) | *p*-value |
| Age group | 0.011 | 329.64 (1, 30277) | <0.001* | 0.001 | 24.02 (1, 30364) | <0.001* |
| Cycle | 0.184 | 6828.08 (2, 60554) | <0.001* | 0.046 | 1461.83 (2, 60728) | <0.001* |
| Age group x Cycle | 0.005 | 142.27 (2, 60554) | <0.001* | 0.003 | 76.46 (2, 60728) | <0.001* |
| Sex at birth | 0.007 | 207.12 (1, 30277) | <0.001* | 0.026 | 805.89 (1, 30364) | <0.001* |
| Cycle | 0.179 | 6599.49 (2, 60554) | <0.001* | 0.043 | 1350.08 (2, 60728) | <0.001* |
| Sex x Cycle | 0.001 | 22.43 (2, 60554) | <0.001* | 0.002 | 73.00 (2, 60728) | <0.001* |
| Country of birth | 0.002 | 25.58 (2, 30276) | <0.001* | 0.009 | 135.11 (2, 30363) | <0.001* |
| Cycle | 0.071 | 2297.81 (2, 60552) | <0.001* | 0.017 | 532.57 (2, 60726) | <0.001* |
| Country of birth x Cycle | 0.006 | 88.85 (4, 60552) | <0.001* | 0.001 | 16.11 (4, 60726) | <0.001* |
| Ethnicity | 0.007 | 66.96 (3, 30275) | <0.001* | 0.012 | 122.38 (3, 30362) | <0.001* |
| Cycle | 0.169 | 6142.55 (2, 60550) | <0.001* | 0.041 | 1302.60 (2, 60724) | <0.001* |
| Ethnicity x Cycle | 0.009 | 87.39 (6, 60550) | <0.001* | 0.004 | 43.84 (6, 60724) | <0.001* |
| Cultural identity | 0.005 | 156.46 (1, 30277) | <0.001* | 0.007 | 200.40 (1, 30364) | <0.001* |
| Cycle | 0.027 | 842.02 (2, 60554) | <0.001* | 0.012 | 375.35 (2, 60728) | <0.001* |
| Cultural identity x Cycle | 0.000 | 7.94 (2, 60554) | <0.001* | 0.002 | 49.10 (2, 60728) | <0.001* |
| Marital status | 0.005 | 140.32 (1, 30277) | <0.001* | 0.006 | 196.86 (1, 30364) | <0.001* |
| Cycle | 0.143 | 5043.87 (2, 60554) | <0.001* | 0.041 | 1310.07 (2, 60728) | <0.001* |
| Marital status x Cycle | 0.002 | 63.16 (2, 60554) | <0.001* | 0.003 | 79.16 (2, 60728) | <0.001* |
| Area of residence | 0.009 | 90.12 (3, 30275) | <0.001* | 0.000 | 3.36 (1, 30364) | 0.067 |
| Cycle | 0.045 | 1412.01 (2, 60554) | <0.001* | 0.010 | 316.25 (2, 60728) | <0.001* |
| Residence x Cycle | 0.000 | 12.24 (2, 60554) | <0.001* | 0.000 | 13.35 (2, 60728) | <0.001* |
| Home type | 0.005 | 150.22 (1, 30163) | <0.001* | 0.003 | 77.75 (1, 30250) | <0.001* |
| Cycle | 0.124 | 4283.46 (2, 60326) | <0.001* | 0.032 | 987.75 (2, 60500) | <0.001* |
| Home x Cycle | 0.001 | 15.19 (2, 60326) | <0.001* | 0.000 | 12.73 (2, 60500) | <0.001* |
| House ownership | 0.011 | 330.83 (1, 30277) | <0.001* | 0.028 | 875.79 (1, 30364) | <0.001* |
| Cycle | 0.091 | 3028.39 (2, 60554) | <0.001* | 0.018 | 560.98 (2, 60728) | <0.001* |
| House ownership x Cycle | 0.001 | 29.73 (2, 60554) | <0.001* | 0.004 | 129.93 (2, 60728) | <0.001* |
| Province of residence | 0.022 | 112.55 (6, 30272) | <0.001* | 0.049 | 262.33 (6, 30359) | <0.001* |
| Cycle | 0.049 | 1543.57 (2, 60544) | <0.001* | 0.009 | 289.72 (2, 60718) | <0.001* |
| Province x Cycle | 0.042 | 219.88 (12, 60544) | <0.001* | 0.032 | 166.63 (12, 60718) | <0.001* |
| Education | 0.001 | 21.22 (1, 18614) | <0.001* | 0.007 | 127.23 (1, 18671) | <0.001* |

| | | | | | | |
|---|---|---|---|---|---|---|
| Cycle | 0.161 | 3576.84 (2, 37228) | <0.001* | 0.048 | 939.74 (2, 37342) | <0.001* |
| Education x Cycle | 0.002 | 28.25 (2, 37228) | <0.001* | 0.000 | 1.98 (2, 37342) | 0.139 |
| Occupation type | 0.000 | 0.26 (1, 27061) | 0.611 | 0.000 | 0.01 (1, 27146) | 0.910 |
| Cycle | 0.106 | 3205.28 (2, 54122) | <0.001* | 0.018 | 502.64 (2, 54292) | <0.001* |
| Occupation x Cycle | 0.002 | 45.53 (2, 54122) | <0.001* | 0.002 | 51.45 (2, 54292) | <0.001* |
| Retirement status | 0.008 | 250.60 (1, 30277) | <0.001* | 0.008 | 256.06 (1, 30364) | <0.001* |
| Cycle | 0.142 | 5011.10 (2, 60554) | <0.001* | 0.030 | 934.60 (2, 60728) | <0.001* |
| Retirement x Cycle | 0.002 | 63.48 (2, 60554) | <0.001* | 0.001 | 19.14 (2, 60728) | <0.001* |
| Total household income (THI) | 0.006 | 78.24 (2, 27911) | <0.001* | 0.016 | 222.28 (2, 27977) | <0.001* |
| Cycle | 0.090 | 2759.29 (2, 55822) | <0.001* | 0.019 | 543.70 (2, 55954) | <0.001* |
| THI x Cycle | 0.003 | 37.35 (4, 55822) | <0.001* | 0.003 | 47.64 (4, 55954) | <0.001* |
| Wealth/Investment | 0.029 | 259.81 (3, 26318) | <0.001* | 0.063 | 587.34 (3, 26391) | <0.001* |
| Cycle | 0.122 | 3655.30 (2, 52636) | <0.001* | 0.037 | 1009.75 (2, 52782) | <0.001* |
| Wealth x Cycle | 0.008 | 72.51 (6, 52636) | <0.001* | 0.015 | 135.87 (6, 52782) | <0.001* |
| Social status | 0.001 | 19.97 (2, 29623) | <0.001* | 0.014 | 204.40 (2, 29696) | <0.001* |
| Cycle | 0.092 | 2991.37 (2, 59246) | <0.001* | 0.021 | 626.29 (2, 59392) | <0.001* |
| Social status x Cycle | 0.008 | 123.62 (4, 59246) | <0.001* | 0.005 | 72.27 (4, 59392) | <0.001* |
| Religion affiliation | 0.001 | 38.64 (1, 30102) | <0.001* | 0.005 | 149.31 (1, 30189) | <0.001* |
| Cycle | 0.113 | 3835.85 (2, 60204) | <0.001* | 0.036 | 1114.68 (2, 60378) | <0.001* |
| Religion x Cycle | 0.002 | 50.47 (2, 60204) | <0.001* | 0.001 | 40.22 (2, 60378) | <0.001* |

Source: weighted Canadian Longitudinal Study on Ageing dataset. * = $F$-statistic was significant at $p < 0.05$. TUG = timed-up and go test score (sec). 4MWT = four-meter walk test score (sec).

**Multivariate analysis**

The mixed-design ANOVA results (Table 6.3) showed significant main effects of sociodemographic variables, study cycles, and significant sociodemographic*cycle interaction effects. However, there was no significant main effect of occupation type (TUG $F$ [1, 27061] = 0.26, $p$ = 0.611, $\eta^2_p$ = 0.000; 4MWT $F$ [1, 27146] = 0.01, $p$ = 0.910, $\eta^2_p$ = 0.000) and area of residence (4MWT $F$ [1, 30364] = 3.36, $p$ = 0.067, $\eta^2_p$ = 0.000). The estimated marginal mean differences in *log* TUG and *log* 4MWT scores at baseline, FU1 and FU2 across the categories of the sociodemographic variables were plotted in Figures 6.1 to 6.4.

The post hoc pairwise comparison of the *log mean differences* [*MD*] showed that people aged 70 to 74 years had a significant mobility decline compared to younger counterparts 65 to 69 years (TUG *MD* = 0.015, $p < 0.001$; 4MWT *MD* = 0.004, $p < 0.001$). Females had a significant mobility decline than males (TUG *MD* = 0.012, $p < 0.001$; 4MWT *MD* = 0.022, $p < 0.001$). Mobility decline trajectory of other non-modifiable factors, such as country of birth and ethnicity, are shown in Figure 6.1.

Figures 6.2 to 6.4 show the linear trend of mobility decline across categories of modifiable sociodemographic factors. Specifically, Figure 6.2 shows that non-Caucasians had a significant mobility decline relative to Caucasians (TUG *MD* = 0.026, $p < 0.001$; 4MWT *MD = 0.029*, $p < 0.001$). Participants who were single/divorced/separated/widowed had a significant mobility decline compared to their married counterparts (TUG *MD* = 0.011, $p < 0.001$; 4MWT *MD = 0.013*, $p < 0.001$). Non-rural dwellers had a significant mobility decline compared to rural-dwelling older adults (TUG *MD* = 0.011, $p < 0.001$). The 4MWT *MD* = 0.003 ($p$ = 0.067) was not significant. Older adults who lived in apartments or condominiums had a significant mobility decline relative

to those who lived in a single detached, semi-detached, duplex or townhouse (TUG *MD* = 0.013, $p < 0.001$; 4MWT *MD = 0.009*, $p < 0.001$).

Figure 6.3 shows that older adults who were tenants had a significant mobility decline than those who owned their homes (TUG *MD* = 0.022, $p < 0.001$; 4MWT *MD = 0.034*, $p < 0.001$). Older adults with secondary education or less had a significant mobility decline than their counterparts with higher education levels (TUG *MD* = 0.005, $p < 0.001$; 4MWT *MD = 0.012*, $p < 0.001$). However, there was no significant difference in mobility decline between participants who engaged in manual vs. non-manual occupations (TUG *MD* = -0.01, $p = 0.611$; 4MWT *MD* = 0.000, $p = 0.910$). Figure 6.3 (b) shows the mobility trajectory across the seven Canadian provinces included in CLSA. Briefly, the mean *log* TUG and 4MWT showed that older adults in Manitoba had the highest rate of mobility decline. The TUG showed that Nova Scotia had the lowest decline rate, while the 4MWT suggests that British Columbia had the lowest decline, followed closely by Nova Scotia.

Figure 6.4 shows that older adults in low-income households had a significant mobility decline than those in the middle (TUG *MD* = 0.010, $p < 0.001$; 4MWT *MD* = 0.015, $p < 0.001$) and high-income households (TUG *MD* = 0.014, $p < 0.001$; 4MWT *MD* = 0.025, $p < 0.001$). Participants with moderate wealth *($100,000 to $999,999)* had better mobility trajectory than those less than *$50,000* (TUG *MD* = -0.030, $p < 0.001$; 4MWT *MD* = -0.041, $p < 0.001$), and *$50,000 to $100,000* (TUG *MD* = -0.013, $p < 0.001$; 4MWT *MD* = -0.019, $p < 0.001$). However, participants with moderate wealth *($100,000 to $999,999)* had better mobility than those with *$1,000,000 and above* (TUG *MD* = -0.012, $p < 0.001$; 4MWT *MD* = -0.008, $p < 0.001$). Older adults of lower social status had a significant mobility decline than those in the middle (TUG *MD* = 0.002, $p = 0.112$; 4MWT *MD* = 0.009, $p < 0.001$) and high social status (TUG *MD* = 0.007, $p < 0.001$; 4MWT

*MD* = 0.025, $p < 0.001$). Participants with religious affiliation had a more significant mobility decline than their irreligious counterparts (TUG *MD* = 0.006, $p < 0.001$; 4MWT *MD* = 0.012, $p<0.001$). Retirees' mobility declined significantly more than their counterparts who were partly or not retired (TUG *MD* = 0.015, $p < 0.001$; 4MWT *MD* = 0.014, $p < 0.001$).

We completed a simultaneous entry multivariate linear regression to estimate the association between sociodemographic factors and mobility outcome at baseline and mobility decline at FU1 and FU2. Tables 6.4 and 6.5 show the results for TUG and 4MWT, respectively. Sociodemographic determinants of mobility decline after the 6-year follow-up (FU2 minus baseline) were reported in the text if they had a significant standardized regression coefficient (β) and the same effect direction for both TUG and 4MWT. For simplicity, only the results for TUG were presented in the text.

Increasing age (β = 0.088, $p < 0.001$), being a female (β = -0.035, $p < 0.001$), being born in Canada compared with other OECD (β = -0.046, $p < 0.001$) or non-OECD countries (β = -0.083, $p < 0.001$), and being a non-Caucasian (β = -0.063, $p < 0.001$) significantly associated with higher mobility decline rate.

The following modifiable factors were significant predictors of mobility decline. Economic factors such as having a THI of $50,000 to $99,999 (β = 0.039, $p < 0.001$), wealth/investment worth lower than $50,000 compared to $50,000 to $100,000 (β = -0.089, $p < 0.001$), $100,000 to $1M (β = -0.084, $p < 0.001$), $1M and above (β = -0.039, $p < 0.001$). Employment factors include being retired at baseline (β = -0.058, $p < 0.001$) and remaining in retirement at FU2 (β = 0.084, $p < 0.001$). Residential factors such as living in Alberta (β = 0.035, $p < 0.001$) compared with Ontario, or in Ontario compared with Quebec (β = -0.106, $p < 0.001$), being a tenant (β = 0.050, $p < 0.001$), and remaining in a semi-/detached house up until FU2 (β = -0.144, $p < 0.001$).

Other modifiable variables include sociobehavioural factors such as not being married or not having a partner (β = -0.057, $p < 0.001$), having religious affiliation (β = 0.036, $p < 0.001$), low social status (β = -0.018, $p = 0.025$), a further drop in social status (β = -0.026, $p < 0.001$), lesser alcohol intake (β = -0.028, $p < 0.001$), and poor self-reported general health (β = -0.164, $p < 0.001$). The TUG ($F$ [40, 12424] = 181.42, $p < 0.001$, $R = 0.64$, adjusted $R^2 = 0.41$) and 4MWT models ($F$ [40, 12435] = 112.38, $p < 0.001$, $R = 0.55$, adjusted $R^2 = 0.30$) were robust, accounting for 41% and 30% of the total variance, respectively.

**Table 6.4: Multivariate longitudinal regression for association between TUG and sociodemographic factors.**

| Variable | Baseline (BL) | | FU1 minus BL | | FU2 minus FU1 | | FU2 minus BL | |
|---|---|---|---|---|---|---|---|---|
| *Baseline demographic characteristics* | β-statistic | *p*-value | β-statistic | *p*-value | β-statistic | *p*-value | β-statistic | *p*-value |
| Age (increase in years) | 0.100 | <0.001* | 0.107 | <0.001* | 0.036 | <0.001* | 0.088 | <0.001* |
| Sex (ref: female) | -0.025 | <0.001* | 0.026 | <0.001* | -0.027 | <0.001* | -0.035 | <0.001* |
| Marital status (ref: has no partner) | -0.001 | 0.906 | -0.027 | <0.001* | -0.014 | 0.060 | -0.057 | <0.001* |
| Country of birth (ref: Canada) | | | | | | | | |
| OECD excluding Canada | 0.014 | 0.052 | -0.026 | <0.001* | 0.013 | 0.054 | -0.046 | <0.001* |
| Non-OECD | -0.031 | <0.001* | -0.063 | <0.001* | -0.085 | <0.001* | -0.083 | <0.001* |
| Ethnicity (ref: Canada) | | | | | | | | |
| French | .0035 | <0.001* | -0.017 | 0.004* | 0.038 | <0.001* | 0.013 | 0.101 |
| English | -0.028 | 0.001* | -0.023 | 0.001* | -0.001 | 0.920 | -0.006 | 0.560 |
| Others | -0.047 | <0.001* | -0.025 | 0.001* | 0.005 | 0.583 | -0.003 | 0.720 |
| Cultural identity (ref: non-Caucasian) | -0.036 | <0.001* | -0.076 | <0.001* | -0.047 | <0.001* | -0.063 | <0.001* |
| Province (ref: Ontario) | | | | | | | | |
| Alberta | -0.026 | <0.001* | 0.077 | <0.001* | -0.051 | <0.001* | 0.035 | <0.001* |
| British Columbia | -0.004 | 0.637 | 0.062 | <0.001* | 0.130 | <0.001* | 0.169 | <0.001* |
| Manitoba | 0.022 | 0.002* | 0.047 | <0.001* | 0.007 | 0.332 | 0.025 | 0.001* |
| Newfoundland/ Labrador | 0.011 | 0.102 | 0.006 | 0.291 | -0.010 | 0.116 | -0.008 | 0.269 |
| Nova Scotia | -0.044 | <0.001* | -0.026 | <0.001* | 0.001 | 0.882 | -0.014 | 0.053 |
| Quebec | -0.030 | 0.003* | -0.044 | <0.001* | -0.108 | <0.001* | -0.106 | <0.001* |
| Area of residence (ref: rural) | 0.020 | 0.002* | 0.011 | 0.078 | -0.015 | 0.063 | -0.010 | 0.264 |
| House (ref: semi-/detached house) | 0.029 | <0.001* | 0.016 | 0.093 | -0.027 | 0.002* | 0.028 | 0.018* |
| House ownership (ref: owner) | 0.000 | 1.000 | -0.010 | 0.112 | -0.035 | <0.001* | 0.050 | <0.001* |
| THI $ (ref: below 50,000) | | | | | | | | |
| 50,000 – 99,999 | -0.031 | <0.001* | 0.011 | 0.106 | -0.006 | 0.452 | 0.039 | <0.001* |
| 100,000 and above | -0.018 | 0.024* | -0.011 | 0.103 | 0.040 | <0.001* | 0.006 | 0.466 |
| Wealth/Invest. $ (ref: below 50,000) | | | | | | | | |
| 50,000 – 100,000 | -0.045 | <0.001* | -0.054 | <0.001* | -0.038 | <0.001* | -0.089 | <0.001* |
| 100,000 – 1,000,000 | -0.098 | <0.001* | -0.078 | <0.001* | -0.043 | <0.001* | -0.084 | <0.001* |
| 1,000,000 and above | -0.071 | <0.001* | -0.069 | <0.001* | -0.021 | 0.024* | -0.039 | <0.001* |
| Education (ref: secondary and below) | -0.022 | 0.001* | 0.062 | <0.001* | 0.021 | 0.002* | 0.043 | <0.001* |
| Occupation (ref: manual) | -0.055 | <0.001* | -0.028 | <0.001* | -0.013 | 0.044* | -0.002 | 0.833 |
| Retirement (ref: retired) | -0.049 | <0.001* | -0.035 | <0.001* | -0.053 | <0.001* | -0.058 | <0.001* |
| Social status ladder (unit increase) | 0.049 | <0.001* | 0.011 | 0.079 | -0.015 | 0.023* | -0.018 | 0.025* |
| Religion affiliation (ref: no) | -0.014 | 0.035* | 0.011 | 0.045* | 0.025 | <0.001* | 0.036 | <0.001* |
| Smoked 100 cigarettes in life (ref: no) | 0.090 | <0.001* | 0.047 | <0.001* | -0.009 | 0.163 | 0.002 | 0.750 |
| Frequency of alcohol (a unit increase) | -0.100 | <0.001* | -0.014 | 0.015* | -0.025 | <0.001* | -0.028 | <0.001* |
| Chronic disease status (ref: no) | -0.007 | 0.285 | 0.035 | <0.001* | -0.005 | 0.480 | 0.024 | 0.001* |
| General health rating (ref: poor) | -0.188 | <0.001* | -0.099 | <0.001* | -0.136 | <0.001* | -0.164 | <0.001* |
| *Sociodemographic change* | | | | | | | | |
| Marital status change (ref: no partner) | | | 0.063 | <0.001* | 0.025 | <0.001* | -0.048 | <0.001* |
| Social status ladder (unit increase) | | | -0.035 | <0.001* | - | - | -0.026 | 0.001* |
| More religious (ref: same state) | | | 0.014 | 0.009* | -0.032 | <0.001* | 0.017 | 0.029* |
| Less religious (ref: same state) | | | -0.040 | <0.001* | 0.016 | 0.014* | -0.002 | 0.768 |

| | | | | | | | | |
|---|---|---|---|---|---|---|---|---|
| Education gain (ref: no) | | | -0.007 | 0.222 | -0.006 | 0.317 | -0.038 | <0.001* |
| Remained retired (ref: no) | | | 0.045 | <0.001* | 0.032 | <0.001* | 0.084 | <0.001* |
| House (ref: semi-/detached house) | | | 0.039 | <0.001* | 0.074 | <0.001* | -0.144 | <0.001* |
| Change of residence (ref: went rural) | | | -0.010 | 0.120 | -0.034 | <0.001* | 0.035 | 0.036* |
| | | | | | | | | |
| *F-statistics* | $F(32, 22664) = 82.61$, $p < 0.001$* | | $F(40, 20690) = 381.99$, $p < 0.001$* | | $F(39, 13253) = 37.44$, $p < 0.001$* | | $F(40, 12424) = 181.42$, $p < 0.001$* | |
| *R-statistics* | R=0.32, $AR^2$=0.10 | | R=0.66, $AR^2$=0.43 | | R=0.70, $AR^2$=0.49 | | R=0.64, $AR^2$=0.41 | |

Source: weighted Canadian Longitudinal Study on Ageing dataset. * = standardized regression coefficient (β) was significant at $p < 0.05$. THI = total household income. OECD = Organisation for Economic Cooperation and Development. R = correlation coefficient. $AR^2$ = adjusted R squared.

**Table 6.5. Multivariate longitudinal regression for association between 4MWT and sociodemographic factors.**

| Variable | Baseline (BL) | | FU1 minus BL | | FU2 minus FU1 | | FU2 minus BL | |
|---|---|---|---|---|---|---|---|---|
| *Baseline demographic characteristics* | β-statistic | *p*-value | β-statistic | *p*-value | β-statistic | *p*-value | β-statistic | *p*-value |
| Age (increase in years) | 0.069 | <0.001* | 0.085 | <0.001* | 0.074 | <0.001* | 0.092 | <0.001* |
| Sex (ref: female) | -0.083 | <0.001* | -0.070 | <0.001* | -0.059 | <0.001* | -0.066 | <0.001* |
| Marital status (has no partner) | 0.016 | 0.029* | 0.029 | <0.001* | -0.147 | <0.001* | -0.171 | <0.001* |
| Country of birth (ref: Canada) | | | | | | | | |
| OECD excluding Canada | 0.024 | 0.001* | -0.032 | <0.001* | -0.032 | <0.001* | -0.064 | <0.001* |
| Non-OECD | -0.035 | <0.001* | -0.052 | <0.001* | -0.033 | 0.001* | -0.041 | <0.001* |
| Ethnicity (ref: Canada) | | | | | | | | |
| French | 0.052 | <0.001* | 0.055 | <0.001* | -0.041 | <0.001* | -0.026 | 0.003* |
| English | -0.022 | 0.010* | -0.003 | 0.739 | -0.029 | 0.003* | -0.012 | 0.241 |
| Others | -0.044 | <0.001* | 0.030 | <0.001* | 0.012 | 0.237 | 0.050 | <0.001* |
| Cultural identity (ref: non-Caucasian) | -0.018 | 0.020* | -0.072 | <0.001* | -0.022 | 0.020* | -0.048 | <0.001* |
| Province (ref: Ontario) | | | | | | | | |
| Alberta | 0.013 | 0.076 | 0.100 | <0.001* | 0.016 | 0.054 | 0.071 | <0.001* |
| British Columbia | -0.144 | <0.001* | -0.084 | <0.001* | -0.055 | <0.001* | -0.087 | <0.001* |
| Manitoba | 0.046 | <0.001* | 0.060 | <0.001* | -0.058 | <0.001* | -0.027 | 0.002* |
| Newfoundland/ Labrador | 0.013 | 0.044* | -0.016 | 0.006* | -0.045 | <0.001* | -0.054 | <0.001* |
| Nova Scotia | -0.041 | <0.001* | -0.017 | 0.004* | 0.013 | 0.099 | 0.005 | 0.562 |
| Quebec | 0.002 | 0.868 | -0.046 | <0.001* | -0.121 | <0.001* | -0.082 | <0.001* |
| Area of residence (ref: rural) | 0.013 | 0.041* | 0.034 | <0.001* | -0.036 | <0.001* | -0.014 | 0.151 |
| House (ref: semi-/detached house) | 0.058 | <0.001* | 0.002 | 0.849 | -0.036 | <0.001* | 0.008 | 0.525 |
| House ownership (ref: owner) | -0.030 | <0.001* | -0.007 | 0.319 | -0.005 | 0.585 | 0.023 | 0.013* |
| THI $ (ref: below 50,000) | | | | | | | | |
| 50,000 – 99,999 | 0.011 | 0.159 | -0.052 | <0.001* | 0.035 | <0.001* | 0.041 | <0.001* |
| 100,000 and above | 0.013 | 0.108 | -0.010 | 0.175 | -0.011 | 0.206 | -0.040 | <0.001* |
| Wealth/Invest. $ (ref: below 50,000) | | | | | | | | |
| 50,000 – 100,000 | -0.075 | <0.001* | -0.079 | <0.001* | -0.047 | <0.001* | -0.074 | <0.001* |
| 100,000 – 1,000,000 | -0.128 | <0.001* | -0.139 | <0.001* | -0.065 | <0.001* | -0.088 | <0.001* |
| 1,000,000 and above | -0.112 | <0.001* | -0.116 | <0.001* | -0.030 | 0.004* | -0.033 | 0.003* |
| Education (ref: secondary and below) | -0.029 | <0.001* | 0.006 | 0.282 | 0.011 | 0.149 | 0.005 | 0.562 |
| Occupation (ref: manual) | -0.046 | <0.001* | 0.015 | 0.009* | 0.001 | 0.937 | 0.016 | 0.039* |
| Retirement (ref: retired) | -0.061 | <0.001* | -0.045 | <0.001* | -0.010 | 0.257 | -0.040 | <0.001* |
| Social status ladder (unit increase) | 0.032 | <0.001* | 0.035 | <0.001* | 0.003 | 0.681 | 0.033 | <0.001* |
| Religion affiliation (ref: no) | -0.013 | 0.049* | -0.055 | <0.001* | 0.065 | <0.001* | 0.037 | <0.001* |
| Smoked 100 cigarettes in life (ref: no) | 0.054 | <0.001* | 0.052 | <0.001* | 0.007 | 0.317 | 0.053 | <0.001* |
| Frequency of alcohol (a unit increase) | -0.085 | <0.001* | -0.035 | <0.001* | -0.030 | <0.001* | -0.025 | 0.003* |
| Chronic disease status (ref: no) | 0.010 | 0.117 | -0.005 | 0.412 | 0.032 | <0.001* | 0.000 | 0.998 |
| General health rating (ref: poor) | -0.153 | <0.001* | -0.097 | <0.001* | -0.083 | <0.001* | -0.120 | <0.001* |
| *Sociodemographic change* | | | | | | | | |
| Marital status change (ref: no) | | | 0.046 | <0.001* | 0.013 | 0.081 | 0.029 | <0.001* |
| Social status ladder (unit increase) | | | -0.010 | 0.124 | - | - | -0.075 | <0.001* |
| More religious (ref: same state) | | | -0.049 | <0.001* | -0.053 | <0.001* | 0.002 | 0.835 |
| Less religious (ref: same state) | | | -0.028 | <0.001* | 0.020 | 0.007* | -0.051 | <0.001* |

| | | | | | | | | |
|---|---|---|---|---|---|---|---|---|
| Education gain (ref: no) | | | 0.023 | <0.001* | 0.004 | 0.560 | 0.010 | 0.184 |
| Remained retired (ref: no) | | | 0.067 | <0.001* | 0.008 | 0.316 | 0.023 | 0.050* |
| House (ref: semi-/detached house) | | | 0.037 | <0.001* | 0.030 | 0.002* | -0.123 | <0.001* |
| Change of residence (ref: went rural) | | | -0.032 | <0.001* | 0.011 | 0.209 | 0.003 | 0.866 |
| | | | | | | | | |
| *F-statistics* | $F(32, 22615) = 91.11$, $p < 0.001$* | | $F(40, 20674) = 260.77$, $p < 0.001$* | | $F(39, 13300) = 169.86$, $p < 0.001$* | | $F(40, 12435) = 112.38$, $p < 0.001$* | |
| *R-statistics* | R=0.34, $AR^2$=0.11 | | R=0.58, $AR^2$=0.34 | | R=0.58, $AR^2$=0.34 | | R=0.55, $AR^2$=0.30 | |

Source: weighted Canadian Longitudinal Study on Ageing dataset. * = standardized regression coefficient (β) was significant at $p < 0.05$. THI = total household income. OECD = Organisation for Economic Cooperation and Development. R = correlation coefficient. $AR^2$ = adjusted R squared.

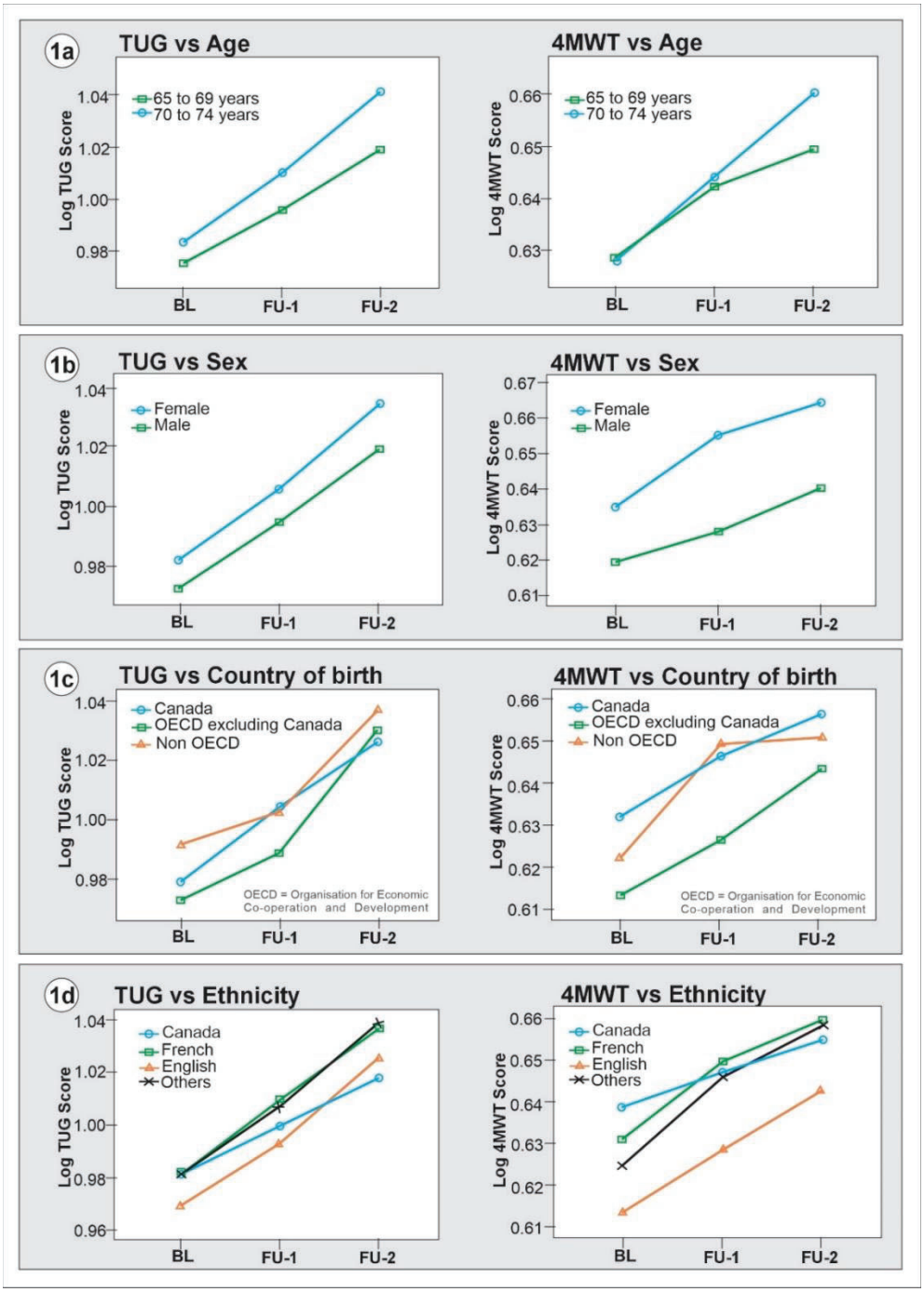


**Figure 6.1: Marginal mean differences in mobility trajectory across sociodemographic factors: age, sex, country of birth and ethnicity.**

Source: weighted CLSA dataset.

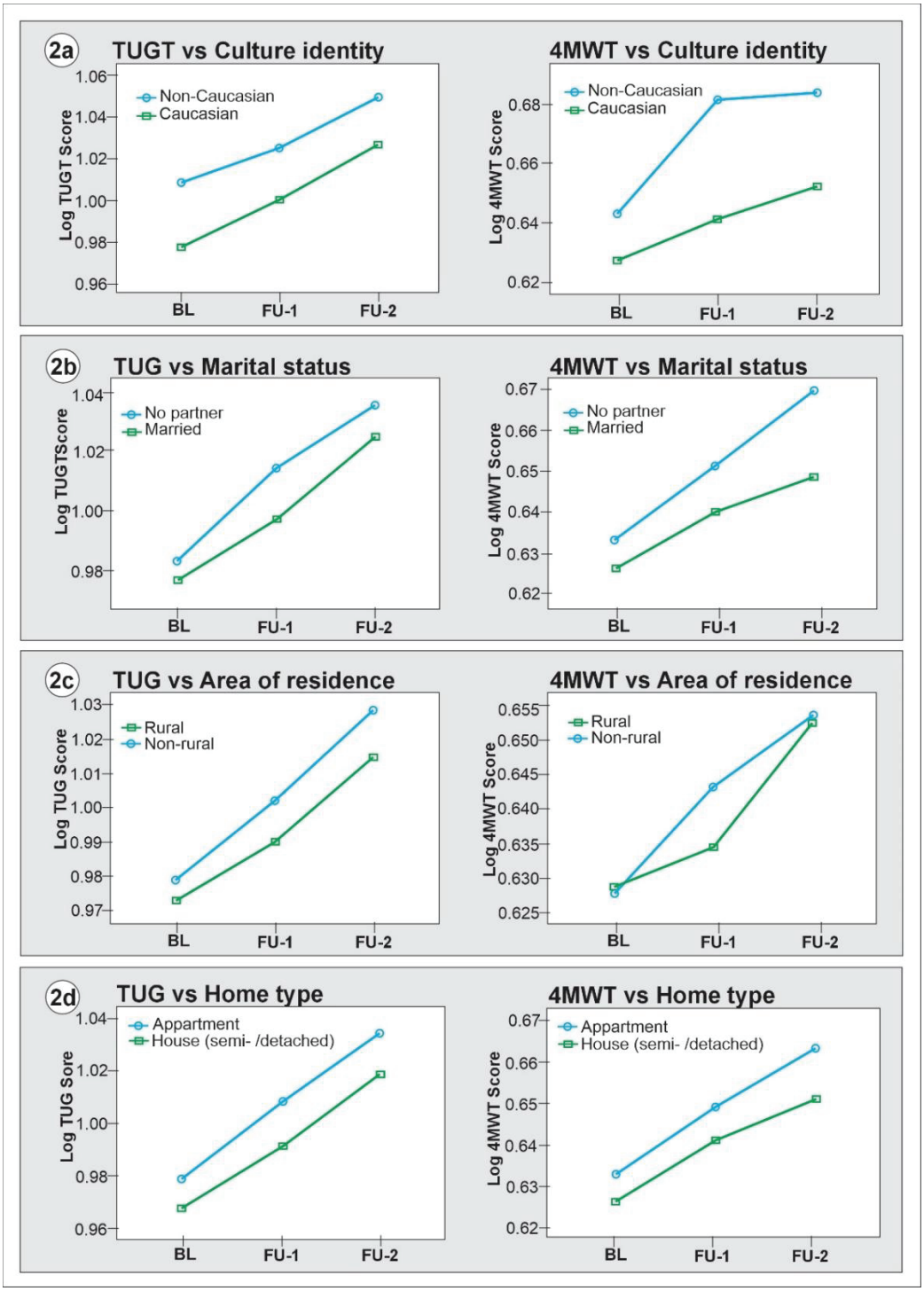


**Figure 6.2: Marginal mean differences in mobility trajectory across sociodemographic factors: cultural identity, marital status, residence, and home type.**

Source: weighted CLSA dataset.

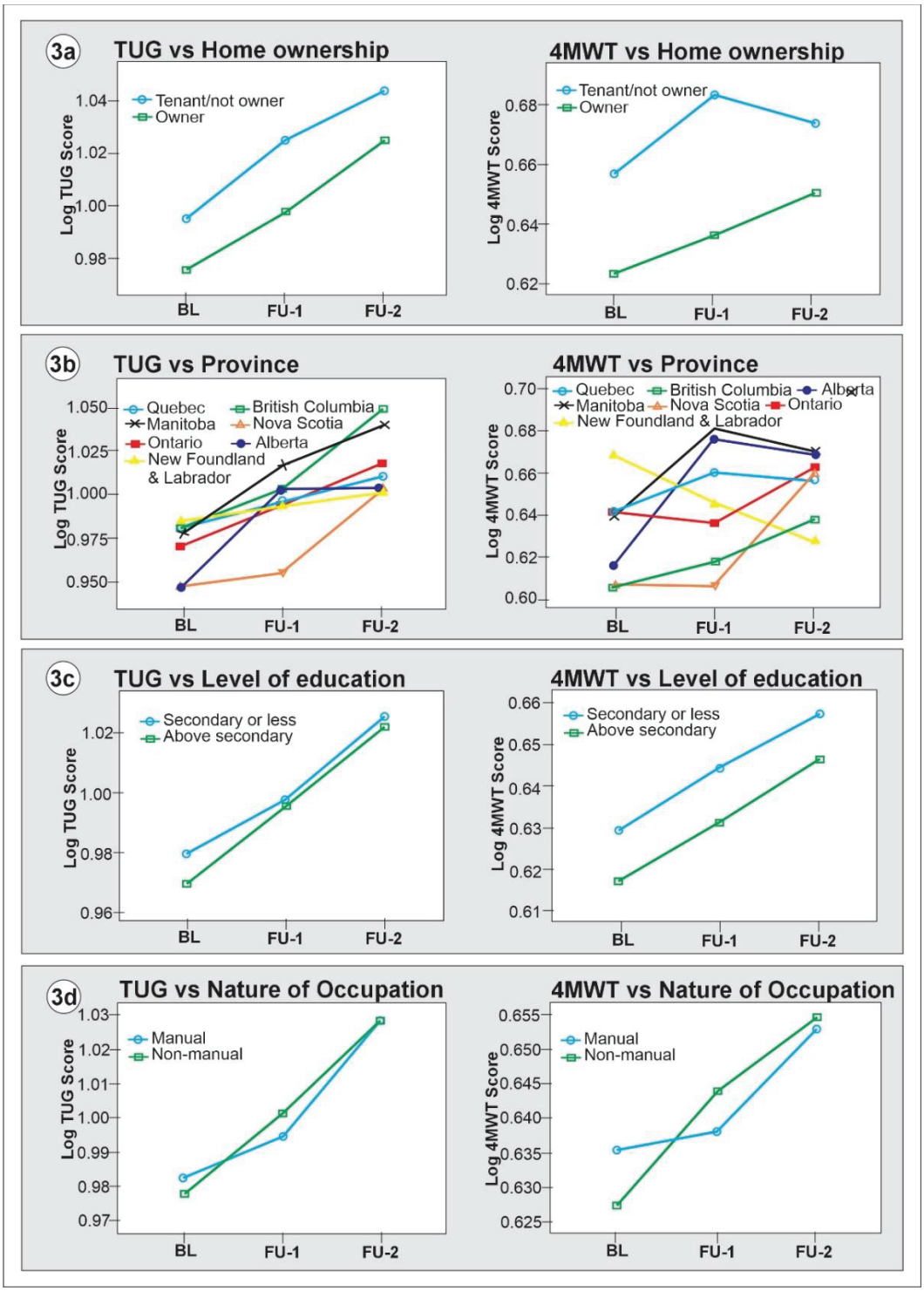


**Figure 6.3: Marginal mean differences in mobility trajectory across sociodemographic factors: home ownership, province, education, and occupation.**

Source: weighted CLSA dataset.

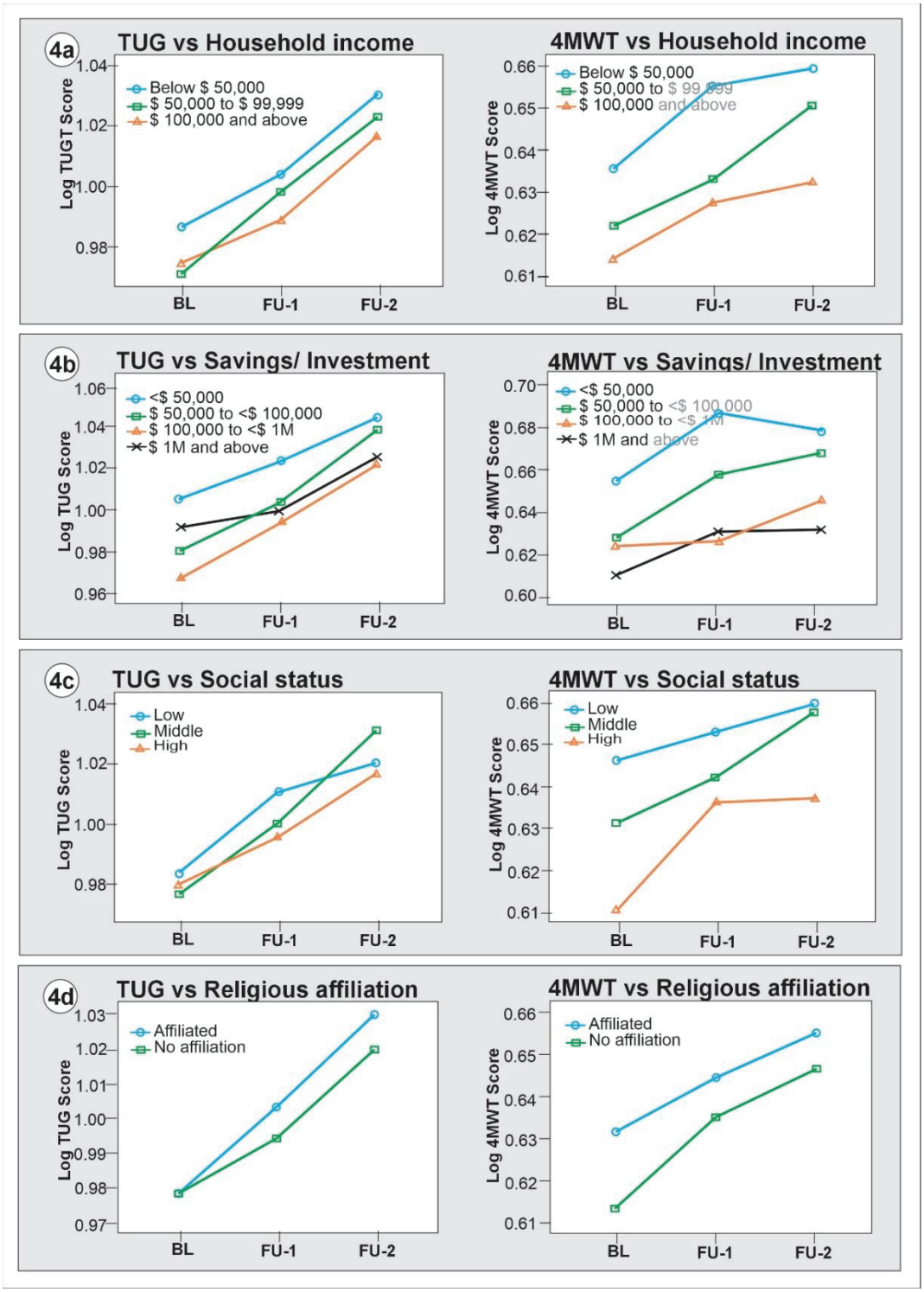


**Figure 6.4: Marginal mean differences in mobility trajectory across sociodemographic factors: household income, wealth, social status, and religion.**

Source: weighted CLSA dataset.

## Discussion

This longitudinal analysis provides valuable insights into the sociodemographic determinants of mobility decline among older adults in Canada. The findings underscore the complexity of ageing, highlighting the role of various sociodemographic factors in mobility decline. As evidenced by the significant associations found between mobility outcomes and age, gender, marital status, country of birth, cultural identity, province of residence, income, wealth, home ownership, dwelling type, religious affiliation, retirement, and social status, our study contributes to the growing body of literature on geriatric health and mobility (Maresova et al., 2023; National Institute on Aging, 2020; Satariano et al., 2012; Webber et al., 2010). The weighted sociodemographic profile of the current study was similar to the original CLSA baseline comprehensive cohort (Raina et al., 2019) and other profiles of the Canadian older adult population (Bartholomew et al., 2021). The remainder of this section discusses non-modifiable factors, followed by modifiable factors, the concurrent validity of the outcome measures, and recommendations.

Non-modifiable sociodemographic determinants of older adults' mobility trajectory identified in our study, such as age, sex, country of birth, ethnicity, and cultural identity, are consistent with existing literature. Similar to our result, Wu and Zhao (2021) revealed that increasing age was associated with a decline in walking speed among older Chinese. A meta-analysis of age effect on walking mechanics showed age-related gait decline (Boyer et al., 2017). Our findings also align with previous research conducted among older adults from the USA, Taiwan, Korea, Mexico, China, Indonesia, and Bolivia, indicating that women often experience higher rates of mobility decline (Wheaton & Crimmins, 2016). A 7-year follow-up longitudinal study found a significant sex difference in the prevalence of mobility disability among 10,263

community-dwelling older adults in the United States (Leveille et al., 2000). Beyond biological sex or physiological factors, socioculturally constructed gender roles may affect mobility outcomes in older women (Ahmed et al., 2016). Life course accumulation of these roles, including childbearing, childcare, home-making, and other gendered economic activities such as food processing, may lead to earlier and more severe mobility disability in women.

Intersectionality of age, gender, and race exacerbates mobility decline in racialized older women (Boyer et al., 2017; Idland et al., 2013; Leveille et al., 2000; Shumway-Cook et al., 2005; Wu & Zhao, 2021). For instance, while a younger Caucasian woman may experience gender discrimination, an older Black woman faces compounded discrimination due to ageism, sexism, and racism, creating additional structural disadvantages (Thorpe et al., 2011). Among people of similar age and sex, non-Caucasians had a higher mobility decline rate than Caucasians (Thorpe et al., 2011; Vásquez et al., 2020). As Webber et al. (2010) highlighted, demographic, social, and economic factors acting independently and cumulatively influence individuals' experiences, opportunities, and behaviours, leading to disproportionate mobility outcomes. To be effective, the policy action on sociodemographic determinants of health should be comprehensive and holistic (Dover & Belon, 2019; Voelker, 2008). The idea that modifying gender roles can ameliorate mobility decline among older females extends to other non-genetically determined but socially construed non-modifiable sociodemographic factors, such as ethnicity and cultural identities. These factors can be socially engineered through a cultural practices review (Lie et al., 2012; Vásquez et al., 2020), good governance, intentional equity, and social justice (Braveman et al., 2011; Peter, 2001; Voelker, 2008; World Health Organization, 2022).

Modifiable factors identified in our study were marital status, province of residence, housing, retirement, health condition, and economic factors such as income and savings. These

factors are considered modifiable because they can be influenced by personal choices or targeted government policies. Being married or having a partner may improve the mobility trajectory of older adults (Perkins et al., 2016; Sengupta & Agree, 2002). Hossain et al. (2021) posited that married older adults had a lesser risk of mobility difficulty, whereas unmarried status was disadvantageous, particularly for women. It underscores that having aid in the house may not offer the positive effect of a partner. Married individuals have more household income, access to care, housing, and social support, which can help them maintain physical activity and engagement in daily activities (Hossain et al., 2021). Older adults who have lost their spouse may be encouraged to get a partner, cohabit, or coreside for companionship.

Residence in a province is a personal choice based on economic or environmental interests. A systematic review of provincial policies on ageing across Canada showed some critical differences (Wilson et al., 2012). The policies have implications for housing, post-retirement employment, income, and access to health. For instance, Alberta's policy promised financial security, housing, and health care. While having similar statements, Nova Scotia specified workplace support to encourage older workers' participation and post-retirement volunteering (Wilson et al., 2012).

Our findings align with other studies that identify housing (Do & Kim, 2013; García-Esquinas et al., 2016; Oswald et al., 2007) and financial security (Shumway-Cook et al., 2005; Smith & Goldman, 2007) as essential predictors of mobility outcomes in older adults. Higher-income or wealthy individuals have more education and high-paying but sedentary occupations (Beltrán-Sánchez et al., 2017; Darin-Mattsson et al., 2017; Kyrönlahti et al., 2021), leading to inactivity and its life course sequelae. Conversely, low-income earners may have lesser education, manual jobs, limited health access, and early biophysical decline (Beydoun & Popkin, 2005;

Cattell, 2001; Marmot, 2002). We found middle-income earners and moderately wealthy older adults to have better mobility than people at both extremes.

Aside from the study's primary objective, we tested the validity of 4MWT using the TUG as a criterion. Pearson correlation analysis showed a strong positive longitudinal concurrent correlation between TUG and 4MWT scores. However, the lateral displacement of the curves in Figures 6.1-6.4 showed that TUG is a more stable measure of mobility in this population compared to the 4MWT. Previous studies have established good psychometric and clinimetric properties of TUG among community-dwelling older adults (Podsiadlo & Richardson, 1991; Soubra et al., 2019; Steffen et al., 2002). While 4MWT has acceptable levels of validity and reliability among older adults (Peters et al., 2013), there is a paucity of data on its other psychometrics, such as normative values, responsiveness, and minimal clinically important changes (Bohannon & Wang, 2019).

The results and discussions of this study have highlighted areas for policy action. Ageing policies should be formed and implemented in cognizance of sociodemographic inequalities. National resources, infrastructures, utilities, and services should be distributed considering older adults, particularly those from lower socioeconomic backgrounds and women. Future research may investigate the role of technological advancements and their potential to mitigate the decline in mobility.

**Limitations**

This secondary analysis has some limitations inherent in the CLSA comprehensive cohort. Data collection was limited to predominantly urban areas across seven of the ten Canadian provinces. Due to self-selection, cohort studies like CLSA, which require written consent, language proficiency, and in-person visits, may under-represent less literate, recent migrants, and

those with health issues (Raina et al., 2019). However, the weighted baseline variables of CLSA were comparable with estimates generated from Canadian census data and other nationally representative surveys (Raina et al., 2019). One of the typical limitations of longitudinal studies is attrition or loss of follow-up. There were some missing data and variables and losses to follow up in FU1 and FU2, which was more remarkable in FU2 due to the COVID-19 pandemic. Our study may not have covered all the sociodemographic determinants of mobility decline and their intersectionality.

**Conclusion**

This study highlights the impact of sociodemographic factors on the mobility trajectory of older adults. Non-modifiable factors such as being older, a woman, and non-Caucasian, along with modifiable factors including being a retiree, Canadian born, tenant, having no spouse or partner, lower income, social status, wealth and education, and the province of residence were significant predictors of mobility decline in the six-year follow-up multivariate model. These findings underscore the need for nuanced ageing policies that address both sociodemographic inequalities and economic disparities, ensuring equitable distribution of resources, particularly for vulnerable groups such as older women, non-Caucasians, and those with lower socioeconomic status. While the study acknowledges limitations, it offers crucial insights for future research and policy initiatives aimed at mitigating mobility decline among older adults.

**Declarations**

**Ethics and consent to participate.**

The Health Research Ethics Board of the University of Alberta approved the study protocol for this CLSA secondary analysis (reference number: Pro00129371). The original CLSA protocol

was reviewed and approved by 13 university-based ethics committees across Canada (Raina et al., 2009). The CLSA obtained informed consent from study participants before data collection (Raina et al., 2009). We did not have access to identifiable information of the participants. Details about the study are available at https://www.clsa-elcv.ca/data-collection (accessed on 06 January 2024).

**Consent for publication**

Not applicable.

**Availability of data and materials**

The data are available from the Canadian Longitudinal Study on Aging (https://www.clsa-elcv.ca/data-access) for researchers who meet the criteria for access to de-identified CLSA data. The datasets used in the present study were Baseline Comprehensive Dataset (version 7.0), Follow-up 1 Comprehensive Dataset (version 4.0), and Follow-up 2 Comprehensive Dataset (version 2.0).

**Competing interests**

The authors declare that they have no competing interests. The opinions expressed in this manuscript are the authors' own and do not reflect the views of the Canadian Longitudinal Study on Aging.

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There was no external funding for this study.

**Authors' contributions**

OKO, ACO, JV, JD, and OAA contributed to the conception of this study. OKO and OAA acquired the data from CLSA. OKO, CJA, ACO, JV, JD, and OAA substantially contributed to the design. OKO and OAA performed the statistical analysis. OKO was responsible for drafting the article. CJA, ACO, JV, JD, and OAA contributed to its critical revision. All authors approved the final manuscript for publication.

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# CHAPTER 7: MANUSCRIPT FOUR

## Sociodemographic factors in older adults' gait speed decline: a gender disaggregate growth curve analysis of the Ibadan Longitudinal Study of Ageing

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**Running Head:** Sociodemographic determinants of gait speed in older adults

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**Abstract**

**Background**: Gait speed is an important predictor of older adults' well-being. We estimated the influence of sociodemographic factors on the gait speed decline of community-dwelling older Nigerians.

**Methods:** Using the Ibadan Study of Ageing (2007, 2008, and 2009 cycles), we completed a gender disaggregate analysis of sociodemographic influences on participants' gait speed trajectory using mixed-design ANOVA and growth curve analysis.

**Results:** At baseline, 53.2% of participants were female, and 61.9% were married, with an average age of 75.5±6.8years and gait speed of 0.96±0.32m/s. Gender-specific models showed a slower gait speed decline in men ($\beta$=-0.05, $p<0.001$) compared to women ($\beta$=-0.09, $p<0.001$). Widowhood ($\beta$=-0.07, $p=0.001$) for women, high socioeconomic status ($\beta$=-0.01, $p=0.009$) for men, and chronic disease burden for women ($\beta$=-0.02, $p=0.010$) and men ($\beta$=-0.03, $p=0.008$) were significant predictors of gait speed decline.

**Conclusion:** Addressing culture-related widowhood and women's vulnerabilities, improving health coverage, and promoting lifestyle modifications may mitigate mobility decline among older Nigerians.

**Keywords**

Chronic disease, Mobility, Nigeria, Social determinants of health, Socioeconomic

## Background

Mobility is vital for quality of life in ageing, as it promotes functional ability and well-being in older adults (Freiberger et al., 2020). Functional capacity in older adults is often characterized by gait speed (Busch et al., 2015), which facilitates social participation, prevents isolation and depression, and enables independence in daily activities (Freiberger et al., 2020; Hirvensalo et al., 2000; Iezzoni et al., 2001). Decreased gait speed tends to increase the rate of falls, hospitalization, and all-cause mortality in older adults (Hardy et al., 2011; Studenski et al., 1994).

This study was grounded in the Social Determinants of Health (SDOH) framework, which explores how the systems into which individuals are born and live shape their health outcomes (World Health Organization, 2022). While the World Health Organization (WHO) identifies health access, education, economic, social, and environmental factors as key SDOH, demographic factors such as age, gender, marital status, and religious affiliation have also been linked to health inequalities within and across populations (Hosseini Shokouh et al., 2017; Karran et al., 2023). Therefore, this study examined the associations between gait speed decline and a broader range of sociodemographic variables including age, gender, marital status, area of residence, education, religious affiliation, religiosity, and socioeconomic status, using data from the Ibadan Study on Ageing (ISA), Nigeria.

Nigeria is the most populous nation in Africa (He et al., 2020). In 2020, Nigeria's 10.9 million older adults aged 60 years and above was the highest in Africa and the nineteenth in the world, with a projection to rise to eleventh in the world (33.2 million) by 2050 (He et al., 2020). Although studies on the sociodemographic determinants of mobility in older adults have been conducted in high-income countries such as the United States (Shumway-Cook et al., 2005) and

Canada (Onyeso et al., 2024), the findings may not be transferable to sub-Saharan Africa due to distinct societal contexts. For instance, while inequalities due to gender and marital status are less apparent in Western cultures (Pailhé et al., 2021), in Nigeria, gender roles and stereotypes linked to singlehood can significantly affect ageing experiences (Osinuga et al., 2021; Ude & Njoku, 2017). Moreover, whereas existential anxiety may drive religiosity among Western older adults, religiosity often serves their Nigerian counterparts as a coping mechanism against disease burden, low socioeconomic status, and oppressive cultural practices such as the social isolation of widows (Ede et al., 2023; Ekoh et al., 2023; Ude & Njoku, 2017).

The SDOH context varies across countries and regions (Hosseini Shokouh et al., 2017) because health inequalities are shaped by economic policies, development agendas, social norms, social policies, and political systems (World Health Organization, 2022). The study of gait speed decline among older adults holds particular relevance in Nigeria due to the systemic neglect of older adults in government policies (Mbam et al., 2022). There is financial and social insecurity, limited social amenities, and inadequate health coverage for older Nigerians (Mobolaji, 2024; Tanyi et al., 2018). Though access to healthcare, social and financial security, critical in preserving mobility during old age, have been espoused in the nascent Nigerian National Policy on Ageing (Federal Republic of Nigeria, 2020), its implementation remains limited (Mbam et al., 2022; Mobolaji, 2024). Older adults with stable finances can afford essential health services, medications, balanced diets, mobility aids, tickets to recreational facilities, and social events. (Mobolaji, 2024). This study aligns with the broader objectives of promoting healthy ageing through the lenses of social justice (Rudnicka et al., 2020).

In line with the global efforts to address the life-course socio-determinants of health, stakeholders continue to advocate for the implementation of the World Health Organization's

(WHO) Decade of Healthy Ageing (2020 to 2030) (Rudnicka et al., 2020) and Age-Friendly Cities initiatives (van Hoof & Marston, 2021). Through these initiatives, the WHO supports older adults' participation in all spheres of life, including social, cultural, civic, spiritual, and economic activities, without prejudice due to sociodemographic inequalities (Beard et al., 2017). The mission of these initiatives includes enhancing mobility in older adults by promoting physical activity, creating age-friendly environments, integrating health and social care, and fostering inclusivity. These initiatives are expected to be nationalized and implemented (Mbam et al., 2022; Tanyi et al., 2018) as governments in sub-Saharan Africa, including Nigeria, have started enacting national policies on ageing (Federal Republic of Nigeria, 2020; Saka et al., 2019).

Despite the recognized importance of maintaining mobility for the health and independence of older adults, there is a paucity of literature on the sociodemographic correlates of gait speed decline among older Nigerians. This paper appears to be the first longitudinal analysis of the sociodemographic determinants of gait speed decline among community-dwelling older Nigerians. Previous analyses of ISA focused on the association of habitual gait speed with cognitive functioning (Ojagbemi et al., 2015) and biophysical factors (Sprague et al., 2023). These studies found that slower gait speed was associated with poor cognitive performance (Ojagbemi et al., 2015; Sprague et al., 2023), as well as reduced physical activity, higher body mass index, and history of hypertension, after adjusting for age, gender, and education (Sprague et al., 2023). While Sprague et al. (2023) conducted a cross-sectional analysis of the 2007 wave of ISA, our study completed a longitudinal gender-disaggregated growth curve analysis spanning the three-year follow-up period (2007–2009). In addition to age, gender, and education, we incorporated marital status, area of residence, religious affiliation, religiosity, socioeconomic status, and chronic disease burden, and provided a more in-depth discussion contextualized within the Nigerian setting. We

offered policy recommendations to mitigate the risk of mobility impairments and enhance the quality of life for older adults in Nigeria.

Specifically, this study seeks to identify the extent to which factors such as age, gender, marital status, rurality, education level, and economic status are associated with changes in gait speed over time. We hypothesized that: (i) there would be a significant gender difference in participants' sociodemographic distribution; (ii) There would be a significant difference in participants' mean gait speed across study cycles (1 to 3) and categories of selected sociodemographic variables; (iii) There would be a significant linear and quadratic effect of time on gait speed trajectory over the follow-up period; (iv) There would be a significant fixed effect of sociodemographic variables on the gait speed trajectory; and (v) There would be a significant difference in the gait speed changes across individual participants (random slope variance).

## Methods

### Data source

This study is a secondary analysis of the Ibadan Study on Ageing (ISA), a community-based prospective observational study investigating the profile and determinants of successful ageing. The ISA focused on mental health, physical health, functioning, and disability among older Nigerians aged 65 years and above, with baseline data collected between November 2003 and August 2004. The study was conducted across eight Yoruba-speaking states in Nigeria: Lagos, Ogun, Osun, Ondo, Oyo, Ekiti, Kogi, and Kwara (Gureje et al., 2007). These states represented approximately 22% of the Nigerian population at the time of the study. A four-stage area probability sampling method was employed to select participants, with the Kish table used to recruit one participant per household if more than one eligible individual (≥ 65 years and fluent in Yoruba) was present. Baseline in-home interviews and physical assessments were conducted on

2,149 consenting participants, yielding a response rate of 74.2% (Gureje et al., 2007). The 25.8% non-response rate was attributed to the inability to trace participants using their recorded addresses, unavailability despite multiple attempts, refusal to participate, physical incapacitation, or death (Oladeji et al., 2011).

Gait speed measurements were first recorded in the 2007 cycle of the ISA, which comprised 1,356 participants, continuing in 2008 (n = 1,044) and 2009 (n = 957). Therefore, this secondary analysis focused on the second to fourth cycles of the ISA, with the 2007 cycle as the baseline for this analysis. Detailed descriptions of the ISA methodology are provided in earlier reports (Bekibele & Gureje, 2008; Gureje et al., 2007). Ethics approval for ISA was granted by the University of Ibadan/University College Hospital Joint Ethical Review Board.

**Outcome variable**

The primary outcome was habitual gait speed measured in the 2007, 2008, and 2009 data collection cycles. Participants were instructed to walk at their normal pace through a 1-metre acceleration zone, a central 4-metre testing zone, and a 1-metre deceleration zone, marked on a safe flat surface, without any verbal prompt (Ojagbemi et al., 2015). Gait speed (m/s) was calculated as distance in meters divided by time in seconds (measured with a stopwatch). In each cycle, the participants repeated the procedure twice and the shortest time was recorded (Ojagbemi et al., 2015). Habitual gait speed is one of the most commonly used tools for assessing mobility and functionality among community-dwelling older adults (Soubra et al., 2019). A recent systematic review of the measurement properties of the habitual gait speed test in community-dwelling older adults reported that the test has good psychometric and clinimetric properties, including intraclass correlation reliability ($r$ = 0.72 to 0.98) and concurrent, convergent, or discriminant validity ($r$ = 0.79 to 0.93) (Mehdipour et al., 2024).

**Exposure variables**

The explanatory variables were (sociodemographic factors obtained in the 2007 cycle) age, gender, marital status, area of residence, education, religious affiliation, and socioeconomic status. The number of chronic diseases (arthritis, diabetes, stroke, hypertension, chronic lung diseases, and cancer) was introduced in the regression models as a covariate.

**Variable description**

Age (years), habitual gait speed (m/s), years of education, socioeconomic status, and chronic disease count were continuous variables categorized afterwards for descriptive statistics. The categorical variables were age (68 to 74 years [youngest-old], 75 to 84 years [middle-old], 85 to108 years [oldest-old]), gender (male, female), area of residence (rural, urban [town, city]), marital status (married, single/separated/divorced, widowed), education (secondary and lower, above secondary), socioeconomic status (low, middle, high), religion affiliation (Christian Orthodox, Christian Pentecostal, Muslim, Traditional Religion, Others), religious frequency (more than once weekly, once weekly, once in many weeks), chronic disease status (no, yes), and attrition status (completed, lost).

**Data analysis**

The data were analyzed using R version 4.4.1, incorporating the tidyverse, psych, lme4, and lmerTest packages. The ISA analytic weight was applied to the dataset before analysis. The chronic disease and socioeconomic status were derived as follows: chronic disease count was a summation of the diagnoses of (value = 1) arthritis, diabetes, stroke, hypertension, chronic lung diseases, and cancer. The chronic disease count was dichotomized into chronic disease status: no (= 0) and yes (≥ 1). The socioeconomic status was derived using principal component analysis (PCA) of participants' household possessions at baseline (Vyas & Kumaranayake, 2006). Of the

21 household items, 11 items (bucket, desk telephone, motorbike, gas or electric cooker, bicycle, air conditioner, microwave, personal computer, mobile phone, deep freezer, motor vehicle) were excluded from the model due to having a category with less than 10% in the frequency distribution (Vyas & Kumaranayake, 2006). The factor loadings of the remaining ten items (tape player, clock, radio, electric fan, television, livestock, video cassette recorder, kerosene stove or coal pot, laundry iron, refrigerator) were obtained through PCA with tetrachoric correlation matrix to correct for the binary nature of the data. Each participant's socioeconomic status was calculated as their ∑ (item values X corresponding factor loadings), subsequently categorized into tertiles (low, middle, and high) (Vyas & Kumaranayake, 2006). The PCA showed good model fit indices: Bartlett's Sphericity Test $\chi^2(45) = 6528.47$, $p < 0.001$, and Kaiser-Meyer-Olkin Measure of Adequacy (KMO) = 0.860.

Participants' sociodemographic characteristics and gait speed were summarized using descriptive statistics: frequency, percentage, mean, and standard deviation. Before the inferential analysis, the data were tested for the assumptions of the statistical tool. The percentage and pattern of missingness did not require multiple imputation procedures (Fox-Wasylyshyn & El-Masri, 2005). Continuous variables were tested for univariate and multivariate outliers using a standardized Z-score > ± 3.29 and Mahalanobis-distance approaches (Garson, 2012; Tabachnick & Fidell, 2013). Normality (skewness test), sphericity (Mauchly's test), homogeneity of variance (Levene's test), linearity (Q-Q plot), and multicollinearity (variance inflation factor < 4) were determined (Garson, 2012; Tabachnick & Fidell, 2013).

For hypothesis I, Pearson's chi-square test ($\chi^2$) was used to test the gender differences in the distribution of the categories of the sociodemographic variables. Hypothesis II was tested using repeated measures mixed-design ANOVA ($F$) with Bonferroni adjusted post hoc comparison,

reporting Greenhouse-Geisser correction where Mauchly's assumption was violated. Hypotheses III to V were tested using maximum likelihood linear and quadratic growth curve analysis (GCA). Given that only 61.7% of participants (837 out of 1,356) completed all three data collection cycles, GCA was employed instead of multivariate longitudinal linear regression to avoid listwise deletion of participants with incomplete data and to preserve statistical power (Curran et al., 2010). GCA offers additional advantages of random effects modelling and linear and quadratic curve estimation, which provide a more nuanced understanding of variability in change across participants. Heckman's correction was applied to account for potential selection bias due to attrition. The model fit indices were assessed using the Akaike Information Criterion (AIC), the Schwarz Bayesian Criterion (BIC), and -2 Log Likelihood = (-2LL). The alpha level was set at 0.05 for all the inferential statistics.

**Results**

The ISA commenced in 2003 with a cohort of 2,149 participants. However, gait speed data was first collected in 2007 (n =1,356), with subsequent follow-ups in 2008 (n = 1,044) and 2009 (n = 957). Therefore, we refer to the 2007, 2008, and 2009 data as cycles 1, 2, and 3, respectively. Only 837 participants completed all three cycles, with attrition primarily attributed to deaths.

**Sociodemographic characteristics**

Table 7.1 shows the gender differences in the distribution of participants' sociodemographic characteristics. A little above half of the participants (53.2%) were within the youngest-old age group (68 to 74 years), with women having a higher proportion in older groups ($\chi^2[2] = 19.09, p < 0.001$). Concordantly, a higher proportion of the women (80.2%) were widowed relative to men (6.7%). The gender difference in marital statuses was significant ($\chi^2[2] = 820.72$, $p < 0.001$). Compared to women, a higher proportion of men had a higher level of education ($\chi^2[1]$

= 29.46, $p < 0.001$), held a higher socioeconomic status ($\chi^2[2] = 39.69$, $p < 0.001$), experienced fewer chronic diseases ($\chi^2[1] = 7.95$, $p = 0.005$), and demonstrated better gait speed ($\chi^2[1] = 35.74$, $p < 0.001$). There were no gender differences in religious affiliation or area of residence.

**Sociodemographic characteristics and time interaction in gait speed decline**

The gender-aggregated repeated measures mixed-design ANOVA (Table 7.2) presents the unadjusted main and interaction effects of sociodemographic characteristics and time (cycles) on participants' speed. The analysis was further visualized with separate line plots showing the gait speed trajectory across categories of each sociodemographic variable, using estimated marginal means (Figure 7.1). Table 7.2 showed a significant gait speed difference between the age groups and within each age group over time. The post hoc analysis showed that those aged 85-108 years had a significantly lower gait speed across the timeline compared to 75-84 years (estimated marginal mean difference [*MD*] = -0.16 m/s, 95% CI: -0.24, -0.08, $p < 0.001$) and 68-74 years (*MD* = -0.24 m/s, 95% CI: -0.32, -0.16, $p < 0.001$). Those aged 75-84 years also had significantly lower gait speed than their younger counterparts aged 68-74 years (*MD* = -0.08 m/s, 95% CI: -0.11, -0.04, $p < 0.001$). There was no significant difference in the rate of decline due to age group (age group*time interaction).

There were significant gender differences between and within groups, and gender*time interactions. Women had a significantly greater gait speed decline than men (*MD* = -0.13 m/s, 95% CI: -0.16, -0.09, $p < 0.001$). Similarly, there was a significant effect of marital status, time, and marital status*time interactions in the gait speed trajectory. Widowed participants had a significantly greater decline than their married counterparts (*MD* = -0.12 m/s, 95% CI: -0.16, -0.08, $p < 0.001$). Divorced, never married, and separated participants were not included in the comparison due to the extremely small sample size (1.5%).

There were significant between- and within-groups gait speed differences due to area of residence and socioeconomic status, but no significant group*time interactions. The between-groups post hoc analyses showed that both city (*MD* = -0.05 m/s, 95% CI: -0.10, -0.01, $p = 0.024$) and town dwellers (*MD* = -0.09 m/s, 95% CI: -0.14, -0.05, $p < 0.001$) had lower gait speed than rural dwellers. There was no significant difference between town and city dwellers (*MD* = -0.04 m/s, 95% CI: -0.08, 0.00, $p = 0.071$). Participants of high (*MD* = -0.11 m/s, 95% CI: -0.18, -0.04, $p = 0.003$) and middle socioeconomic status (*MD* = -0.05 m/s, 95% CI: -0.09, -0.01, $p = 0.009$) had lower gait speeds than those of low status. There was no significant difference between participants of high and middle socioeconomic status (*MD* = -0.06 m/s, 95% CI: -0.13, 0.02, $p = 0.149$). There was no significant between-group effect of level of education and religious affiliation or group*time interactions in the participants' gait speed.

**Table 7.1: Participants' sociodemographic characteristics (2007 cycle)**

| Parameter | Weighted Percentage (%) | | | χ2-statistic | *p*-value |
|---|---|---|---|---|---|
| | Male (n = 635) | Female (n = 721) | Total (n = 1356) | | |
| **Age group (years)** | | | | **19.09** | **<0.001*** |
| 68 – 74 | 56.4 | 48.6 | 53.2 | | |
| 75 – 84 | 36.8 | 38.2 | 37.3 | | |
| 85 – 108 | 6.8 | 13.2 | 9.5 | | |
| **Marital Status** | | | | **820.72** | **<0.001*** |
| Married | 91.8 | 18.3 | 61.9 | | |
| Never married/Separated/Divorced | 1.5 | 1.5 | 1.5 | | |
| Widowed | 6.7 | 80.2 | 36.6 | | |
| **Area of Residence** | | | | **5.58** | **0.60** |
| City | 37.2 | 40.0 | 38.4 | | |
| Town | 33.3 | 36.1 | 34.4 | | |
| Rural | 29.5 | 23.9 | 27.2 | | |
| **Education** | | | | **29.46** | **<0.001*** |
| Secondary and lower | 87.5 | 97.6 | 91.0 | | |
| Above secondary | 12.5 | 2.4 | 9.0 | | |
| **Economic Status** | | | | **39.69** | **<0.001*** |
| Low | 57.8 | 73.5 | 64.2 | | |
| Middle | 34.1 | 23.0 | 29.6 | | |
| High | 8.1 | 3.5 | 6.2 | | |
| **Religion** | | | | **5.43** | **0.246** |
| Christian Pentecostal | 7.4 | 9.8 | 8.4 | | |
| Christian Orthodox | 40.1 | 41.8 | 40.8 | | |
| Muslim | 46.3 | 42.4 | 44.7 | | |
| African Traditional Religion | 1.8 | 1.0 | 1.5 | | |
| Others | 4.4 | 5.0 | 4.6 | | |
| **Chronic Disease Status** | | | | **7.95** | **0.005*** |
| No | 55.4 | 47.9 | 52.3 | | |
| Yes | 44.6 | 52.1 | 47.7 | | |
| **Gait speed (m/s)** | | | | **35.74** | **<0.001*** |
| 1 m/s and above (normal) | 56.5 | 35.1 | 48.0 | | |
| Below 1 m/s (abnormal) | 43.5 | 64.9 | 52.0 | | |

Source: ISA 2007 cycle. * = χ2-statistic was significant ($p<0.05$)

**Table 7.2: Mixed-design ANOVA for sociodemographic and study cycle effects on gait speed decline.**

| Parameter | Partial Eta Squared ($\eta^2_p$) | *F*-statistic (df) | *p*-value |
|---|---|---|---|
| **Age group** | 0.075 | 21.46 (2, 528) | <0.001* |
| Cycle | 0.072 | 41.09 (2, 1056) | <0.001* |
| Age group x Cycle | 0.007 | 1.84 (4, 1056) | 0.120 |
| **Gender** | 0.079 | 45.22 (1, 529) | <0.001* |
| Cycle | 0.169 | 107.56 (2, 1058) | <0.001* |
| Gender x Cycle | 0.020 | 10.89 (2, 1058) | <0.001* |
| **Marital status** | 0.070 | 39.70 (1, 525) | <0.001* |
| Cycle | 0.160 | 99.83 (2, 1050) | <0.001* |
| Marital status x Cycle | 0.011 | 5.82 (2, 1050) | 0.003* |
| **Area of residence** | 0.031 | 8.36 (2, 528) | <0.001* |
| Cycle | 0.200 | 131.69 (2, 1056) | <0.001* |
| Residence x Cycle | 0.008 | 2.052 (4, 1056) | 0.085 |
| **Education** | 0.002 | 0.89 (1, 360) | 0.346 |
| Cycle | 0.075 | 29.02 (2, 720) | <0.001* |
| Education x Cycle | 0.009 | 3.22 (2, 720) | 0.042* |
| **Socioeconomic status** | 0.025 | 6.63 (2, 528) | 0.001* |
| Cycle | 0.086 | 49.99 (2, 1056) | <0.001* |
| Socioeconomic status x Cycle | 0.009 | 2.28 (4, 1056) | 0.059 |
| **Religion affiliation** | 0.017 | 2.31 (4, 522) | 0.057 |
| Cycle | 0.060 | 33.33 (2, 1044) | <0.001* |
| Religion x Cycle | 0.014 | 1.88 (8, 1044) | 0.059 |

Source: weighted ISA dataset 2007, 2008, and 2009 cycles. * = *F*-statistic was significant at $p < 0.05$.

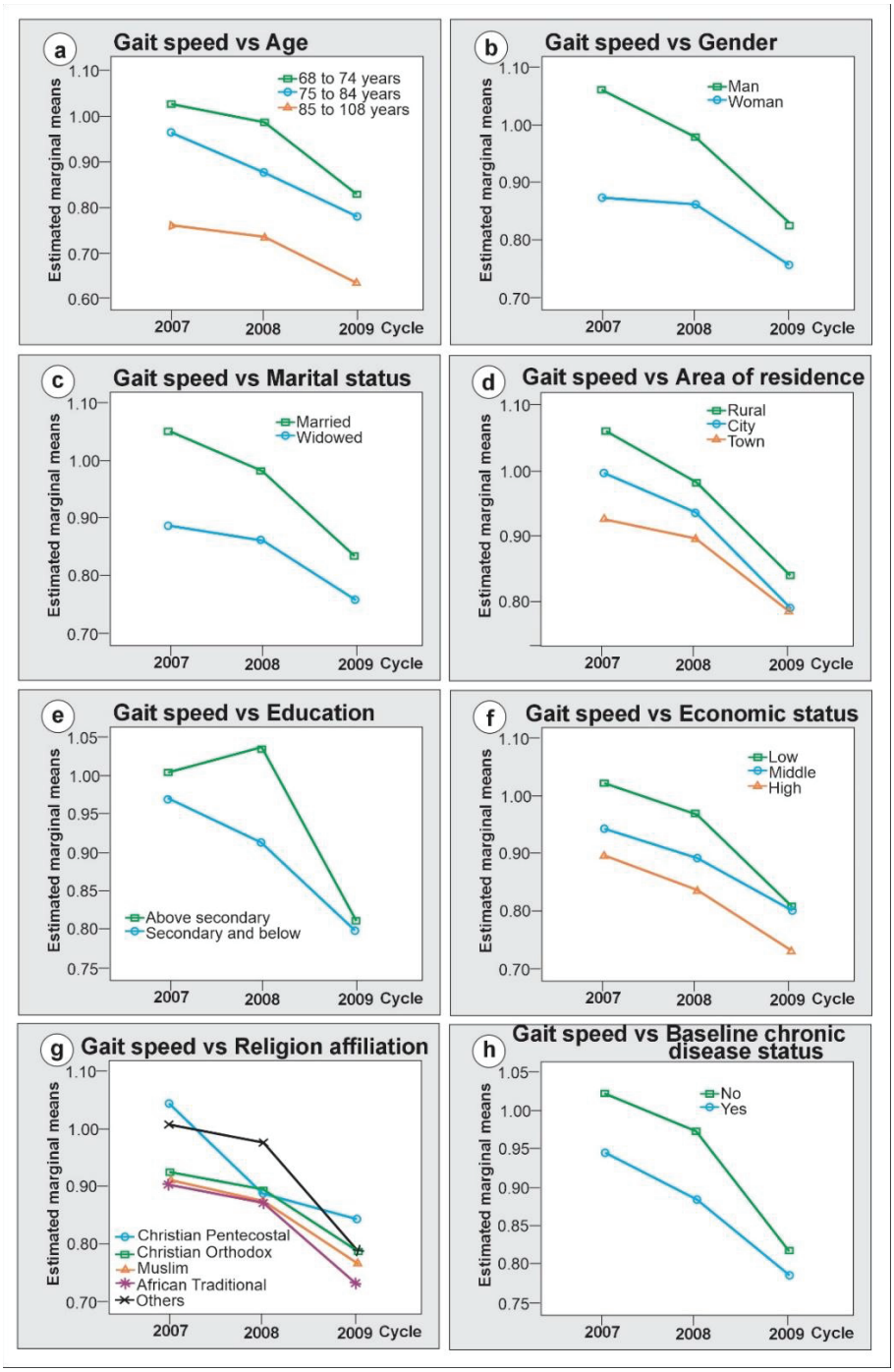


**Figure 7.1: Marginal mean differences in gait speed decline across sociodemographic factors.**

Source: weighted ISA dataset.

**Multivariate analysis**

**Fixed effects**

Table 7.3 shows the multivariate linear growth curve models for the fixed effects of time and sociodemographic factors on gait speed trajectories. In the combined model, time, age, gender, socioeconomic status, religious affiliation, frequency of religious practice, and the count of chronic diseases demonstrated significant associations with gait speed. The intercept values indicated that baseline gait speed was significantly higher among men (β = 1.97, 95% CI: 1.70, 2.25, $p < 0.001$) compared to women (β = 1.55, 95% CI: 1.35, 1.76, $p < 0.001$). The β-statistic for the cycle/time in the combined and gender-disaggregated models indicated that gait speed declined significantly across the study period. However, the disaggregated models showed that men had a slightly slower rate of decline (β = -0.05, 95% CI: -0.07, -0.03, $p < 0.001$) than women (β = -0.09, 95% CI: -0.11, -0.08, $p < 0.001$), indicating a gender-specific pattern in mobility trajectory. Increased age was associated with a consistent decline in gait speed in both genders, with each additional year reducing gait speed by a small but significant margin across both women and men (β = -0.01, 95% CI: -0.01, -0.01, $p < 0.001$).

Marital status had a significant effect only among women, with widows displaying a significant gait speed decline compared to married women (β = -0.07, 95% CI: -0.11, -0.03, $p = 0.001$). No significant differences were observed for men or in the combined model. Higher socioeconomic status was associated with a faster gait speed decline in the combined (β = -0.01, 95% CI: -0.01, -0.00, p = 0.003) and men's models (β = -0.01, 95% CI: -0.01, -0.00, p = 0.009). Religious affiliation also influenced gait speed negatively for Muslims in the combined (β = -0.05, 95% CI: -0.07, -0.02, p = 0.001) and men's models (β = -0.06, 95% CI: -0.10, -0.02, p = 0.004) compared to the Orthodox Christians. Frequency of religious practice, however, was a significant

predictor across all models, with greater religious involvement correlating with greater gait speed decline (combined model: β = -0.06, 95% CI: -0.09, -0.04, $p < 0.001$; women: β = -0.07, 95% CI: -0.10, -0.05, $p < 0.001$; men: β = -0.07, 95% CI: -0.01, -0.04, $p < 0.001$). Similarly, chronic diseases significantly impacted gait speed decline across all models, with increased chronic disease burden associated with lower gait speed (combined model: β = -0.03, 95% CI: -0.04, -0.01, $p < 0.001$; women: β = -0.02, 95% CI: -0.04, -0.01, $p = 0.010$; men: β = -0.03, 95% CI: -0.05, -0.01, $p = 0.008$). However, the level of education and area of residence were not associated with any statistically significant differences in gait speed across gender groups.

The model fit indices, including the AIC and BIC, confirmed a good fit for all models, with the combined model achieving the best fit -2 LL = 411.69 (Table 7.3). We compared the linear and quadratic growth curve models using the likelihood ratio test (LRT) to determine whether adding a quadratic time component improved model fit. Though there were minimal differences in AIC, BIC, and -2LL between the two models, there was no statistically significant difference ($\chi^2[1] = 2.409$, $p = 0.121$), indicating a steady rate of decline in gait speed over time without acceleration in later cycles. Therefore, there was insufficient evidence to support the addition of a quadratic time term to the model; the linear growth curve model was deemed sufficient to capture the trajectory of gait speed within this cohort.

**Table 7.3: Linear growth curve: Fixed effects of time and sociodemographic factors on gait speed decline.**

| Variable | Both Gender | | | Women | | | Men | | |
|---|---|---|---|---|---|---|---|---|---|
| | β-statistic | 95% CI | *p*-value | β-statistic | 95% CI | *p*-value | β-statistic | 95% CI | *p*-value |
| **Intercept** | 1.85 | 1.67, 2.02 | <0.001* | 1.55 | 1.35, 1.76 | <0.001* | 1.97 | 1.70, 2.25 | <0.001* |
| **Cycle** (time linear) ref: 2007 | -0.08 | -0.09, -0.06 | <0.001* | -0.09 | -0.11, -0.08 | <0.001* | -0.05 | -0.07, -0.03 | <0.001* |
| **Gender** (ref: men) | -0.07 | -0.11, -0.03 | 0.001* | - | - | - | | | |
| **Age** (increase in years) | -0.01 | -0.01, -0.01 | <0.001* | -0.01 | -0.01, -0.00 | <0.001* | -0.01 | -0.01, -0.01 | <0.001* |
| **Marital status** (ref: married) | -0.02 | -0.06, 0.02 | 0.386 | -0.07 | -0.11, -0.03 | 0.001* | 0.06 | -0.02, 0.14 | 0.115 |
| **Area of residence** (ref: rural) | 0.00 | -0.03, 0.03 | 1.000 | -0.03 | -0.07, 0.01 | 0.191 | 0.01 | -0.04, 0.05 | 0.724 |
| **Education** (ref: ≤ secondary) | -0.04 | -0.09, 0.01 | 0.138 | -0.20 | -0.73, 0.33 | 0.452 | -0.03 | -0.10, 0.03 | 0.294 |
| **Socioeconomic status** (increase) | -0.01 | -0.01, -0.00 | 0.003* | -0.00 | -0.01, 0.00 | 0.196 | -0.01 | -0.01, -0.00 | 0.009* |
| **Religion** (ref: Christian Orthodox) | - | - | - | - | - | - | | | |
| Christian Pentecostal | -0.01 | -0.06, 0.05 | 0.828 | -0.05 | -0.10, 0.01 | 0.119 | 0.03 | -0.05, 0.12 | 0.415 |
| Muslim | -0.05 | -0.07, -0.02 | 0.001* | -0.03 | -0.07, 0.01 | 0.095 | -0.06 | -0.10, -0.02 | 0.004* |
| **Religion frequency** (increase) | -0.06 | -0.09, -0.04 | <0.001* | -0.07 | -0.10, -0.05 | <0.001* | -0.07 | -0.10, -0.04 | <0.001* |
| **Chronic diseases count** (increase) | -0.03 | -0.04, -0.01 | <0.001* | -0.02 | -0.04, -0.01 | 0.010* | -0.03 | -0.05, -0.01 | 0.008* |
| **Model fit indices** | | | | | | | | | |
| -2 Log Likelihood (-2LL) | 411.69 | | | 20.88 | | | 252.34 | | |
| Akaike's Information Criterion (AIC) | 443.69 | | | 50.88 | | | 282.34 | | |
| Schwarz's Bayesian Criterion (BIC) | 526.21 | | | 116.40 | | | 350.62 | | |

Source: weighted ISA dataset. * = Standardised regression coefficient (β) was significant at $p < 0.05$. Note: There was no significant difference between the linear and quadratic growth curves.

**Random effects**

The random effects analysis highlights individual differences in baseline gait speed and its trajectory across time for each model. The intercept variance ± standard deviations for the combined model (0.052 ± 0.228 m/s), women model (0.054 ± 0.232 m/s), and men model (0.052 ± 0.228 m/s) showed significant variability in baseline gait speed among individuals. The slightly higher intercept variance in the women's model indicates more variation in initial gait speed among women compared to men. The variance for the linear time component reflects moderate variation in the rate of gait speed decline across individuals (combined: 0.009 m/s, women: 0.010 m/s, men: 0.009 m/s). The negative correlation between intercept and time linear effects (women: -0.83, men: -0.78) indicated that individuals with higher initial gait speed experienced a faster decline over time, especially among women. The residual variance reflects individual differences unexplained by the model (combined and men: 0.0418, women: 0.0143). Lower residual variance in the women's model suggests that sociodemographic factors accounted for a larger portion of the variance in gait speed decline among women compared to men.

**Discussion**

Biophysical factors in older adults' gait speed decline are often researched, but there is a paucity of literature on the social determinants of gait speed trajectory (Onyeso et al., 2023). Therefore, we explored the sociodemographic determinants of gait speed among community-dwelling older adults in Nigeria. The baseline sociodemographic profile of our study cohort was similar to observations from older adult cohorts from around the world (Sprague et al., 2023). Here, women tended to live longer, had more chronic diseases, and were more likely to be widowed compared with men. On the other hand, men had higher education, greater socioeconomic status, and faster gait speed (Gureje et al., 2007; Sprague et al., 2023).

The unadjusted repeated measures mixed-design analysis of variance showed that being older, a woman, widowed, an urban dweller, and of high socioeconomic status predisposes Nigerian older adults to a faster mobility decline. No statistically significant differences were found across religious affiliations and levels of education. However, the multivariate-adjusted gender disaggregated models show that older age, widowhood, religiosity, and more chronic disease burden were significantly associated with mobility decline in women, while for men it was older age, high socioeconomic status, religiosity, being a Muslim, and more chronic disease burden. Since the effects of age, sex, and multi-comorbidity in older age mobility have been explained in the biophysical models (Ahmed et al., 2016; Boulifard et al., 2019; Sprague et al., 2023), our discussion focused on social factors such as marital status, religiosity, socioeconomic status, area of residence, and education. Notwithstanding, the biological implications of ageing and sex in functioning, intersecting socially constructed factors such as ageism and sexism can deepen inequalities which affect the life-course mobility experiences (Ahmed et al., 2016).

The influences of post-colonization and globalization on Nigerian younger generations have led to the erosion of cultural values of respect and empathy for older adults, fostering implicit ageism and reducing community-based social support for older Nigerians (Tanyi et al., 2018). Ageism involves stereotyping and discrimination against older adults, which can reduce their confidence and lead to social isolation (Achenbaum, 2015). This discrimination restricts supportive environments and opportunities for physical activity, contributing to sedentary lifestyles that may accelerate physical decline and impair mobility and health among older adults (Chang et al., 2020). In Africa, the intersectionality of ageism and sexism disproportionately affects older women due to traditional gendered roles, such as childbearing, childcaring,

homemaking, food processing, farming, and other forms of unrecognized and unpaid labour which may contribute to earlier and more severe mobility disabilities in women (Osinuga et al., 2021).

Marital status was found to be a significant determinant of mobility decline, aligning with previous studies that suggested being married positively impacts older adults' mobility (Onyeso et al., 2024; Perkins et al., 2016; Sengupta & Agree, 2002). Our results indicated that widowed older Nigerians experienced a greater decline in gait speed than their married counterparts, particularly among women, highlighting the importance of spousal companionship for maintaining mobility (Hossain et al., 2021). Widowhood, in particular, introduces an additional layer of intersectionality for women. Widowed individuals across different cultures in sub-Saharan Africa, especially women, often face demeaning culturally prescribed mourning rituals that can extend up to one year, involving social isolation, oppression, deprivation, abuse, economic hardship, and powerlessness (Ude & Njoku, 2017). This situation makes it difficult for widows to access essential care and social services critical to delaying gait speed decline (Perkins et al., 2016). Additionally, psychosocial distresses of widowhood, including grief, anxiety, depression, and isolation (Trivedi et al., 2009) may accelerate mobility decline (Hossain et al., 2021). In the context of the WHO's Decade of Healthy Ageing, stakeholders should broaden discussions to include remedies for older people affected by such oppressive practices (Ude & Njoku, 2017). Unlike biological age and sex at birth, the negative impact of ageism, gender roles, and widowhood are modifiable. By reducing stereotypes about the widowed, older adults who have lost a spouse might be encouraged to find a new partner, cohabit, or live with others to foster companionship.

We found that higher socioeconomic status was significantly associated with greater mobility decline. In contrast, a four-year follow-up longitudinal study in the USA associated higher socioeconomic status with lesser mobility decline (Chen et al., 2012). Other studies suggest that

higher socioeconomic status supports better mobility in older age by improving access to healthcare and recreational facilities and reducing the likelihood of engaging in physically demanding manual jobs in midlife (Beltrán-Sánchez et al., 2017; Landsbergis et al., 2003; Shumway-Cook et al., 2005). In Nigerian society, individuals from lower socioeconomic backgrounds often engage in active lifestyles, including farming, fishing, crafting, cycling, and walking as part of activities of daily living, maintaining their mobility through midlife to older age. Conversely, individuals from higher socioeconomic backgrounds experience greater affluence, engage in more sedentary occupations, and adopt less active lifestyles, which have been associated with a higher risk of chronic diseases and mobility limitations (Akarolo-Anthony & Adebamowo, 2014). The context and methods of measuring socioeconomic status are crucial. Instead of a subjective assessment of social status using a ten-rung social ladder (Chen et al., 2012), we calculated the socioeconomic index based on ownership of certain household items, reflecting participants' relative affluence within the cohort. Moreover, higher socioeconomic scores correlated with the prevalence of chronic diseases, suggesting the possibility of a sedentary lifestyle among wealthy Nigerians (Akarolo-Anthony & Adebamowo, 2014). Therefore, we recommend healthcare insurance and social schemes to mitigate the effects of low socioeconomic status on disadvantaged populations and encourage lifestyle modifications among affluent individuals.

High religiosity was associated with greater mobility decline. In the Nigerian context, older adults often believe in supernatural intervention for various life circumstances, including chronic incurable diseases and age-related disabilities (Ede et al., 2023). Anecdotally, this belief is especially prevalent among women, vulnerable groups such as widows, and individuals with lower educational and socioeconomic status, as observed in this cohort. While religiosity was not

explicitly defined in the ISA dataset, it may encompass both spiritual beliefs and social engagement through religious activities, which can help older adults remain active and maintain independence (Kleiber & Genoe, 2012). Religion can also involve physical activities such as dancing, processions, and prolonged sitting, standing, bending, or kneeling, which may have musculoskeletal implications, particularly increased joint load and degeneration among older adults (Nisa et al., 2024). Our findings indicated that older Muslim men experienced more gait speed decline than Orthodox Christians. It remains unclear whether this difference arises from spiritual beliefs, social engagement, specific physical practices associated with Muslim worship (Nisa et al., 2024), or religious marginalization within the population. Given these findings, it may be beneficial to consider older adults' physical health status and trajectories when advising on worship activities, ensuring routines align with individual health status.

We found no significant effect of educational attainment and area of residence in the multivariate models, while rural dwellers had a lesser decline in the unadjusted model. Similar to our findings, Sprague et al. (2023) analyzed secondary datasets from six countries and found higher education associated with better gait speed, except for the ISA dataset which showed no significant result. Another longitudinal study with a four-year follow-up reported that higher education attainment was associated with less mobility decline (Gomes et al., 2023). Notably, 91% of ISA participants had secondary or lower education, which may result in a dominance effect in the model (Tabachnick & Fidell, 2013). Our recent systematic review showed a paucity of literature on the influence of the area of residence on gait speed decline, with contrasting outcomes. For instance, compared to urban residents, rural residence was significantly associated with lower gait speed in bivariate analyses (Lunar et al., 2019) but faster gait speed within a multivariate-adjusted model (Boulifard et al., 2019). While urban living may increase access to health and social

services, it can also encourage a more sedentary lifestyle due to reliance on technology and the availability of efficient public transport systems (Keating, 2008; van Hoof et al., 2021). In contrast, rural areas often provide advantages such as neighbourhood safety, social cohesion, informal support networks, natural environments, and food security (Tanyi et al., 2018). Regardless of where one ages, the WHO's Decade of Healthy Ageing (2020–2030) (Rudnicka et al., 2020) and the Age-Friendly Cities initiative (van Hoof et al., 2021) advocate for supportive socio-environmental conditions that enable individuals to maximize their mobility potential and maintain participation in all life activities as they age.

**Clinical Significance**

Gait speed is often regarded as the "sixth vital sign" in geriatrics due to its strong predictive value for health outcomes such as hospitalization, disability, and all-cause mortality (Mehdipour et al., 2024). Gait speeds below 1 m/s are associated with an increased risk of falls, speeds below 0.8 m/s predict poor clinical outcomes and speeds at or below 0.6 m/s indicate significant mobility impairment in community-dwelling older adults (Abellan van Kan et al., 2009). Our study revealed that 43.5% of men and 64.9% of women had gait speeds below 1 m/s, with a multivariate-predicted annual decline of 0.08 m/s. These findings highlight the critical need to incorporate gait speed assessments into routine geriatric evaluations, particularly in Nigeria, where a significant proportion of older adults fall below the critical gait speed threshold.

We recommend annual gait speed assessments for adults aged 65 years and above to enable early detection of mobility impairments and facilitate targeted sociomedical interventions. These interventions should include financial and social security measures, as well as improved access to healthcare services such as physiotherapy, structured exercise programs, and fall prevention initiatives. A proactive approach to mobility assessment and intervention has the potential to

enhance health outcomes, reduce disability rates, and improve the overall quality of life among older adults globally.

**Policy Implications**

There is a need for targeted policy interventions to address sociodemographic factors influencing gait speed decline in older Nigerians. The Nigerian National Orientation Agency and the Federal and State Ministries of Women Affairs should explore gender-sensitive programs aimed at improving literacy, access to health, and community-based recreational opportunities among women. Moreover, cultural barriers should be addressed through awareness campaigns and legal protections to challenge discriminatory and oppressive practices against women and widows by setting a precedent in the Customary Court of Appeal.

The National Senior Citizens Centre (NSCC) is responsible for coordinating the efforts to address Nigerian older adults' financial and social insecurities and economic barriers to healthcare via the implementation of the National Policy on Ageing (Federal Republic of Nigeria, 2020). One priority area for NSCC should be an expansion of the National Health Insurance Scheme (NHIS) for total coverage of geriatric care, physiotherapy, fitness activities, and walking aids for older adults. Additionally, integrating chronic disease management into primary healthcare, routine mobility screening, subsidized medication, and lifestyle modification programs can help mitigate mobility decline in the short term.

In the medium- and long-term, policies should be tailored to improve the walkability of the environments and provide public recreational facilities, especially in rural areas, to encourage physical activity participation among sedentary older adults of all socioeconomic backgrounds. Age-friendly community templates can be adopted from global frameworks such as the World Health Organization's Age-Friendly Cities and the Decade of Healthy Ageing initiatives. These

strategies can enhance mobility, reduce disability rates, and improve the overall quality of life for Nigeria's ageing population.

**Limitations**

This secondary analysis has some limitations inherent in the Ibadan Longitudinal Study on Ageing (ISA) design and dataset. Though ISA offers substantial insights into the health of older Nigerians, several limitations impact the interpretation and generalisability of its findings such as sample frame, demographic characteristics of participants, attrition, and follow-up interval. Primarily focused on Yoruba-speaking regions in southwestern and north-central Nigeria, the study's geographical and cultural scope limits its applicability to other ethnic groups and regions within the country, though analytic weight was applied to account for national variations. Additionally, even with Heckman's correction, missing data and participant attrition stemming from mortality and loss to follow-up could introduce biases. Reliance on self-reported data for chronic health conditions may not align with clinical assessments, and variables such as education, religious frequency, and household items are susceptible to social desirability which may affect data accuracy. Although ISA has a longitudinal design, the yearly follow-up cycles between 2007 and 2009 limit the ability to observe extended temporal changes essential to ageing research.

**Conclusion**

Sociodemographic factors such as age, gender, marital status, religiosity, and socioeconomic status influence mobility trajectory among older Nigerians. The findings bring to the fore certain sociocultural realities of ageing within the Nigerian context. While gait speed declines with age across all participants, women tend to have lower baseline values and steeper decline. These gender differences may be attributed to socially constructed women's roles, such as homemaking and childcare demands, as well as multifaceted feminine deprivations, including

unequal access to education, healthcare, social participation, and economic resources. Additionally, widowhood in women emerged as a significant predictor of gait speed decline, potentially linked to oppressive cultural practices such as forced isolation, stereotyping, and restrictions on social engagements during a prescribed period of mourning and afterwards.

Men of high socioeconomic status exhibited greater mobility decline. While they could afford healthcare, they are anecdotally known to lead more sedentary lifestyles, which may contribute to this trend. Islamic religious affiliation was a significant factor for men, while chronic disease burden and high religiosity were associated with greater gait speed decline in both genders. Nigerian older adults often resort to supernatural intervention when faced with anxieties resulting from debilitating life course conditions such as chronic diseases and mobility decline. These findings highlight the nuanced influence of sociodemographic factors on gait speed decline, suggesting a need for targeted interventions that account for these gender-specific trajectories.

## Statements and declarations

### Ethical considerations

The University of Ibadan/University College Hospital Joint Ethical Review Board approved the original ISA protocol and secondary analyses.

### Consent to participate

All participants signed a written informed consent form before participating in the study. Details about the study are available at https://portal.dementiasplatform.com.au/crs-directory/isa?form=MG0AV3.

### Consent for publication

Not applicable.

## Conflicting interests

The authors declare that they have no conflicting interests. The opinions expressed in this manuscript are the authors' own and do not reflect the views of the Ibadan Study of Ageing.


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## Data availability

The data are available from the Ibadan Study of Ageing, University College Hospital, Ibadan, Nigeria. Researchers who meet the criteria for access to anonymized ISA data can apply using the link: https://portal.dementiasplatform.com.au/crs-directory/isa?form=MG0AV3.


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## Authors' contributions

OKO, ACO, JV, JD, and OAA contributed to the conception of this study. OKO, ACO, and OAA acquired the data from ISA. OKO, CJA, AO, KMO, ACO, JV, JD, TB, OY, and OAA substantially contributed to the design. OKO, CJA, and OAA performed the statistical analysis. OKO, CJA, and KMO were responsible for drafting the article. AO, KMO, ACO, JV, JD, TB, OY, and OAA contributed to its critical revision. All authors approved the final manuscript for publication.

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## CHAPTER 8: MANUSCRIPT FIVE

Manuscript under review in the BMC Geriatrics

# Life-course sociodemographic determinants of mobility decline: a comparative qualitative study of Canadian and Nigerian older adults' perspectives


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**Running Head:** Sociodemographic determinants of mobility decline


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**Abstract**

**Background:** Mobility is fundamental to healthy ageing and quality of life, emphasizing that older adults should be able to continue participating in all spheres of life, including social, cultural, civic, spiritual, and economic activities. This study explored and compared the perspectives of Canadian and Nigerian older adults on the life course sociodemographic determinants of mobility decline.

**Methods:** We recruited eighteen Canadian and eighteen Nigerian community-dwelling older adults from diverse sociodemographic strata through community-based organizations. Using a qualitative description design, we interviewed the participants about their perceptions of life-course mobility decline with a focus on sociodemographic determinants. The transcripts were coded and analyzed using conventional content analysis.

**Results:** Of the 36 participants aged 65 to 89 years, 52.8% were men, 66.7% were married, and 86.1% were middle-income earners. Four themes emerged: Demographic factors were perceived to influence mobility decline with notable cultural differences in perception. While countries' participants believed that older age, ageism, and having no partner or spouse negatively influence mobility, most Canadian participants perceived no gender impact, whereas Nigerians perceived a negative impact of women's roles on life-course mobility. Socioeconomic factors (education, occupation type, and income) emerged as critical determinants. Sociocultural factors (traditional dietary patterns, religious practices, and social participation) and socioenvironmental factors (urban versus rural living conditions, housing, and climatic challenges) also influence the mobility trajectories of older adults. Most Canadians perceived poorer mobility among rural dwellers, while Nigerians believed the converse. Participants advocated for supportive environments and policies to mitigate mobility decline, recognizing the unique sociodemographic contexts of older adults.

**Conclusion:** Sociodemographic factors may disproportionately influence mobility decline. Policymakers can enhance equity in ageing experiences by implementing age-friendly community initiatives that support the mobility of older adults, especially in low-resource and rural areas.

**Keywords**: Gerontology, Healthy ageing, Independent living, Life course, Mobility limitation, Social determinants of health

## Background

The global rise in the ageing population accentuates the importance of understanding and addressing the challenges of ageing (Freiberger et al., 2020; United Nations, 2023). Ageing is a life-course process that culminates in human senescence (World Health Organization, 2020). Although ageing is a universal phenomenon, older adults across various sociodemographic backgrounds experience it differently (Plouvier et al., 2016; World Health Organization, 2020), These differences extend to its effects on biopsychosocial functioning, including mobility (Hirvensalo et al., 2000).

Mobility was conceptualized in this study as community ambulation (Patla & Shumway-Cook, 1999), and defined as a person's ability to move around safely and independently, with or without an assistive device (Reijnierse et al., 2023). Mobility is a key predictor of healthy ageing, quality of life, physical disability, dependency, and mortality among older adults (Freiberger et al., 2020; Hirvensalo et al., 2000). Life-course mobility decline may be influenced by various sociodemographic factors, such as age, gender, income, occupation, social status, and living environment (Shumway-Cook et al., 2005; World Health Organization, 2020). Beyond the direct impact of individual sociodemographic factors, there exists a complex interplay of intersecting disadvantages that can exacerbate the experiences of certain marginalized groups. For instance, a Black older woman living in a Caucasian-dominated society may encounter higher mobility limitations due to compounded challenges in socioeconomic integration arising from the intersection of ageism, sexism, and racism (Thorpe et al., 2011).

Several global initiatives have been formulated to address the disparities in social determinants of health and promote healthy ageing. For instance, the World Health Organization's (WHO) Global Strategy and Action Plan on Ageing and Health and the Global Network for Age-

Friendly Cities and Communities aim to promote age-friendly environments and healthy ageing by aligning health and social systems with the needs of older adults (Beard et al., 2017). Similarly, the United Nations Decade of Healthy Ageing (2021-2030) fosters cross-sector collaboration to enhance older adults' lives through community-based programs and integrated care (Rudnicka et al., 2020; van Hoof et al., 2021). Additionally, the Healthy Ageing Collaborative and the European Innovation Partnership on Active and Healthy Ageing aim to promote the rights and quality of life of older adults, focusing on income security, healthcare access, and social inclusion (Bousquet et al., 2014; Rudnicka et al., 2020). Understanding the life course sociodemographic influences on mobility decline from the perspectives of older adults is crucial for developing effective strategies to enhance mobility and well-being among older adults (Birnie et al., 2011; National Institute on Aging, 2020; Onyeso et al., 2023; Plouvier et al., 2016).

This study aimed to explore the perspectives of Canadian and Nigerian older adults on the sociodemographic determinants of mobility limitations. The increasing older adult population in Canada, from 14% in 2006 to 19% in 2022 (Statistics Canada, 2023), and in Nigeria, from 3.1% to about 5% between 2012 and 2022 (Mbam et al., 2022), underline the need for this investigation. Canada and Nigeria were selected for their contrasting sociocultural, economic, and policy contexts, which offer a valuable opportunity for comparative analysis of ageing experiences. Canada represents a high-income country with well-developed social welfare systems (Statistics Canada, 2023), while Nigeria exemplifies a low-resource setting with community-based informal support systems (Mbam et al., 2022). This study addresses gaps in the global literature by incorporating perspectives from both the Global North and South, thereby contributing to universal and context-specific insights. The researcher’s expertise and familiarity with both countries enhance the study’s depth and authenticity. This research forms the qualitative component of a

broader multi-methods study examining the sociodemographic determinants of mobility decline. The larger study also includes a systematic review (Onyeso et al., 2023) and secondary analyses of data from the Ibadan Longitudinal Study of Ageing and the Canadian Longitudinal Study on Aging (Onyeso et al., 2024).

Grounded in Life Course Perspective (Elder et al., 2003), this study provides a comparative perspective of Canadian and Nigerian older adults on the cumulative impact of sociodemographic factors on mobility decline in older adults, emphasizing how lifelong experiences in diverse cultural contexts shape mobility outcomes in later life. This study addressed two key research questions: (a) What sociodemographic factors might play a role in the experiences of mobility decline among Canadian and Nigerian older adults? and (b) What are the participants' perceived sociodemographic modifications that can reduce their mobility decline? This study's findings will provide valuable insights for caregivers, mobility experts, and policymakers to support the ageing population effectively.

## Methods

### Study design

The study adopted a qualitative description design, a research paradigm rooted in constructionist epistemology and a naturalist perspective (Bradshaw et al., 2017). The holistic approach of the naturalistic perspective, which emphasizes capturing the complexity and interconnectedness of phenomena rather than isolating variables, aligns with the life course perspective (Elder et al., 2003). Qualitative description captures the distinctive aspects of qualitative research that differ from other methodologies, such as narrative inquiry, ethnography, phenomenology, or grounded theory (Bradshaw et al., 2017). For example, while descriptive phenomenology explores the essence and deep meanings of lived experiences, qualitative

description provides a broader, more practical understanding of experiences, emphasizing contextual and cultural factors (Willis et al., 2016). In healthcare research, qualitative description studies typically involve two sequential components: learning from participant insights and then leveraging this understanding to shape interventions (Sullivan-Bolyai et al., 2005). Therefore, the findings often hold significant relevance for practitioners and policymakers. Qualitative description design is best suited for the study as it focuses on uncovering and understanding phenomena, processes, or perceptions and perspectives of individuals experiencing the studied phenomenon (Bradshaw et al., 2017). This approach allows a nuanced understanding of how sociodemographic factors influence mobility in diverse cultural contexts.

**Ethics Approval**

The study was conducted in Canada and Nigeria between April 2023 and February 2024, with ethical approval from the Health Research Ethics Board of the University of Alberta, Edmonton, Alberta, Canada (reference number: Pro00134818) and the Health Research and Ethics Committee of the Faculty of Health Sciences and Technology, Nnamdi Azikiwe University, Awka, Anambra, Nigeria (reference number: ERC/FHST/NAU/2022).

**Context and Setting**

Canada is a high-income developed country with a population of 40 million, low population density (4 per $km^2$), life expectancy of 84.2 years, 81.9% urban settlement, and 19.0% of its population being 65 years and older (Central Intelligence Agency, 2024; Statistics Canada, 2023). In contrast, Nigeria is a lower middle-income developing country with over 200 million people, a higher population density (218 per $km^2$), a lower life expectancy of 62.2 years, 54.3% urban settlement, and 5.0% of its population being 65 years and older (Central Intelligence Agency, 2024; Mbam et al., 2022). The older adults in both countries belong to diverse

sociodemographic backgrounds, with English being the common language of communication. However, there are climatic differences, unlike Canada, there are no winters in Nigeria (Central Intelligence Agency, 2024).

The Canadian interviewees were located in Lethbridge, Southern Alberta. Lethbridge is known for its older adult-friendly environment, including accessibility, greenery, medical services, and low housing and living costs. Main occupations in Lethbridge span sales and services, trades, education, government services, healthcare, and agriculture, reflecting a diverse economy with a strong focus on service-oriented roles and farming. The Nigerian study was conducted in the southern Nigerian states of Anambra, Bayelsa, Enugu, Delta, Lagos, and Oyo, covering a multiethnic area characterized by diverse culture and geography ranging from savanna to rainforest zones. Most of the older adults in the region are located in rural areas, engaging in traditional occupations such as farming, animal husbandry, fishing, trading, and crafting.

**Participants and Recruitment**

In qualitative description design, the dynamics of a particular social group are scrutinized, and participants are purposefully selected based on the broader population that the study targets (Bradshaw et al., 2017). We purposively recruited 36 participants, 18 from each study setting, which aligns with a previous study that adopted this methodology (Fuseini et al., 2023). Canadian participants were recruited through recruitment posters shared at the Lethbridge Senior Citizens Organization, social events, public gardens, malls, and religious places. Nigerian participants comprised three individuals drawn from Anambra, Bayelsa, Enugu, Delta, Lagos, and Oyo states through recruitment posters shared in worship centres, markets, primary health centres, and the social media platforms of regional pensioners' organizations. Participants were eligible if they (i) were Canadian or Nigerian older adults (65 and above) with lived experience of mobility decline,

(ii) had resided in any of the study settings for the previous 20 years, (iii) were fluent in English, and (iv) were willing to sign an individual informed consent.

**Data Collection and Management**

The first author with the third or fifth author, conducted 30 to 60-minute in-person in-depth interviews or through video calls in the few instances ($n$ = 8) where in-person was not feasible (Irani, 2019). All interviews were conducted in English in the participants' chosen venue. Each participant signed an informed consent form before granting the interview. Participants' anonymity, confidentiality, data security, and rights to withdraw from the study were guaranteed.

The questions asked were: (i) Could you share your walking experiences – any notable changes or events related to your walking ability over the years? [Prompt: walking speed or distance], (ii) Can you discuss any specific circumstances, conditions, or factors that, if altered, you believe would have improved your walking status today? [Probe: Could you elaborate on how these factors have impacted your walking?], and (iii) What support do you think older adults need to maintain their mobility going forward? The interviewees were prompted or asked to expand where necessary. Reoccurring perspectives and intuitive nonverbal communications were recorded in a field note.

The interview was audio-recorded for both in-person and videoconference modes. Each interview was assigned a code comprising the participant's setting, serial number, and interview date. The recorded interviews were transcribed verbatim and shared with each participant for concurrence or clarification. This approach is part of the triangulation that enhances the credibility and trustworthiness of the data. The transcripts were anonymized and transferred to NVivo version 14.23.2 software for content analysis. All records pertaining to the interviews were converted to

electronic copies, password-protected and saved in a secure digital storage device at the University of Lethbridge.

**Data Analysis**

We employed a conventional qualitative content analysis by coding the data inductively without using preconceived categories (Hsieh & Shannon, 2005). This approach, closely resembling thematic analysis, is the most suitable type of content analysis when there is no existing theory or research to inform preconceived coding (Hsieh & Shannon, 2005).

The content analysis followed the steps described by Graneheim and Lundman (2004) and Zhang and Wildemuth (2017): (i) The first, third, and fifth authors read all the transcripts (12 each) to identify the breadth of the responses and independently develop a codebook based on emerging patterns. The codebooks were compared and harmonized. (ii) The transcripts were segmented into meaning units, which were later condensed. (iii) The underlying meanings of these condensed units were interpreted and abstracted into codes. (iv) Based on their differences and similarities, codes were organized into categories representing the manifest and latent content of participants' perspectives. (v) Subsequently, the authors derived the themes from interrelated categories.

The NVivo software helped us organize the transcripts for easy pooling and separation into study settings for code comparison and data visualization. The analysis focused on identifying convergent and divergent patterns within and between the Canadian and Nigerian participants, taking note of how their sociocultural contexts shaped their views. Convergence was determined when at least 90% of participants from both settings held a similar perspective about the influence of a sociodemographic factor on their mobility decline. We searched for dominant patterns, dissenting voices, and latent meanings. We also paid attention to code networks and overlaps; for instance, diet may belong to each of economic, cultural, and environmental factors, while race,

tribe, ethnicity, culture, and values may overlap. Our field notes were helpful as they contained subtle remarks and salient points necessary to contextualize the narratives. This enhanced the reflexivity in the coding process and kept us on track with the overall content of the interviews while paying attention to details.

**Positionality**

All the authors have strived for objectivity, continually reflecting on their preconceptions and the impact on the research process, from interviewing to data analysis, ensuring a balanced and respectful representation of participants' perspectives. The authorship includes Canadians and Nigerians with diverse sociodemographic identities, such as age, religion, and professional affiliations. The authors comprised four women and four men; one has a bachelor's degree, two have master's degrees, and five have doctoral degrees.

**Findings**

**Participants' Demographic Characteristics**

A total of 36 older adults, evenly split between Canada and Nigeria, were interviewed. Table 8.1 shows that the majority of participants (61.1%) were within the age range of 65-75 years, with Canadian participants being relatively older than Nigerians. Gender distribution was fairly balanced, whereby 52.8% of participants identified as men. Many participants had a spouse or partner (66.7%), lived in (semi)urban areas (72.2%), and reported moderate levels of lifetime incomes (86.1%). Many Nigerian participants reported low-level post-retirement incomes (38.9%) compared to their Canadian counterparts (0.0%). A small proportion of participants experienced loneliness (8.3%), social isolation (11.1%), or had disabilities (19.4%), and 16.7% used walking aids.

**Table 8.1: Participants' sociodemographic characteristics**

| Variable | Frequency (%) | | |
|---|---|---|---|
| | Canada (*n*=18) | Nigeria (*n*=18) | Total (*n*=36) |
| **Age (years)** | | | |
| 65-75 | 9 (50.0) | 13 (72.2) | 22 (61.1) |
| 76-89 | 9 (50.0) | 5 (27.8) | 14 (38.9) |
| **Gender** | | | |
| Women | 10 (55.6) | 7 (38.9) | 17 (47.2) |
| Men | 8 (44.4) | 11 (61.1) | 19 (52.8) |
| **Area of residence** | | | |
| Rural | 4 (22.2) | 6 (33.3) | 10 (27.8) |
| Urban/City | 14 (77.8) | 12 (66.7) | 26 (72.2) |
| **Marital status** | | | |
| Have no spouse/partner | 10 (55.6) | 2 (11.1) | 12 (33.3) |
| Have a spouse/partner | 8 (44.4) | 16 (88.9) | 24 (66.7) |
| **Religion** | | | |
| Irreligious | 4 (22.2) | 0 (0.0) | 4 (11.1) |
| Religious | 14 (77.2) | 18 (100.0) | 32 (88.9) |
| **Race** | | | |
| Caucasian | 18 (100.0) | 0 (0.0) | 18 (50.0) |
| Southern Nigerian | 0 (0.0) | 18 (100.0) | 18 (50.0) |
| **Education** | | | |
| Secondary or below | 2 (11.1) | 4 (22.2) | 6 (16.7) |
| Above secondary | 16 (88.9) | 14 (77.8) | 30 (83.3) |
| **Highest lifetime income** | | | |
| Low | 0 (0.0) | 1 (5.6) | 1 (2.8) |
| Middle | 15 (83.3) | 16 (88.9) | 31 (86.1) |
| High | 3 (16.7) | 1 (5.5) | 4 (11.1) |
| **Current income level** | | | |
| Low | 0 (0.0) | 14 (77.8) | 14 (38.9) |
| Middle | 13 (72.2) | 4 (22.2) | 17 (47.2) |
| High | 5 (27.8) | 0 (0.0) | 5 (13.9) |
| **House type** | | | |
| Shared building | 2 (11.1) | 5 (27.8) | 7 (19.4) |
| Private building | 16 (88.9) | 13 (72.2) | 29 (80.6) |
| **House ownership** | | | |
| Owner | 17 (94.4) | 13 (72.2) | 30 (83.3) |
| Rent | 1 (5.6) | 5 (27.8) | 6 (16.7) |
| **Lifetime main occupation** | | | |

| | | | |
|---|---|---|---|
| Homemaker | 2 (11.1) | 0 (0.0) | 2 (5.6) |
| Health worker | 3 (16.7) | 3 (16.7) | 6 (16.7) |
| Agric/trade/industry | 7 (38.9) | 4 (22.2) | 11 (30.6) |
| Teacher | 3 (16.7) | 6 (33.3) | 9 (25.0) |
| Civil and public servant | 3 (16.6) | 5 (27.8) | 8 (22.1) |
| **Social status** | | | |
| Low | 0 (0.0) | 2 (11.1) | 2 (5.6) |
| Middle | 16 (88.9) | 15 (83.3) | 31 (86.1) |
| High | 2 (11.1) | 1 (5.6) | 3 (8.3) |
| **Health Status** | | | |
| Poorer than agemates | 2 (11.1) | 1 (5.6) | 3 (8.3) |
| Same as agemates | 5 (27.8) | 3 (16.7) | 8 (22.3) |
| Better than agemates | 11 (61.1) | 14 (77.7) | 25 (69.4) |
| **Personality trait** | | | |
| Extroversion | 7 (38.9) | 7 (38.9) | 14 (38.9) |
| Ambiversion | 8 (44.4) | 4 (22.2) | 12 (33.3) |
| Introversion | 3 (16.7) | 7 (38.9) | 10 (27.8) |
| **Disability** | | | |
| No | 14 (77.8) | 15 (83.3) | 29 (80.6) |
| Yes | 4 (22.2) | 3 (16.7) | 7 (19.4) |
| **Loneliness** | | | |
| No | 17 (94.4) | 16 (88.9) | 33 (91.7) |
| Yes | 1 (5.6) | 2 (11.1) | 3 (8.3) |
| **Social isolation** | | | |
| No | 16 (88.9) | 16 (88.9) | 32 (88.9) |
| Yes | 2 (11.1) | 2 (11.1) | 4 (11.1) |
| **Walking aid** | | | |
| No | 14 (77.8) | 16 (88.9) | 30 (83.3) |
| Yes | 4 (22.2) | 2 (11.1) | 6 (16.7) |

**Experiences with Ageing, Mobility, and Sociodemographic Factors**

The first research question explored older adults' perceived sociodemographic factors in their life course mobility experiences. Table 8.2 shows the four factors (themes) that emerged from the codes, subcategories, and categories, and their weighted percentage contribution to the overall perspectives. Figure 8.1 shows perspective convergence and divergence among Canadian and Nigerian participants.

**Demographic Factors**

Demographic factors, including age, gender, and marital status, influenced mobility decline. Canadian and Nigerian participants frequently cited ageing, age-related restrictions in social and economic participation, and neglect of older persons as significant factors influencing mobility decline.

> *"It's difficult for me to walk around to church to social activities, going out of my house because my legs are becoming weak due to ageing."* – NG1, Man, 76, Construction.
>
> *"I guess our body's going to only work for so long before they start going downhill. Think age plays a role in mobility."* – CA4, Woman, 78, Nurse

Negative attitudes towards ageing and neglect of older adults were evident from the response, as exemplified by these quotes:

> *"I see some of my cohort with canes and walkers, diabetes, mobility, and some of them with heart problems like me. I wonder how we got into that terrible condition. If it wasn't an accident or genetic condition, then it's our fault. You've got to take charge of your own health."* – CA1, Man, 80, Teacher.

*"I have a friend right now who's in a facility she spent day after day, hour after hour, at home alone, while her daughter worked, and she thought the best place for her was a facility. She's doing the very same thing in the facility. I'm thinking that there could be more encouragement for this person to come out into the public. I think facilities should be downsized so that the people they are taking care of will have more attention.* – CA4, Woman, 78, Nurse.

Figure 8.1 shows that contrary to Nigerian participants, many Canadians did not perceive gender as a factor in their mobility experience, and when probed further, they asserted that men had more decline.

*"I don't think that gender has anything to do with mobility decline."* – CA16, Woman, 76, Homemaker/Housewife.

*"I see more crippled-up old men and I relate that back to doing more physical work. ... there are more overweight men than women and you see that gut that's sticking out six or eight inches and that causes back problems…you got mobility problems."* – CA8, Man, 76, Agrarian.

Conversely, in the Nigerian context, women were perceived as having more mobility problems.

*"Women suffer more mobility problems than men because they deliver children, do lots of home chores, women become aged [faster], they will have leg and waist pain. Sometimes they become too fat, which contributes [to mobility decline]* – NG11, Woman, 65, Civil Servant

*"...most women of my age in this village, I move faster than them. An average woman here from 50 years, finds it very difficult to move for half a kilometre."* - NG6, Man, 65, Police.

Most participants from Canada and Nigeria believed that harmonious partner or spousal support was beneficial for maintaining a good mobility trajectory in later life. The following quote summarizes participants' perspectives on marital status.

*"I think people who are married are generally healthier and that's partly physical, but it's also partly mental and social. Part of why people keep doing things and therefore keep being able to do things is because they have the motivation and when you're married, you have someone to encourage you and do things with you."* – CA8, Man, 76, Agrarian.

*"Having a spouse is one thing and having a friend is another thing. Yes, we're happy, always together and we do things together to some extent. Sometimes, I have to ginger [encourage] him to do certain things, which is not quite as easy for him. If you have a partner who understands you, who you understand, and you love each other, it will definitely affect your physical health."* – NG8, Woman, 73, Nurse.

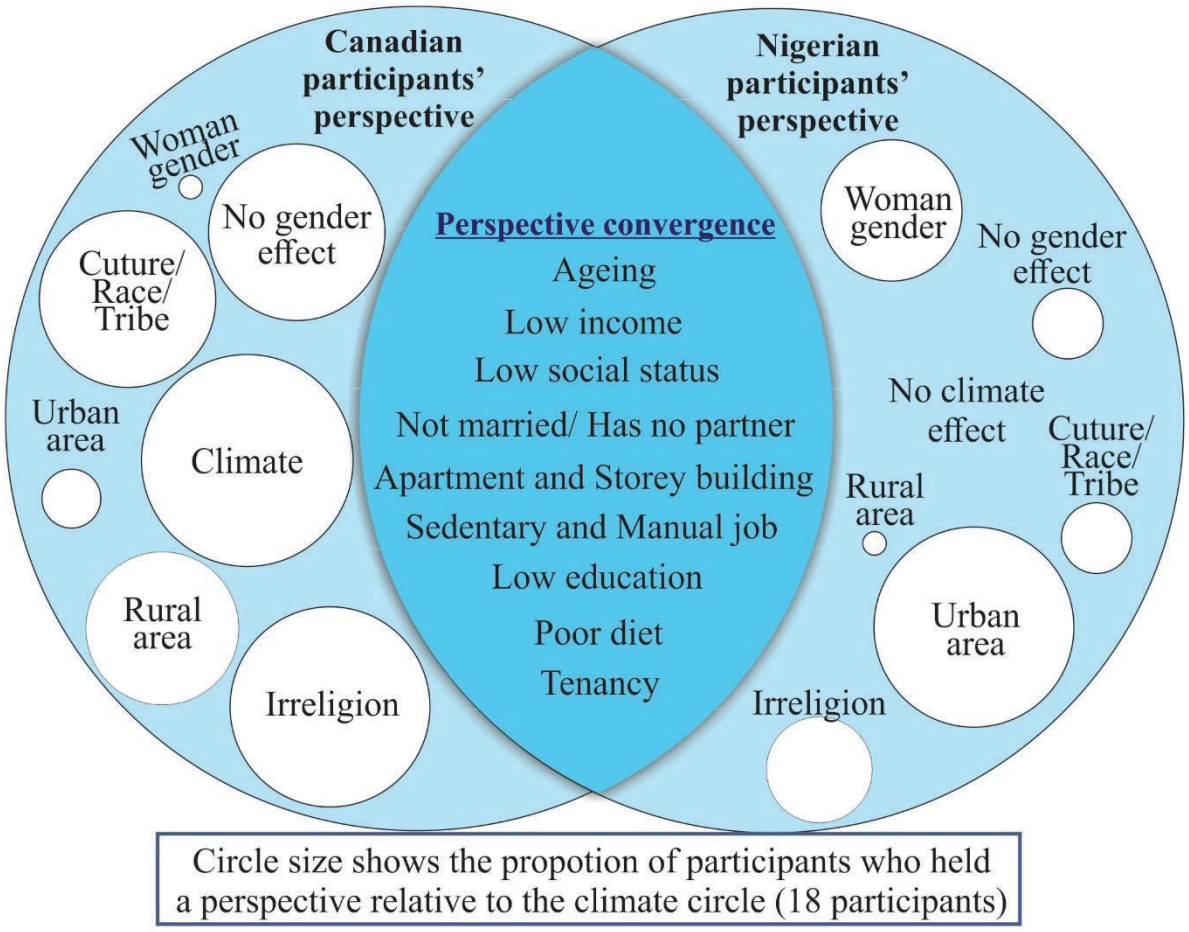


**Figure 8.1: Perspective convergence and divergence of Canadian and Nigerian participants on sociodemographic influences on mobility decline in older adults**

**Socioeconomic Factors**

Mobility experiences among the participants were also attributed to socioeconomic factors, including education, occupation, and income, constituting about 36% of the perceived social determinants (Table 8.2). A network visualization of the categories (Figure 8.2) shows the connection between socioeconomic factors and other sociodemographic determinants of mobility decline. For instance, a Canadian participant said,

> "*Education plays a role in career choice. If you are a high school dropout, your opportunities to make a living are a lot less than if you finish high school. That of course affects your financial situation. It affects your ability to decide whether you will have an apartment or whether you own your own home, and type of job…They will physically age more quickly than a teacher, let's say."* – CA1, Man, 80, Teacher.

Beyond economic status, most Canadian and Nigerian respondents linked education to health literacy which they believed influenced better mobility outcomes.

> *"Education helps a lot because I can understand the doctor's advice."* – NG3, Man, 67, Teacher.
>
> *"Education also kind of prepares you to know more about your health and how to take care of yourself and look after your mobility. Just to access, you know, resources and information."* CA2, Woman, 89, Homemaker

Financial stability was frequently mentioned as a crucial factor in maintaining mobility.

> *"The money you have and the support you get from people around you help you to eat good food and resolve minor health problems."* – NG1, Man, 76, Construction.

*"... if I were a very low income and I wanted to have surgery on my feet, forgetting that it didn't work out that well, I had the ability to take time off and do it. So, you don't have to be super rich, but if you're living from pay cheque to pay cheque, you don't have the ability to pay attention to stuff that supports your mobility."* – CA9, Woman, 76, Teacher.

Many participants acknowledged the positive role of financial stability, but some further posited that older adults who lived in excessive opulence may be caught up in a sedentary lifestyle, obesity, and mobility problems. Similarly, many believed that physically demanding jobs would be detrimental to later life mobility, but sedentary occupations would even be worse, hence, the perspective that people with a moderate income and work-life balance would have better mobility outcomes.

*"If you were engaged in a very act of demanding job, like lots of heavy lifting, moving, and exertion, I suppose if I apply that to myself, that would have been harder on my mobility, but being very sedentary is also extremely hard on keeping your mobility going."* – CA9, Woman, 76, Teacher.

*"Comparing myself to my age mates when I see them, some of them are just bent down, some are using walking sticks…But I move straight because of the type of job I did, physical education, I train people and I trained myself too, so I'm always moving."* – NG14, Man, 77, Naval Officer.

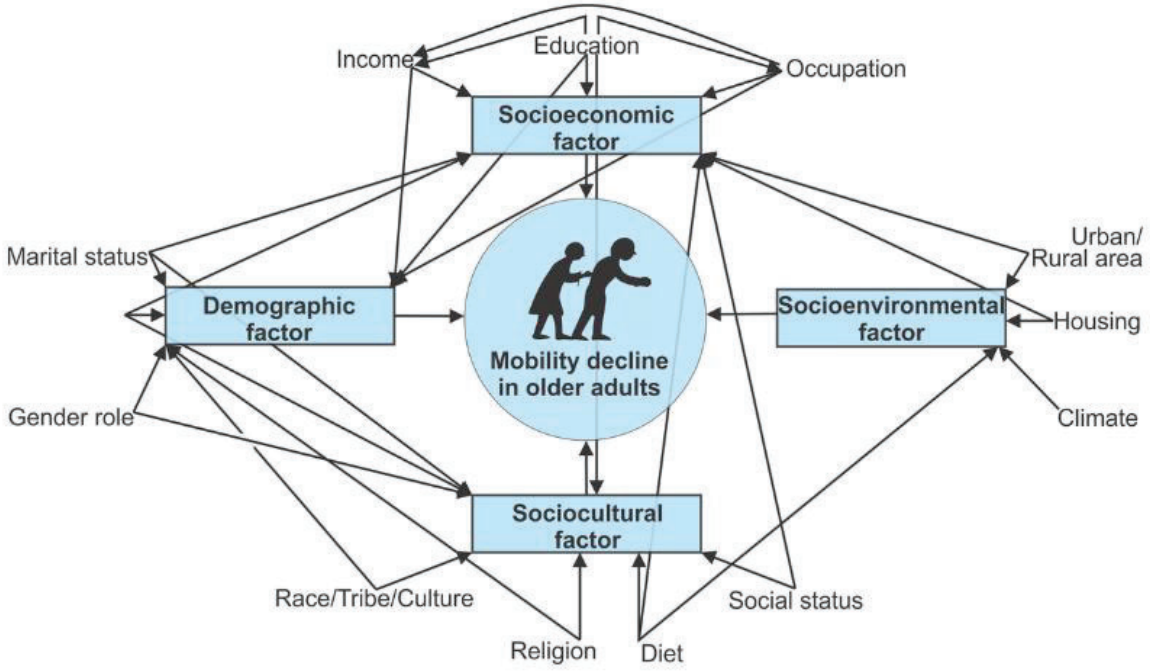


**Figure 8.2: Network visualization of the interactions among sociodemographic determinants of mobility decline in older adults**

**Sociocultural Factors**

Cultural factors, including health beliefs, lifestyle choices, and diet, were perceived to affect mobility in later life. A retired Nigerian nurse emphasized the life course effect of inter-tribal differences in dietary patterns.

> *"I've moved around [Southern Nigeria] … Our own children look better, not necessarily because there is a lot of protein, but lots of vegetables…every back of the house there is something to make food, and you understand we have seafood. So, nutrition is a big part of this situation in ageing."* – NG8, Woman, 73, Nurse.

Another participant criticized the genetically modified and processed North American diet, while a retired Canadian nurse emphasized the importance of a balanced diet and admonished food industries and the government to regulate the fat and sugar contents in packaged food.

> *"Their [traditional Kenyan] diet is not as fattening as the North American diet or the Western Diet. I think nutrition is one of the key factors in staying healthy and mobility…when I came to Lethbridge, I was 160 lbs., but now 220...carrying around 60 extra pounds 24hrs…have an effect on you."* – CA1, Man, 80, Teacher.

> *"Well, if you don't eat the proper food, it will affect your bones and your brain. So, we have the Canadian Food Guide…As you know, there's a lot of obesity, against in the years when people cooked their own food…Someone [Regulatory Agencies] needs to determine how much fat, or sugar could be in a product."* – CA4, Woman, 78, Nurse.

Social status and participation in community activities were among the sociocultural factors highlighted as beneficial in slowing down mobility decline. Two octogenarians emphasized the importance of social participation and social support.

*"I'm still engaged as a part-time teacher…being involved in social activities like community gatherings and church events helps me stay active and mobile."* – NG5, Man, 83, Teacher.

*"I'm in a privileged condition position, so I have access to support, but as you decline in the economic and social structure, the less and less support."* – CA7, Man, 84, Judge.

Perspectives differ on the roles of religiosity and spiritual beliefs in older adults' mobility trajectory. Many expressed that religion offers people opportunities for social participation and support, as depicted in the NG5 quote above. Others went further to discuss the benefits of spirituality.

*"There's a whole thing about hope and encouragement rather than just plain community participation… I'm a Christian. I believe that God loves me and wants the best for me and if I pray and ask for help and guidance in particular areas, including how I get around and my mobility and keeping me safe, I hope that he will answer my prayers, support, love and be with me."* – CA9, Woman, Teacher.

However, some participants did not recognize any impact of religion.

*"Why I said it [that religion does not matter] is that our [Pastor] used to stand while preaching, he's now 80 years old, he'll bring a seat, so no matter religion, when you stress in any way, it will affect your movement when you get old."* -NG13, Woman, 65, Trader.

**Socioenvironmental Factors**

Housing conditions, including homeownership and type of residence, impacted mobility, as can be deduced from the following quote.

*"If you live in your own home, which I do, I'm far more mobile than I would be if I lived in an apartment…you have a yard to maintain… you're out, walking, lifting, bending. I guess it's the yard that's probably the biggest thing."* – CA6, Woman, 70, Author.

There was a divergence of opinion between Canadian and Nigerian participants regarding the influence of neighbourhoods (Figure 8.1). Participants believed that Nigerian rural areas were more ageing-friendly than cities due to higher social support, security, a natural and safe environment, and opportunities for active living.

*"Just in day-to-day living, there's less physical activity in the city than there is in the villages. I have worked in agriculture; I've had a lot of experience with farm people as well and I would say generally when they are older, they're more able to do more than us, their agemates in the city."* – NG13, Woman, 65, Trader.

In contrast, many Canadian participants believed that older adults in the cities have more opportunities to access services beneficial to their mobility, including economic activities, and social, recreational, and healthcare facilities.

*"In the cities, there's more activity around us. If you're on the farm, then you have to rely maybe on your neighbour to come and do things with you."* – CA18, Woman, 68, Janitor.

Unlike Nigerian participants, their Canadian counterparts were wary of the seasonal weather conditions.

*"I think we are more exposed to the climate. When they're out in the country [environment], the weather in this area, of course, the wind is the major factor in the summertime, followed by the cold in winter."* – CA1, Man, 80, Teacher.

*"That's a very scary thing when you get older. So, the alleys are impassable during the winter and quite often, I can't get my vehicle out of the garage."* – CA5, Woman, 65, Teacher.

**Table 8.2: Content analysis showing example quotes and code, and the factors that emerged.**

| Factor (Theme) | Category | Subcategory | Code | Quote | % |
|---|---|---|---|---|---|
| Demographic Factor (35%) | Age | Age-related decline | Age, Aging, Older adult, Elderly, Senior, | "It's difficult for me to walk around to church to social activities going out of my house because my legs are becoming weak due to ageing." NG1, Male, 76 years<br><br>"I guess our body's going to only work for so long before they start going downhill. Think age plays a role in mobility." CA4, Female, 78 years | 10% |
| | | Age-related decline | | "It's called body betrayal…we want to do something but Oh, my hips are a little sore today…you know, I could wake up tomorrow morning and not be able to get out of bed." CA14, Male, 71 years<br>"I see some of my cohort with canes and walkers, diabetes, and some of them with heart problems like me. I wonder how we got into that terrible condition. If it wasn't an accident or genetic condition, then it's our fault. You've got to take charge of your own health. CA1, Male, 80 years | |
| | Gender | Gender differences | Man, Woman, Gendered role | "Women suffer more mobility problems than men because they deliver children, do lots of home chores, women become aged, they will have leg and waist pain. Sometimes they become too fat, that contribute…" NG 11, Female, 65 years<br><br>"…most women of my age in this village, I move faster than them. An average woman here from 50 years, finds it very difficult to move for half a kilometre." NG6, Male, 65 years | 15% |
| | | Gender attribute | | I don't think that gender has anything to do with mobility decline. CA17 Female, 70 years<br><br>I see more crippled-up old men and I relate that back to doing more physical work. … there are more overweight men than women and you see that gut that's sticking out six or eight inches and that causes back problems…you got mobility problems. CA8, Male, 76 years | |
| | Marital status | Partners' support | Married, Widowed, Partner | I think people who are married are generally healthier and that's partly physical. But it's also partly mental and social. Part of why people keep doing things and therefore keep being able to do things is because they have the motivation and when you're married you have someone to encourage you and do things with you. For sure, I think married are better off in their mobility. CA8, Male, 76 years | 10% |
| | | | | | |
| Socioeconomic Factor (36%) | Income | Financial stability | Bills, Money, | "The money you have and the support you get from people around you help you to eat good food | 18% |

| | | | | | |
|---|---|---|---|---|---|
| | | | Income, Pension, Poverty, Earnings, Retirement, Economic status, | and resolve minor health problems." – NG1, Male, 76 years<br><br>"… if I were a very low income and I wanted to have surgery on my feet, forgetting that it didn't work out that well, I had the ability to take time off and do it. So, you don't have to be super rich, but if you're living from pay cheque to pay cheque, you don't have the ability to pay attention to stuff that supports your mobility." CA9 Female, 76 years | |
| | Education | Health literacy | Education, Literacy, School, | "Higher education levels correlate with better health literacy and proactive health behaviours." CA5, Female, 65 years<br><br>"Education helps a lot because I can understand the doctor's advice." NG3, Male, 67 years | 15% |
| | Occupation | Job stress | Job type, Career, Manual job, Sedentary job, Profession | "I said 35 years I was a judge, I sat like this day in and day out for 35 years, and I didn't move. So, if you're in construction, obviously your mobility would be better. It would appear that in terms of mobility, even the privileged are at a disadvantage because they're not used to exercising." CA7, Male, 84 years<br><br>" Comparing myself to my age mates when I see them, some of them are just bent down, some are using walking sticks…But I move straight because of the type of job I did, physical education, I train people and I trained myself too, so I'm always moving." NG14, Male, 77 years<br><br>If you were engaged in a very act of demanding job, like lots of heavy lifting, moving, and exertion, I suppose if I apply that to myself, that would have been harder on my mobility in later years, but being very sedentary is also extremely hard on keeping your mobility going. CA9, Female, 76 years | 3% |
| | | | | | |
| Sociocultural Factor (14%) | Culture | Lifestyle | Race, Tribe, Nutrition, Diet, Physical activity | "I've moved around [Southern Nigeria] … Our own children look better, not necessarily because there is a lot of protein, but lots of vegetables…every back of the house there is something to make food, and you understand we have seafood. So, nutrition is a big part of this situation in ageing." NG8, Female, 73 years | 7% |
| | Social Status | Social participation | Social status, Social capital | I'm still engaged as a part-time teacher…being involved in social activities like community gatherings and church events helps me stay active and mobile. NG5, Male, 83 years<br><br>I'm in a privileged condition position, so I have access to support but as you decline in the economic and social structure, the less and less support. CA7, Male, 84 years | 5% |

| | | | | | |
|---|---|---|---|---|---|
| | Religion | Religious | Religiosity, Spirituality | "There's a whole thing about hope and encouragement [in Church and religious associations] rather than just plain community participation… you've got to stay as mobile as you can to continue to participate in that community. I'm a Christian. I believe that God loves me and wants the best for me and if I pray and ask for help and guidance in particular areas, including how I get around and my mobility and keeping me safe. I hope that he will answer my prayers, support, love and be with me." CA9 Female 76 years<br><br>"Why I said it is that our [Pastor] used to stand while preaching he's now 80 years old, he'll bring a seat, so no matter religion, when you stress in any way, it will affect your movement when you get old. NG13, Female, 65 years | 2% |
| | | | | | |
| Socioenvironmental Factor (15%) | Housing | Living Conditions | Homeownership, House type | "If you live in your own home, which I do, I'm far more mobile than I would be if I lived in an apartment…you have a yard to maintain… you're out, walking, lifting, bending. I guess it's the yard that's probably the biggest thing." CA6, Female, 70 years | 6% |
| | Area of residence | Neighbourhood | Neighbourhood safety, Rural, Urban, Physical environment | Just in day-to-day living, there's less physical activity in the city than there is in the villages. I have worked in agriculture; I've had a lot of experience with farm people as well and I would say generally when they are older, they're more able to do more than us, their agemates in the city. NG13, Female, 65 years<br><br>"In the cities, there's more activity around us. If you're on the farm, then you have to rely maybe on your neighbour to come and do things with you." CA18, Female, 68 years | 7% |
| | Climate | Weather | Cold, Winter, Wind, Summer, Icy walkway, Slippery | *"I think we are more exposed to the climate. When they're out in the country [environment], the weather in this area, of course, the wind is the major factor in the summertime, followed by the cold in winter." CA1, Male, 80 years*<br><br>*"That's a very scary thing when you get older. So, the alleys are impassable during the winter and quite often, I can't get my vehicle out of the garage." CA5, Female, 65 years* | 2% |
| 100% | | | | | 100% |

% = weighted percentage of code frequency.

**Modifications to Enhance Mobility in Older Adults**

The second research question explored the participants' perceived sociodemographic modifications that can ameliorate mobility decline among them. The word cloud of recommendations (Figure 8.3) showed that both Canadian and Nigerian participants connected mobility decline with social inequality and emphasized the need to encourage social participation and economic support. Table 8.3 shows the word frequency table for the fifty most frequently used words and phrases in the recommendation part of the transcripts.

Specifically, Canadian participants believed that subsidizing fresh food, exercise facilities, and social services for older adults would positively impact their mobility. They recommended that walkways be regularly cleaned in winter, additional crosswalks be installed on streets, pedestrian crossing times at traffic lights be extended, bicycle lanes be provided, and public buildings be made more accessible by installing guardrails.

> *"Maybe due to income, [recreational] activities could be priced [discount] for the individual so that they can get into more physical activity. Similarly, a lot of people will spend less on food or quality food because of income."* – CA11, Woman, 71, Admin. Executive.
>
> *"Governments should make buildings and the environment senior friendly. Walker accessibility such as inclined entrances, doors that open through pressing with your hand and all those things that the government does for us are really important. You know, elevators for the disabled and stair rails and sidewalks, that's very important too."* – CA2, Woman, 89, Homemaker.

Participants advocated for increased access to social organizations, citing one example in the City of Lethbridge that provides its members with social activities,

networking, health literacy, and physical activity facilities, which are crucial for maintaining mobility.

> *"I would say that the biggest single factor is to be socially involved, to have friends, to have people that are going to look after you and encourage you so to have a social network, whether that's through the family, a church, or a volunteering something. ... I see old folks' homes and lodges and stuff where people just sit all day."* – CA8, Man, 76, Agrarian.

One participant wanted the government to take note of older adults who are living solitarily without friends, family, or community support, while another advocated for more social participation for those in care homes.

> *"In fact, there's a gentleman that comes here [social club]. He's 89 years old and he's living at home on the... No, he doesn't have a friend. He doesn't know anybody... The authorities should [open a register for isolated older adults] come in and even know who he is, ...there are a lot of other people who are not mobile…and they rely on Meals on Wheels delivered to all kinds of people who are locked in their residences. Maybe someone could take them over, even if they identify who they are, you know, maybe through a social service system or the public services…find people and set up a program to get them out of there."* – CA7, Man, 84, Judge.

Similarly, Nigerian participants recommended various strategies to alleviate the social influences of mobility decline in older adults. Key suggestions included government support through better pension schemes, free healthcare, and recreational facilities for older adults.

*"It's so bad that so many people will get retired for years, with no gratuity, no pension. There is no person, no politician who will come up and speak for the elderly, everyone is fighting for his pocket. So, I'm suggesting the government should at least have a policy on ageing to ensure financial and social security [for older adults]."* – NG14, Man, 77, Naval Officer

*"…emulate what is happening overseas, those who are not pensioners or those who are not working are being paid, they can be able to take care of themselves, they can be able to select the type of food they want to eat but if you don't have money, you have no choice."* – NG4, Woman, 65, Nurse.

*"The governments over there will help Nigerians recognize [formulate a policy for] their old women [and men] to get a [caregiving] home, old age homes, not a foundation, like a public one [in communities] as we have the general hospitals."* – NG18, Woman, 65, Teacher.

Participants stressed the importance of physical exercise, balanced nutrition, avoiding sedentary lifestyles, and taking advantage of community cohesion and social support, especially in rural areas.

*"I think, what they [the government] can do is to provide recreational facilities for senior citizens in villages... make all public places accessible to people with wheelchairs, walking sticks, or whatever …if somebody is using a wheelchair and approaches a hospital without a ramp, it will be difficult for the person to get access to that facility."* – NG17, Man, 66, Teacher.

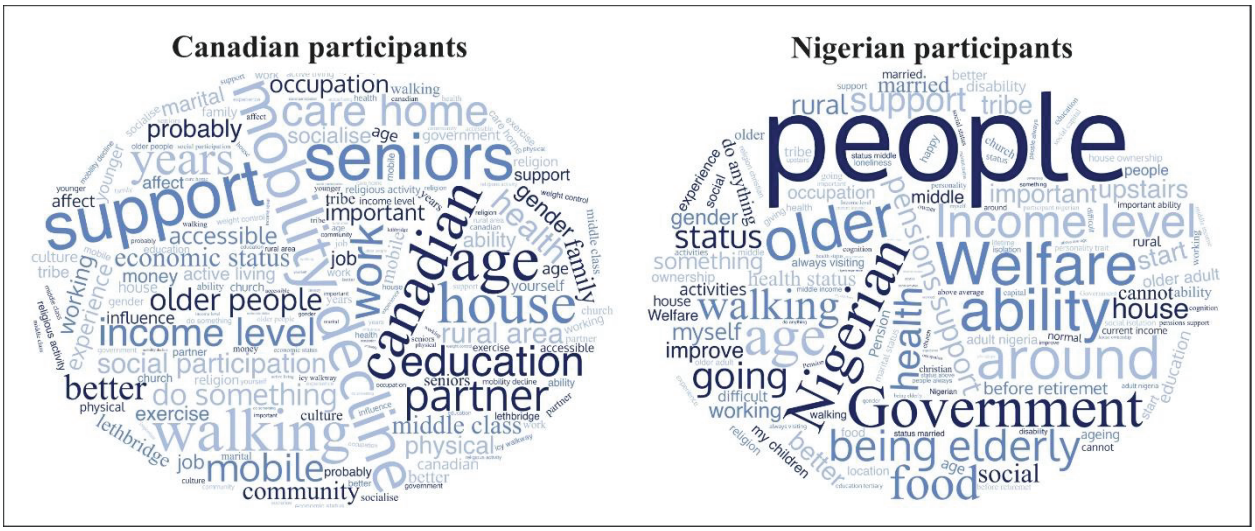


**Figure 8.3: Word cloud derived from participants' recommendations on how to ameliorate sociodemographic effects on mobility decline**

**Table 8.3: Frequency table for common words and phrases used in the recommendation.**

| | Canadian participants | | | Nigerian participants | |
|---|---|---|---|---|---|
| SN | Words/Phrases | Frequency | | Words/Phrases | Frequency |
| 1 | Canadian | 541 | | Nigerian | 982 |
| 2 | mobility decline | 414 | | pensions support | 761 |
| 3 | older people | 404 | | people | 750 |
| 4 | income level | 164 | | welfare | 342 |
| 5 | support | 140 | | older | 334 |
| 6 | seniors | 137 | | ability | 301 |
| 7 | age | 135 | | government | 292 |
| 8 | walking | 129 | | age | 282 |
| 9 | do something | 126 | | [move] around | 274 |
| 10 | house | 125 | | food | 234 |
| 11 | social participation | 117 | | income level | 220 |
| 12 | economic status | 115 | | walking | 209 |
| 13 | years | 104 | | health status | 206 |
| 14 | accessible | 99 | | being elderly | 202 |
| 15 | work | 95 | | health | 182 |
| 16 | care home | 92 | | support | 165 |
| 17 | partner | 92 | | status | 155 |
| 18 | education | 89 | | house | 134 |
| 19 | mobile | 80 | | rural | 128 |
| 20 | active living | 75 | | social | 126 |
| 21 | health | 69 | | tribe | 125 |
| 22 | rural area | 60 | | married | 109 |
| 23 | middle class | 55 | | cannot [disability] | 98 |
| 24 | religion | 55 | | do anything | 89 |
| 25 | community | 54 | | occupation | 86 |
| 26 | family | 54 | | Middle [class] | 85 |
| 27 | physical | 52 | | activities | 80 |
| 28 | occupation | 51 | | before retirement | 80 |
| 29 | Church | 49 | | education | 80 |
| 30 | experience | 47 | | my children | 67 |
| 31 | gender | 47 | | pension | 64 |
| 32 | working | 47 | | adult Nigeria | 62 |
| 33 | socialize | 46 | | upstairs | 61 |
| 34 | marital | 45 | | Church | 58 |
| 35 | ability | 44 | | [do things] myself | 55 |
| 36 | Lethbridge | 43 | | visiting | 54 |
| 37 | religious activity | 43 | | improve | 52 |
| 38 | exercise | 42 | | gender | 51 |
| 39 | Job | 41 | | working | 50 |

| | | | | | |
|---|---|---|---|---|---|
| 40 | money | 39 | | current income | 46 |
| 41 | influence | 35 | | Christian | 45 |
| 42 | tribe | 34 | | marital status | 43 |
| 43 | younger | 34 | | older adult | 39 |
| 44 | weight control | 33 | | above average | 38 |
| 45 | culture | 32 | | cognition | 36 |
| 46 | icy walkway | 31 | | difficulty | 35 |
| 47 | government | 30 | | disability | 35 |
| 48 | age-friendly | 30 | | experience | 34 |
| 49 | farmer | 28 | | middle income | 33 |
| 50 | winter | 24 | | ownership | 33 |

**Discussion**

The rising global population ageing warrants proactive policy actions to prepare for the anticipated pressures on social, economic, and health systems (Mbam et al., 2022; Statistics

Canada, 2023; United Nations, 2023). Mobility in older adults can enhance their social participation, economic engagement, independence, well-being, and quality of life (Freiberger et al., 2020; Hirvensalo et al., 2000; National Institute on Aging, 2020). This study fills a significant gap in the literature by exploring Canadian and Nigerian older adults' perspectives on sociodemographic influences on mobility and their recommendations for improvement. The comparative analysis provides more understanding of how sociodemographic determinants impact mobility decline in different sociocultural contexts (Birnie et al., 2011; Fung, 2013). The analysis of participants' perspectives yielded four themes: demographic, socioeconomic, sociocultural, and socioenvironmental factors, demonstrating how they shape mobility trajectories in later life.

Participants perceived age, gender, and marital status are pivotal demographic factors influencing mobility decline. Both Canadian and Nigerian participants identified ageing as a primary cause of mobility decline, citing physical frailty and perceived societal neglect of older persons as critical issues. This finding concurs with a previous study that identified age-related biophysical decline and components of ageism as having a negative impact on older adults' mobility and overall health conditions (Hausdorff et al., 1999).

Notably, gender perceptions diverged between the two groups. Canadian participants generally did not see gender as a significant factor. Conversely, Nigerian participants perceived women as more vulnerable to mobility problems, attributing this to gendered roles such as childbearing, childcare, and domestic responsibilities. This disparity highlights the culturally specific experiences and societal roles that sustain gendered inequality in mobility decline. While inequalities due to gender roles are less apparent in Western cultures (Pailhé et al., 2021), Nigerian women continue to be significantly more disadvantaged by marital duties, domestic work and other unpaid and often unrecognized jobs (Osinuga et al., 2021). Canada has made significant progress

in gender equality and inclusivity, but systemic inequalities and societal norms still influence gender roles, such that some Canadian couples still divide most household chores along traditional lines (Van Brenk, 2020).

Marital status emerged as a protective factor, with participants from both countries emphasizing the positive impact of spousal support on maintaining mobility. Although few voices highlighted the negative impacts of an unhealthy union, many believed that spousal social, emotional, and physical encouragement was crucial in fostering an active lifestyle, which is essential for sustaining mobility in old age (Perkins et al., 2016; Shumway-Cook et al., 2005). These terms were emphasized: "doing things together'' and "spousal encouragement to do things." We opined that the concept of companionship would be more inclusive than marriage. Cohabitation is increasingly common among older adults as a means of companionship, mutual support, and maintaining independence without the legal ties of marriage. This living arrangement can include shared responsibilities, such as financial obligations and household duties, and may involve a romantic relationship. To address these sociodemographic factors, we agree with Hausdorff et al. (1999) who posited that positive changes in society's view of ageing would help to reduce and prevent age-related mobility decline among older persons. Similarly, attitudinal shifts among spouses will abate the disparities in gendered roles (Pailhé et al., 2021), while widowed and unmarried older adults could be encouraged to have a social circle or cohabit (Perkins et al., 2016).

Socioeconomic factors encompassing occupation type, education, and income levels, were perceived as the most important social determinants of mobility experiences. Canadian and Nigerian participants associated being educated with less strenuous occupations, greater financial stability, and health literacy, enabling individuals to access and understand medical advice and

empowering them to adopt healthier lifestyles. This finding concurs with previous studies that found higher education associated with less physically demanding jobs, higher income, and better mobility outcomes in older adults (Beltrán-Sánchez et al., 2017; Plouvier et al., 2016; Shumway-Cook et al., 2005). A few participants opined that both extremes of the socioeconomic continuum may be deleterious for mobility in later life. Highly educated and very wealthy individuals often have sedentary jobs and lifestyles, resulting in chronic diseases and mobility limitations in old age, while people with menial jobs and poverty will have limited resources to maintain their health. One participant summarized this notion by saying, "Midlife socioeconomic status is a double-edged sword for mobility in later life."

Sociocultural factors, including racial and tribal divides, cultural and religious beliefs, social status, perceptions of ageing, lifestyle choices, and diet, were critical determinants of mobility. Fung (2013) argued that ageing is culturally contextualized, with internalized cultural values guiding adult development. This perspective helps us understand the socioemotional differences in how older adults perceive and pursue lifestyle and health. Both Canadian and Nigerian participants deemed social participation and community involvement vital for preserving mobility. Engaging in social activities, whether through community gatherings, church events, or professional networking, was seen as beneficial for both physical and mental health, aligning with findings from other studies (Corbett et al., 2018; Hirvensalo et al., 2000).

Participants also connected their tribes and cultures with traditional dietary patterns that may influence late-life mobility differently. They advocated for the consumption of organic food, particularly a vegetable-rich diet, from childhood and criticized highly processed packaged food with high sugar and fat content. The sociocultural theme highlights the broader influence of active lifestyles and cultural dietary practices on health and mobility.

Socioenvironmental influences on mobility decline were perceived differently by the Canadian and Nigerian participants. As the debate on which environment is more ageing-friendly between urban and rural settings continues (Keating, 2008; van Hoof et al., 2021), Canadian participants emphasized the benefits of living in urban areas, where access to healthcare, social services, and recreational facilities is improved. In contrast, their Nigerian counterparts viewed rural areas as more conducive to healthy ageing, citing the availability of respect, community cohesion, social support, safe environments, healthy food, lower cost of living, and natural ambience. It is noteworthy that many of the Canadian participants were urban dwellers. The few who lived or worked in rural areas shared a similar perspective with the Nigerians.

Since the launch of the World Health Organisation (WHO)'s Global Age-Friendly Cities project in 2006, stakeholders have been examining various ways to create and sustain age-friendly 'urban' communities, with little emphasis on rural areas (van Hoof et al., 2021). It is unclear why there is a paucity of voices championing age-friendly rural communities. However, the majority of older adults in sub-Saharan Africa reside in rural communities and require improved social amenities such as roads, electricity, potable water supply, access to healthcare, better housing, and financial support (Mbam et al., 2022). Addressing participants' recommendations in this and other studies, as well as conducting broader community needs assessments of older adults could enhance rural communities' natural age-friendliness, potentially making them the best places to age.

The findings of this study also suggest that, in contrast to living in high-rise rental properties with elevators and outsourced home maintenance, such as condominiums and apartments, residing in self-owned townhouses may be more beneficial for maintaining mobility due to the physical activity involved yard in maintenance (García-Esquinas et al., 2016; Oswald et al., 2007). Other environmental factors that may affect mobility in older adults include climatic

and seasonal weather changes, such as rising heatwaves in Nigeria and during summer in Canada, and harsh winters with their related trip hazards (Bergen et al., 2023). For safety reasons, older adults may need assistive devices or living assistance to navigate their environment.

**Policy Implications and Recommendations**

Mobility is a vital component of healthy ageing, reflecting the idea that older adults should be able to continue participating in all spheres of life as long as possible, including social, cultural, civic, spiritual, and economic activities. Although the concept of mobility is captured in Canadian and Nigerian policies on ageing (Federal Republic of Nigeria, 2020; Wilson et al., 2012), implementation has been scant in both countries. Governments should promote healthy ageing through policies that provide social security, protect the rights of older adults, and offer caregiving support. Such policies should be articulated within the framework of age-friendly communities, ensuring access to healthcare, social services, and recreational facilities. The Global Age-Friendly Cities project and similar initiatives should be expanded to include rural areas, particularly in sub-Saharan Africa, where enhancing social amenities such as roads, electricity, potable water, and housing is crucial.

Education policies should involve a lifelong learning agenda to promote health literacy and empower older adults to manage their health effectively. Economic support through effective pension schemes and financial assistance can help maintain mobility by improving social participation and access to nutritious food and healthcare. Operating food banks for older adults is another way to support their dietary intake. Participants asserted that establishing social centres for older adults will foster an active lifestyle and enhance their well-being. Promoting gender-affirmative actions in the labour market remains an effective way to bridge socioeconomic gaps and improve mobility outcomes for women. Beyond economic empowerment, there is a need for

legislation and advocacy for gender equity to ensure greater social autonomy for women, particularly regarding reproductive health. Moreover, recognizing and mitigating the impact of climate change on older adults' mobility is essential. By addressing these factors, policymakers can create a supportive environment that promotes mobility and well-being among older adults.

**Strengths and Limitations**

This study's comparative analysis offers an understanding of how older adults' perspectives on sociodemographic determinants of mobility decline differ in Canadian and Nigerian contexts. Its content analysis is a pragmatic approach to qualitative data with some quantification of the themes within the overall participants' perspectives, offering detailed insights. It also highlights culturally specific factors, making the findings highly relevant for tailored interventions. However, some Nigerian older adults may have limited English proficiency, impacting their ability to discuss abstract topics such as mobility decline. Despite these limitations, the study sets a solid foundation for improving mobility and quality of life in the study populations.

**Conclusion**

This study provides valuable insights into the significant roles of demographic, socioeconomic, sociocultural, and socioenvironmental factors in shaping mobility experiences among older adults in Canada and Nigeria. This comparative analysis buttresses the importance of culturally sensitive interventions, age-friendly communities, and a holistic approach to ageing policies considering the diverse experiences and challenges faced by older adults across sociodemographic strata. Policymakers can support healthier ageing and better mobility outcomes by promoting lifelong learning, providing economic support, social amenities, and discount services, improving housing conditions, and encouraging social participation among older adults. Future research should continue to explore these determinants and develop targeted

strategies for urban and rural age-friendly communities to mitigate mobility decline and enhance the quality of life for older adults globally.

## Statements and declarations

### Ethical considerations

The Health Research Ethics Board of the University of Alberta, Edmonton, Alberta, Canada (reference number: Pro00134818) and the Health Research and Ethics Committee of the Faculty of Health Sciences and Technology, Nnamdi Azikiwe University, Awka, Anambra, Nigeria (reference number: ERC/FHST/NAU/2022) approved the study protocol.

### Consent to participate

Each participant signed an informed consent form before granting the interview. Participants' anonymity, confidentiality, data security, and rights to withdraw from the study were guaranteed in line with the Helsinki Declaration on Human Research.

### Consent for publication

Not applicable.

### Conflicting interests

The authors declare that they have no conflicting interests.


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### Data availability

The data that support the findings of this study are not openly available due to reasons of sensitivity and are available from the corresponding author upon reasonable request. The data are securely stored at the Faculty of Health Sciences, University of Lethbridge, Alberta, Canada, and will be destroyed by December 2029 in compliance with the mandate of the Ethical Review Boards.

**Authors' contributions**

OKO and OAA contributed to the conception of this study. OKO, JV, KMO, BO, CJA, ACO, JD, and OAA substantially contributed to the design. OKO, KMO, and CJA conducted the interviews. OKO, CJA, and KMO completed the transcription and content analysis. OKO, KMO, CJA, and BO were responsible for drafting the article. OKO, JV, JD, ACO and OAA contributed to its critical revision. All authors approved the final manuscript for publication.

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# CHAPTER 9: SUMMARY OF KEY FINDINGS, CONCLUSION, POLICY IMPLICATIONS, AND RECOMMENDATIONS

This chapter summarizes the research questions, presenting the key findings, conclusions, policy implications, and recommendations.

## Summary of Key Findings

The review revealed that among apparently healthy, community-dwelling older adults (mean age = 69.81±7.21years), the average habitual gait speed (HGS) was 1.01 ± 0.28 m/s, while the time-up-and-go (TUG) score was 7.67 ± 3.56 seconds. The narrative synthesis indicated that 92.2% of the studies identified older age, 62.9% identified being a woman, 75.0% identified being non-Caucasian, and 64.5% identified lower educational attainment as significantly associated with greater mobility decline. Only age and gender had sufficient data on specific mobility outcomes, consistent methodologies, and comparable statistical coefficients to permit meta-analysis. The meta-analysis showed that older age (r = -0.37 [-0.42, -0.32]) and being a woman (r = -0.13 [-0.22, -0.03]) were associated with greater gait speed limitations. There was a notable paucity of studies examining the effects of marital status, area of residence, income, occupation, religion, homeownership, and social status on mobility outcomes.

From the CLSA baseline, participants (mean age = 68.82 ± 2.78 years) had average scores for the TUG test and four-meter walk test (4MWT) of 9.59 ± 1.98 seconds and 4.29 ± 0.95 seconds, respectively. The prevalence of mobility limitation (defined as HGS < 1.00 m/s) was 61.4%. The average baseline HGS was 0.96 ± 0.19 m/s, HGS decline over three and six years was 0.03 ± 0.18 m/s and 0.06 ± 0.19 m/s, respectively. Multivariate linear regression analysis identified several significant predictors of six-year mobility decline. These included older age, being female, retired, Canadian-born, non-Caucasian, living in rented accommodation, having no spouse or partner, very

high household income, very low savings/wealth/investment, lower social status, secondary education or less, and residing in certain provinces compared to others.

In the ISA 2007 cycle (baseline for the current study), participants had a mean age of 75.53 ± 6.80 years. The average baseline habitual gait speed (HGS) was 0.96 ± 0.32 m/s, with an HGS decline of 0.17 ± 0.29 m/s over three years. At baseline, the prevalence of mobility limitation (defined as HGS < 1.00 m/s) was 52.0%. Gender-specific multivariate models showed a slower gait speed decline in men compared to women. Widowhood for women, high socioeconomic status for men, and chronic disease burden for both women and men were significant predictors of HGS decline.

Consistent with findings from the CLSA and ISA, four key themes emerged from the perspectives of Canadian and Nigerian older adults. Demographic factors such as older age, ageism, and the absence of a partner or spouse were identified as negatively influencing mobility. While most Canadian participants perceived no gender impact, Nigerians emphasized the negative effects of women's roles on life-course mobility. Socioeconomic factors, including education, occupation type, and income, also emerged as critical determinants of mobility. Sociocultural and socioenvironmental factors were also perceived to influence mobility trajectories. Traditional dietary patterns, religious practices, and social participation were significant sociocultural influences. Socioenvironmental factors such as urban versus rural living conditions, housing, and climatic challenges also played important roles. Most Canadian participants associated rural living with poorer mobility, while Nigerians believed rural dwellers fared better in terms of mobility.

## Conclusion

This study provides a comprehensive understanding of the multifaceted determinants of mobility trajectories among older adults in Canada and Nigeria, with significant contributions to existing knowledge and life-course and social determinants of health theories. The prevalence of mobility limitation, defined as a gait speed below 1 m/s, among community-dwelling adults aged 65 years and older was 61.4% in the CLSA and 52.0% in the ISA baselines. Sociodemographic variables such as age, gender, race, marital status, education, income, occupation, area of residence, religious affiliation, and housing conditions emerged as critical predictors of mobility decline. Non-modifiable factors, such as being older, female, or non-Caucasian, and modifiable factors, including income, marital status, and area of residence, influenced mobility trajectories differently across genders and cultural contexts. The findings highlight the interplay of ageing with social determinants such as gender roles, marital status, and socioeconomic disparities, highlighting the need for nuanced, culturally sensitive interventions and policies.

These findings align with and inform global initiatives such as the WHO's Healthy Ageing Framework and Age-Friendly Communities program. Policymakers can address mobility limitations by promoting equitable access to lifelong learning, social amenities, housing improvements, and economic support while fostering social participation. Despite limitations, such as variability in cultural contexts and gaps in research on certain sociodemographic factors, this study offers valuable insights into the design of targeted, context-specific strategies to mitigate mobility decline. Future research should prioritize the exploration of under-investigated factors, develop controlled trials or prospective cohorts to test the effectiveness of ageing policies on mobility outcomes and advance a holistic approach to enhance the quality of life for older adults worldwide.

## Policy Implications

The findings from this study highlight the influence of sociodemographic factors on the mobility trajectory of older adults. It reiterates the importance of mobility as a critical component of healthy ageing and its role in enabling older adults to participate in social, cultural, civic, spiritual, and economic activities (van Hoof et al., 2021; WHO, 2020a). Addressing mobility limitations is not only a health priority but also a societal and policy imperative, given that ageing affects everyone (Freiberger et al., 2020; WHO, 2020b). To this end, policies must focus on mitigating ageism and other forms of sociodemographic disparities and discrimination through cultural reorientation, promoting social justice and equity in resource allocation, and creating inclusive frameworks that support the mobility and well-being of older adults across diverse contexts (National Institute on Ageing, 2024; Rudnicka et al., 2020).

Governments should prioritize healthy ageing by implementing policies that provide robust social security systems, protect the rights of older adults, and offer caregiving and social support (Federal Republic of Nigeria, 2020; Saka et al., 2019; Wilson et al., 2012). The concept of age-friendly communities, as advocated by the WHO (van Hoof & Marston, 2021), should be expanded and adapted to diverse environments, including rural Canada and rural and urban areas in sub-Saharan Africa. This approach would ensure equitable access to healthcare, social services, recreational facilities, and essential infrastructure, such as roads, electricity, potable water, and housing (Adebowale et al., 2012; Starke et al., 2015; Tanyi et al., 2018).

To address sociodemographic inequalities, policies must emphasize gender-affirmative actions in the labour market, bridging socioeconomic gaps and improving mobility outcomes for women (WHO, 2019). Beyond economic reforms, cultural reorientation and legal measures are required to ensure social autonomy for women, including in areas such as socially assigned gender

roles (Osinuga et al., 2021; Van Brenk, 2020) and cultural oppression against widows (Ude & Njoku, 2017). Special attention should also be given to older adults with lower socioeconomic status by providing access to effective pension schemes, financial assistance, and lifelong learning opportunities to enhance health literacy and empower them to manage their health (Bloom et al., 2015; Plouvier et al., 2016; Yeom et al., 2008; Ziembroski, 2004). Economic interventions should be complemented by the establishment of social centres and food banks specifically designed for older adults (Mendes, 2023). These facilities can support dietary intake, foster active lifestyles, and enhance social participation (Nawai et al., 2021). Promoting inclusive environments where older adults can thrive socially and economically will ensure that mobility limitations do not hinder their quality of life (Ansari & Mehrotra, 2014).

Policymakers should also account for the impact of climatic changes and socioenvironmental barriers on older adults' mobility. Integrating climate adaptation strategies, such as improved infrastructure and housing modifications, will create resilient systems that support older populations in the face of environmental challenges (Berry et al., 2022). By adopting these multifaceted approaches, governments and stakeholders can advance the principles of healthy ageing, ensure the equitable distribution of resources, and create supportive environments that sustain mobility and improve the overall well-being of older adults globally (Ansari & Mehrotra, 2014; Saka et al., 2019; Wilson et al., 2012).

**Recommendations for Future Research**

There is a need for further exploration of under-researched sociodemographic factors such as marital status, income, homeownership, area of residence, occupation type, social status, and religiosity in shaping mobility trajectories. Examining the influences of these factors across diverse cultural and geographic contexts could provide a more nuanced understanding of their roles in

mobility outcomes. Additionally, investigating the environmental influences such as climate, housing quality, and infrastructure, as well as policy frameworks related to social security and healthcare, will be critical to advancing age-friendly community initiatives (van Hoof et al., 2021).

A life-course perspective could reveal how early-life factors, including childhood nutrition, education, and socioeconomic conditions, shape mobility trajectories in older adulthood, informing preventative strategies (Marengoni & Calderon-Larrañaga, 2020). Similarly, the role of technology in mobility enhancement, including assistive devices and digital health tools, warrants further study. Research should assess both the efficacy of these technologies and barriers to their adoption across diverse populations.

In terms of research design, mixed-methods (Nastasi, 2020) and multi-methods (Morse, 2003) utilizing appropriate qualitative methods (e.g., ethnography, narrative inquiry, qualitative description) and quantitative designs (e.g., prospective cohort and longitudinal studies) are essential to identify mobility patterns over time and across diverse sociodemographic groups, particularly in urban and rural settings. Engaging older adults in the research process through participatory approaches is also crucial (Duea et al., 2022). Incorporating their perspectives and lived experiences allows future studies to align research priorities with their needs, leading to the development of more effective and inclusive interventions. Such studies can illuminate cultural and systemic factors influencing mobility, providing valuable insights into context-specific challenges and opportunities.

Furthermore, adopting an intersectional approach to examine how overlapping factors such as gender, race, and socioeconomic status interact could enhance the design of targeted interventions for vulnerable subgroups (Cornwell & Cagney, 2010; Satariano et al., 2016). Investigating interactions, moderation, and mediation effects of individual sociodemographic

factors may help identify at-risk populations. Disaggregated analyses may also be necessary where existing literature highlights significant subgroup disparities, such as differences between men and women or between visible minorities and dominant racial groups.

Importantly, there is a need to strengthen reporting guidelines for studies that use sociodemographic variables as outcomes. The meaning and interpretability of results will be clearer, and evidence synthesis more practicable, when the dimensions of social factors are clearly defined. For example, when reporting on education, it is important to specify whether this refers to literacy, years of formal education, the category of certification attained, and whether informal education, such as Indigenous ways of knowing, is accounted for. Similarly, when studies inquire about religious affiliation, they should clarify what the variable is intended to measure – whether it relates to physical activity, social participation, psychological coping, or the spiritual aspects of religion. These directions for future research have the potential to deepen understanding of the determinants of mobility, inform policy development, and advance strategies that promote healthy ageing across diverse populations.

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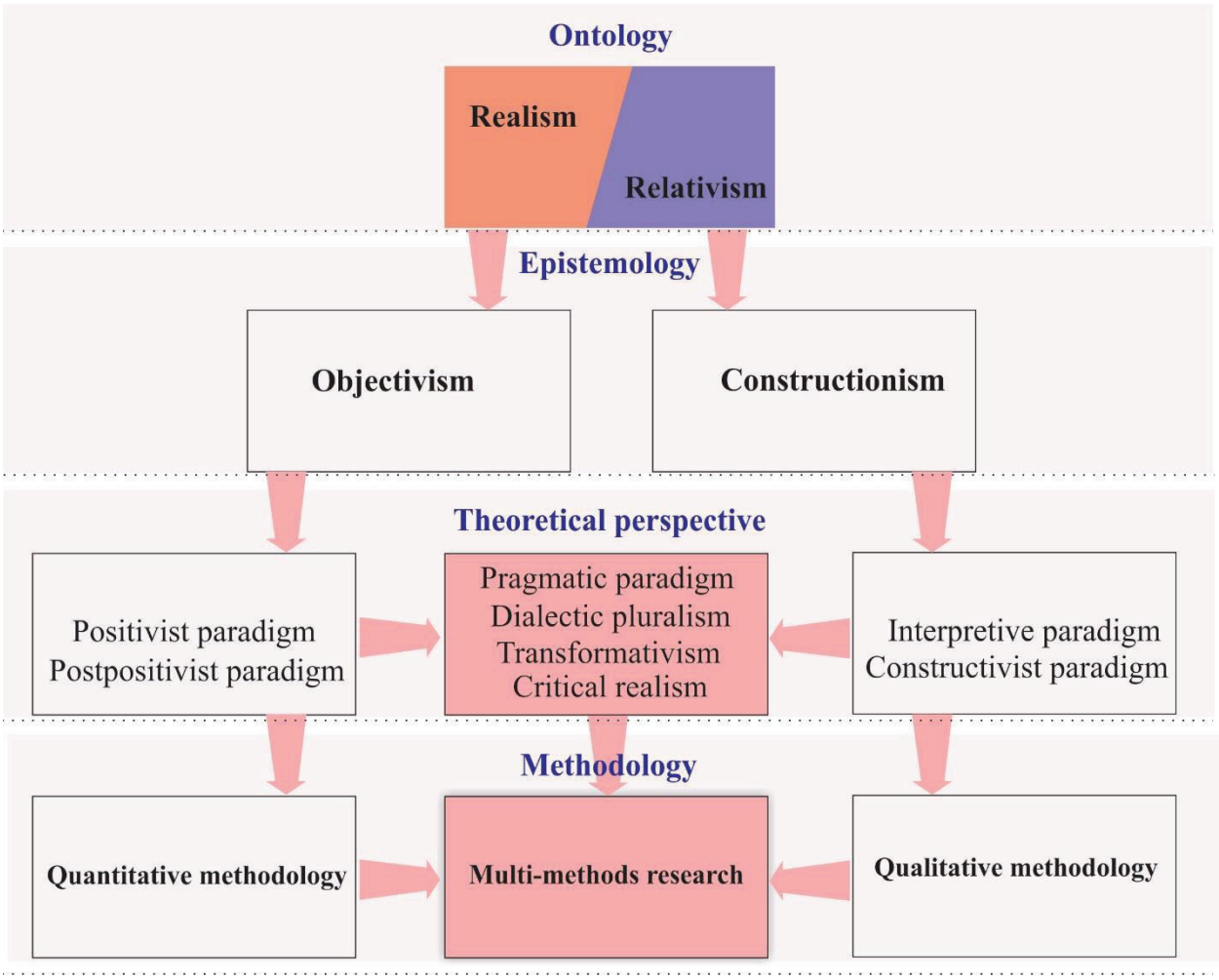
## APPENDIX A: RESEARCH PARADIGM CHART

Philosophical Underpinning of Multi-methods Research



## APPENDIX B: SOCIOECONOMIC STATUS SCALE

Modified Kuppuswamy Socioeconomic Status Scale

| **Education of person/head of the family** | | | **Score** |
|---|---|---|---|
| Professional degree | | | 7 |
| Graduate or postgraduate | | | 6 |
| Intermediate or post-high school diploma | | | 5 |
| High school certificate | | | 4 |
| Middle school certificate | | | 3 |
| Primary school certificate | | | 2 |
| Illiterate | | | 1 |
| | | | |
| **Occupation of person/head of the family** | | | |
| Professional (white collar) | | | 10 |
| Semi-professional | | | 6 |
| Clerical, shop-owner/farm | | | 5 |
| Skilled worker | | | 4 |
| Semi-skilled worker | | | 3 |
| Unskilled worker | | | 2 |
| Unemployed | | | 1 |
| **Monthly income of person/ family** | | | |
| *In 2001 (Base year)* | *In 2017 (January CPI)* | | *In 2019 (February CPI)* | *Score* |
| ≥15,197 | ≥41,430 | | ≥52,734 | 12 |
| 7,595-15,196 | 20,715-41,429 | | 26,355-52,733 | 10 |
| 5,694-7,594 | 15,536-20,714 | | 19,759-26,354 | 6 |
| 3,793-5,693 | 10,357-15,535 | | 13,161-19,758 | 4 |
| 2,273-3,792 | 6,214-10,356 | | 7,887-13,160 | 3 |
| 761-2,272 | 2,092-6,213 | | 2,641-7,886 | 2 |
| ≤760 | ≤2,091 | | ≤2,640 | 1 |

| **Socioeconomic class** | | **Total score** |
|---|---|---|
| I | Upper | 26-29 |
| II | Upper middle | 16-25 |
| III | Lower middle | 11-15 |
| IV | Upper lower | 05-10 |
| V | Lower | 01-04 |

Source. Kuppuswamy (1981), modified by Wani (2019).

## APPENDIX C: PRISMA 2020 CHECKLIST

PRISMA 2020 checklist, Page et al.(2021).

| Section and Topic | Item # | Checklist item | Page |
|---|---|---|---|
| **TITLE** | | | |
| Title | 1 | Identify the report as a systematic review. | 145 |
| **ABSTRACT** | | | |
| Abstract | 2 | See the PRISMA 2020 for Abstracts checklist. | 146 |
| **INTRODUCTION** | | | |
| Rationale | 3 | Describe the rationale for the review in the context of existing knowledge. | 148 |
| Objectives | 4 | Provide an explicit statement of the objective(s) or question(s) the review addresses. | 149 |
| **METHODS** | | | |
| Eligibility criteria | 5 | Specify the inclusion and exclusion criteria for the review and how studies were grouped for the syntheses. | 150 |
| Information sources | 6 | Specify all databases, registers, websites, organizations, reference lists and other sources searched or consulted to identify studies. Specify the date when each source was last searched or consulted. | 151 |
| Search strategy | 7 | Present the full search strategies for all databases, registers and websites, including any filters and limits used. | 151 |
| Selection process | 8 | Specify the methods used to decide whether a study met the inclusion criteria of the review, including how many reviewers screened each record and each report retrieved, whether they worked independently, and if applicable, details of automation tools used in the process. | 152 |
| Data collection process | 9 | Specify the methods used to collect data from reports, including how many reviewers collected data from each report, whether they worked independently, any processes for obtaining or confirming data from study investigators, and if applicable, details of automation tools used in the process. | 154 |
| Data items | 10a | List and define all outcomes for which data were sought. Specify whether all results that were compatible with each outcome domain in each study were sought (e.g. for all measures, time points, analyses), and if not, the methods used to decide which results to collect. | 154 |
| | 10b | List and define all other variables for which data were sought (e.g. participant and intervention characteristics, funding sources). Describe any assumptions made about any missing or unclear information. | 154 |
| Study risk of bias assessment | 11 | Specify the methods used to assess risk of bias in the included studies, including details of the tool(s) used, how many reviewers assessed each study and whether they worked independently, and if applicable, details of automation tools used in the process. | 154 |
| Effect measures | 12 | Specify for each outcome the effect measure(s) (e.g. risk ratio, mean difference) used in the synthesis or presentation of results. | 155 |
| Synthesis methods | 13a | Describe the processes used to decide which studies were eligible for each synthesis (e.g. tabulating the study intervention characteristics and comparing against the planned groups for each synthesis (item #5)). | 155 |
| | 13b | Describe any methods required to prepare the data for presentation or synthesis, such as handling of missing summary statistics, or data conversions. | 155 |
| | 13c | Describe any methods used to tabulate or visually display results of individual studies and syntheses. | 155 |
| | 13d | Describe any methods used to synthesize results and provide a rationale for the choice(s). If meta-analysis was performed, describe the model(s), method(s) to identify the presence and extent of statistical heterogeneity, and software package(s) used. | 155 |
| | 13e | Describe any methods used to explore possible causes of heterogeneity among study results (e.g. subgroup analysis, meta-regression). | 155 |

| Section and Topic | Item # | Checklist item | Page |
|---|---|---|---|
| | 13f | Describe any sensitivity analyses conducted to assess the robustness of the synthesized results. | 155 |
| Reporting bias assessment | 14 | Describe any methods used to assess risk of bias due to missing results in a synthesis (arising from reporting biases). | 155 |
| Certainty assessment | 15 | Describe any methods used to assess certainty (or confidence) in the body of evidence for an outcome. | 155 |
| **RESULTS** | | | |
| Study selection | 16a | Describe the results of the search and selection process, from the number of records identified in the search to the number of studies included in the review, ideally using a flow diagram. | 156 |
| | 16b | Cite studies that might appear to meet the inclusion criteria, but which were excluded, and explain why they were excluded. | 156 |
| Study characteristics | 17 | Cite each included study and present its characteristics. | 156 |
| Risk of bias in studies | 18 | Present assessments of risk of bias for each included study. | 172 |
| Results of individual studies | 19 | For all outcomes, present, for each study: (a) summary statistics for each group (where appropriate) and (b) an effect estimate and its precision (e.g. confidence/credible interval), ideally using structured tables or plots. | 156-172 |
| Results of syntheses | 20a | For each synthesis, briefly summarize the characteristics and risk of bias among contributing studies. | 156-172 |
| | 20b | Present results of all statistical syntheses conducted. If meta-analysis was done, present for each the summary estimate and its precision (e.g. confidence/credible interval) and measures of statistical heterogeneity. If comparing groups, describe the direction of the effect. | 156-172 |
| | 20c | Present results of all investigations of possible causes of heterogeneity among study results. | 162 |
| | 20d | Present results of all sensitivity analyses conducted to assess the robustness of the synthesized results. | 156-172 |
| Reporting biases | 21 | Present assessments of risk of bias due to missing results (arising from reporting biases) for each synthesis assessed. | 156-172 |
| Certainty of evidence | 22 | Present assessments of certainty (or confidence) in the body of evidence for each outcome assessed. | 161 |
| **DISCUSSION** | | | |
| Discussion | 23a | Provide a general interpretation of the results in the context of other evidence. | 174 |
| | 23b | Discuss any limitations of the evidence included in the review. | 174 |
| | 23c | Discuss any limitations of the review processes used. | 174 |
| | 23d | Discuss implications of the results for practice, policy, and future research. | 174 |
| **OTHER INFORMATION** | | | |
| Registration and protocol | 24a | Provide registration information for the review, including register name and registration number, or state that the review was not registered. | 149 |
| | 24b | Indicate where the review protocol can be accessed, or state that a protocol was not prepared. | 149 |
| | 24c | Describe and explain any amendments to information provided at registration or in the protocol. | 149 |
| Support | 25 | Describe sources of financial or non-financial support for the review, and the role of the funders or sponsors in the review. | 179 |
| Competing interests | 26 | Declare any competing interests of review authors. | 179 |
| Availability of data, code and other materials | 27 | Report which of the following are publicly available and where they can be found: template data collection forms; data extracted from included studies; data used for all analyses; analytic code; any other materials used in the review. | 179 |

# APPENDIX D: ELECTRONIC DATABASES SEARCH STRATEGIES

| CINAHL Database Search Strategy | | | |
|---|---|---|---|
| **ID#** | **Search term** | **Search options** | **Results** |
| S25 | S3 AND S8 AND S23 | **Expanders**- Apply equivalent subjects<br>**Narrow by Language**:- English<br>**Search modes**- Boolean/Phrase | 3,000 |
| S24 | S3 AND S8 AND S23 | **Expanders**- Apply equivalent subjects<br>**Search modes**- Boolean/Phrase | 3,085 |
| S23 | S9 OR S10 OR S11 OR S12 OR S13 OR S14 OR S15 OR S16 OR S17 OR S18 OR S19 OR S20 OR S21 OR S22 | **Expanders**- Apply equivalent subjects<br>**Search modes**- Boolean/Phrase | 1,328,779 |
| S22 | (employ* or unemploy* or occupation*) | **Expanders**- Apply equivalent subjects<br>**Search modes**- Boolean/Phrase | 408,804 |
| S21 | (MH "Employment+") | **Expanders**- Apply equivalent subjects<br>**Search modes**- Boolean/Phrase | 54,406 |
| S20 | (((social or socioeconomic or economic) N3 (status* or class*)) or income or poverty) | **Expanders**- Apply equivalent subjects<br>**Search modes**- Boolean/Phrase | 160,178 |
| S19 | (MH "Income+") | **Expanders**- Apply equivalent subjects<br>**Search modes**- Boolean/Phrase | 60,761 |
| S18 | (gender* or sex) | **Expanders**- Apply equivalent subjects<br>**Search modes**- Boolean/Phrase | 420,076 |
| S17 | (MH "Sex Factors") OR (MH "Gender Identity+") | **Expanders**- Apply equivalent subjects<br>**Search modes**- Boolean/Phrase | 143,940 |
| S16 | (ethnic* or race or racial" or immigrant*) | **Expanders**- Apply equivalent subjects<br>**Search modes**- Boolean/Phrase | 176,575 |
| S15 | (MH "Ethnic Groups+") | **Expanders**- Apply equivalent subjects<br>**Search modes**- Boolean/Phrase | 171,096 |
| S14 | (health N3 (determinant* or equity or equities or inequit* or inequal* or equality or equalities or disparit*)) | **Expanders**- Apply equivalent subjects<br>**Search modes**- Boolean/Phrase | 54,329 |
| S13 | (MH "Health inequities") | **Expanders**- Apply equivalent subjects<br>**Search modes**- Boolean/Phrase | 1,616 |
| S12 | (MH "Healthcare Disparities") | **Expanders**- Apply equivalent subjects<br>**Search modes**- Boolean/Phrase | 20,209 |
| S11 | ((social or socioeconomic or economic or population*) N3 (determinant* or factor* or risk* or equity or equities or inequit* or inequal* or equality or equalities or disparit*)) | **Expanders**- Apply equivalent subjects<br>**Search modes**- Boolean/Phrase | 184,910 |
| S10 | (MH "Socioeconomic Factors+") | **Expanders**- Apply equivalent subjects<br>**Search modes**- Boolean/Phrase | 60,134 |
| S9 | (MH "Social Determinants of Health") | **Expanders**- Apply equivalent subjects<br>**Search modes**- Boolean/Phrase | 11,754 |
| S8 | S4 OR S5 OR S6 OR S7 | **Expanders**- Apply equivalent subjects<br>**Search modes**- Boolean/Phrase | 21,822 |
| S7 | (mobilit” N5 limit") | **Expanders**- Apply equivalent subjects<br>**Search modes**- Boolean/Phrase | 2,527 |
| S6 | ((walk* or gait or ambulat* or locomot*) N5 (speed” or pace* or difficult*)) | **Expanders**- Apply equivalent subjects<br>**Search modes**- Boolean/Phrase | 12,920 |
| S5 | (MH "Walking Speed") | **Expanders**- Apply equivalent subjects<br>**Search modes**- Boolean/Phrase | 2,228 |
| S4 | (MH "Physical Mobility") | **Expanders**- Apply equivalent subjects<br>**Search modes**- Boolean/Phrase | 7,539 |
| S3 | S1 OR S2 | **Expanders**- Apply equivalent subjects<br>**Search modes**- Boolean/Phrase | 1,068,746 |
| S2 | (elderly or senior or seniors or "older adult" or "older adults" or geriatric or geriatrics or retir* or "old people” or older-age or “old age" or "older people") | **Expanders**- Apply equivalent subjects<br>**Search modes**- Boolean/Phrase | 340,424 |
| S1 | (MH "Aged+") | **Expanders**- Apply equivalent subjects<br>**Search modes**- Boolean/Phrase | 957,717 |

| SPORTSDiscus Database Search Strategy | | | |
|---|---|---|---|
| **ID#** | **Search term** | **Search options** | **Results** |
| S18 | S3 AND S7 AND S16 | **Expanders**- Apply equivalent subjects<br>**Narrow by Language**:- English<br>**Search modes**- Boolean/Phrase | 346 |
| S17 | S3 AND S7 AND S16 | **Expanders**- Apply equivalent subjects<br>**Search modes**- Boolean/Phrase | 364 |
| S16 | S8 OR S9 OR S10 OR S11 OR S12 OR S13 OR S14 OR S15 | **Expanders**- Apply equivalent subjects<br>**Search modes**- Boolean/Phrase | 284,297 |
| S15 | (employ* or unemploy* or occupation*) | **Expanders**- Apply equivalent subjects<br>**Search modes**- Boolean/Phrase | 96,564 |
| S14 | (((social or socioeconomic or economic) N3 (status* or class*)) or income or poverty) | **Expanders**- Apply equivalent subjects<br>**Search modes**- Boolean/Phrase | 22,684 |
| S13 | DE “HEALTH & income” | **Expanders**- Apply equivalent subjects<br>**Search modes**- Boolean/Phrase | 8 |
| S12 | (gender* or sex) | **Expanders**- Apply equivalent subjects<br>**Search modes**- Boolean/Phrase | 78,394 |
| S11 | DE “GENDER” OR DE “GENDER differences (Sociology)” OR DE “GENDER identity” OR DE “GENDER role” | **Expanders**- Apply equivalent subjects<br>**Search modes**- Boolean/Phrase | 3,505 |
| S10 | (ethnic* or race or racial" or immigrant*) | **Expanders**- Apply equivalent subjects<br>**Search modes**- Boolean/Phrase | 102,306 |
| S9 | (health N3 (determinant* or equity or equities or inequit* or inequal* or equality or equalities or disparit*)) | **Expanders**- Apply equivalent subjects<br>**Search modes**- Boolean/Phrase | 57,36 |
| S8 | ((social or socioeconomic or economic or population*) N3 (determinant* or factor* or risk* or equity or equities or inequit* or inequal* or equality or equalities or disparit*)) | **Expanders**- Apply equivalent subjects<br>**Search modes**- Boolean/Phrase | 17,738 |
| S7 | S4 OR S5 OR S6 | **Expanders**- Apply equivalent subjects<br>**Search modes**- Boolean/Phrase | 8,393 |
| S6 | (mobilit* N5 limit*) | **Expanders**- Apply equivalent subjects<br>**Search modes**- Boolean/Phrase | 775 |
| S5 | ((walk* or gait or ambulat* or locomot*) N5 (speed* or pace* or difficult*)) | **Expanders**- Apply equivalent subjects<br>**Search modes**- Boolean/Phrase | 7,722 |
| S4 | DE "WALKING speed" | **Expanders**- Apply equivalent subjects<br>**Search modes**- Boolean/Phrase | 1,199 |
| S3 | S1 OR S2 | **Expanders**- Apply equivalent subjects<br>**Search modes**- Boolean/Phrase | 79,399 |
| S2 | (elderly or senior or seniors or "older adult" or "older adults" or geriatric or geriatrics or retir* or "old people” or older-age or “old age" or "older people") | **Expanders**- Apply equivalent subjects<br>**Search modes**- Boolean/Phrase | 79,399 |
| S1 | DE “OLDER people” | **Expanders**- Apply equivalent subjects<br>**Search modes**- Boolean/Phrase | 12,625 |

| MEDLINE Database Search Strategy | | |
|---|---|---|
| **ID#** | **Search term** | **Results** |
| 1 | exp Aged/ [MeSH] | 3,470,331 |
| 2 | (elderly or senior or seniors or "older adult" or "older adults" or geriatric or geriatrics or "old people" or older-age or "old age" or "older people").ti,ab. | 514,296 |
| 3 | or/1-2 | 3,600,848 |
| 4 | Mobility Limitation/ [MeSH] | 5,291 |
| 5 | Walking Speed/ [MeSH] | 2,784 |
| 6 | ((walk* or gait* or ambulat* or locomot*) adj5 (speed* or pace* or difficult*)).ti,ab. | 22,834 |
| 7 | (mobilit* adj5 limit*).ti,ab. | 4,649 |
| 8 | or/4-7 | 31,297 |
| 9 | Social Determinants of Health/ [MeSH] | 6,775 |
| 10 | exp Socioeconomic Factors/ [MeSH] | 515,480 |
| 11 | ((social or socioeconomic or economic or population*) adj3 (determinant* or factor* or risk* or equity or equities or inequit* or inequal* or equality or equalities or disparit*)).ti,ab. | 148,113 |
| 12 | (health adj3 (determinant* or equity or equities or inequit* or inequal* or equality or equalities or disparit*)).ti,ab. | 22,466 |
| 13 | "determinants of health".ti,ab. | 20,350 |
| 14 | exp Ethnic Groups/ [MeSH] | 52,117 |
| 15 | exp Continental Population Groups/ [MeSH] | 108,580 |
| 16 | (ethnic* or race or racial* or immigrant*).ti,ab. | 105,716 |
| 17 | exp Gender Identity/ [MeSH] | 285,112 |
| 18 | Sex/ [MeSH] | 24,392 |
| 19 | (gender* or sex).ti,ab. | 907,836 |
| 20 | exp Income/ [MeSH] | 71,371 |
| 21 | (((social or socioeconomic or economic) adj3 (status* or class*)) or income or poverty).ti,ab. | 235,880 |
| 22 | exp Employment/ [MeSH] | 100,850 |
| 23 | (employ* or unemploy* or occupation*).ti,ab. | 752,436 |
| 24 | or/9-23 | 2,413,737 |
| 25 | 3 and 8 and 24 | 3,682 |
| 26 | limit 25 to English language | 3,577 |

| EMBASE Database Search Strategy | | |
|---|---|---|
| **ID#** | **Search term** | **Results** |
| 1 | exp aged/ | 3,680,976 |
| 2 | (elderly or senior or seniors or "older adult" or "older adults" or geriatric or geriatrics or retir* or "old people" or older-age or "old age" or "older people").ti,ab. | 820,149 |
| 3 | 1 or 2 | 3,967,969 |
| 4 | walking difficulty/ | 16,648 |
| 5 | walking speed/ | 24,094 |
| 6 | ((walk* or gait* or ambulat* or locomot*) adj5 (speed* or pace* or difficult*)).ti,ab. | 40,043 |
| 7 | (mobilit* adj5 limit*).ti,ab. | 7,976 |
| 8 | or/4-7 | 66,324 |
| 9 | “social determinants of health”/ | 20,707 |
| 10 | exp socioeconomics/ | 1,366,344 |
| 11 | ((social or socioeconomic or economic or population*) adj3 (determinant* or factor* or risk* or equity or equities or inequit* or inequal* or equality or equalities or disparit*)).ti,ab. | 228,490 |
| 12 | health care disparity/ | 22,868 |
| 13 | health disparity/ | 36,163 |
| 14 | (health adj3 (determinant* or equity or equities or inequit* or inequal* or equality or equalities or disparit*)).ti,ab. | 74,196 |
| 15 | ethnicity/ | 121,764 |
| 16 | race/ | 87,522 |
| 17 | (ethnic* or race or racial* or immigrant*).ti,ab. | 472,856 |
| 18 | exp gender identity/ | 22,606 |
| 19 | (gender* or sex).ti,ab. | 1,552,091 |
| 20 | exp income/ | 134,884 |
| 21 | (((social or socioeconomic or economic) adj3 (status* or class*)) or income or poverty).ti,ab. | 347,134 |
| 22 | exp employment/ | 128,428 |
| 23 | (employ* or unemploy* or occupation*).ti,ab. | 1,156,995 |
| 24 | or/9-23 | 4,319,714 |
| 25 | 3 and 8 and 24 | 6,393 |
| 26 | limit 25 to English language | 6,268 |

| Web of Science Database Search Strategy | | |
|---|---|---|
| **ID#** | **Search term** | **Results** |
| 13 | #1 AND #4 AND #11 AND English (Languages) | 2,832 |
| 12 | #1 AND #4 AND #11 | 2,883 |
| 11 | #5 OR #6 OR #7 OR #8 OR #9 OR #10 | 4,999,925 |
| 10 | TS=((employ* or unemploy* or occupation*)) | 2,437,551 |
| 9 | TS=((((social or socioeconomic or economic) NEAR/3 (status* or class*)) or income or poverty)) | 605,445 |
| 8 | TS=((gender* or sex)) | 1,550,130 |
| 7 | TS=((ethnic* or race or racial* or immigrant*)) | 662,817 |
| 6 | TS=((health NEAR/3 (determinant* or equity or equities or inequit* or inequal* or equality or equalities or disparit*))) | 86,952 |
| 5 | TS=(((social or socioeconomic or economic or population*) NEAR/3 (determinant* or factor* risk* or equity or equities or inequit* or inequal* or equality or equalities or disparit*))) | 330,041 |
| 4 | #3 OR #2 | 47,433 |
| 3 | TS=((mobilit* NEAR/5 limit*)) | 13,394 |
| 2 | TS=((walk* or gait* or ambulat* or locomot*) NEAR/5 (speed* or pace* or difficult*)) | 34,679 |
| 1 | (elderly or senior or seniors or “older adult” or “older adults” or geriatric or geriatrics or retir* or “old people” or older-age or “old age” or “older people”) (Topic) | 792,179 |

| AgeLine Database Search Strategy | | | |
|---|---|---|---|
| **ID#** | **Search term** | **Search options** | **Results** |
| S20 | S3 AND S7 AND S17 | **Expanders**- Apply equivalent subjects<br>**Search modes**- Boolean/Phrase | 1,154 |
| S19 | S8 OR S9 OR S10 OR S11 OR S12 OR S13 OR S14 OR S15 OR S16 OR S17 OR S18 | **Expanders**- Apply equivalent subjects<br>**Search modes**- Boolean/Phrase | 70,408 |
| S18 | (employ* or unemploy* or occupation*) | **Expanders**- Apply equivalent subjects<br>**Search modes**- Boolean/Phrase | 30,588 |
| S17 | DE “Employment” OR DE “Alternative Work Patterns” OR DE “Part Time Employment” OR DE “Postretirement Work” OR DE “Reemployment” OR DE “Self Employment” | **Expanders**- Apply equivalent subjects<br>**Search modes**- Boolean/Phrase | 4,148 |
| S16 | (((social or socioeconomic or economic) N3 (status* or class*)) or income or poverty) | **Expanders**- Apply equivalent subjects<br>**Search modes**- Boolean/Phrase | 21,238 |
| S15 | DE “Income” OR DE “Family Income” OR DE “Household Income” OR DE “Lifetime Income” OR DE “Retirement Income” | **Expanders**- Apply equivalent subjects<br>**Search modes**- Boolean/Phrase | 3,620 |
| S14 | (gender* or sex) | **Expanders**- Apply equivalent subjects<br>**Search modes**- Boolean/Phrase | 20,174 |
| S13 | DE “Sex Differences” | **Expanders**- Apply equivalent subjects<br>**Search modes**- Boolean/Phrase | 5,439 |
| S12 | (ethnic* or race or racial" or immigrant*) | **Expanders**- Apply equivalent subjects<br>**Search modes**- Boolean/Phrase | 13,983 |
| S11 | DE “Racial and Ethnic Groups” OR DE “Aborigines” OR DE “Afghans” OR DE “Africans” OR DE “American Indians” OR DE “Arabs” OR DE “Armenians” OR DE “Asians” OR DE “Australians” OR DE “Azerbaijanis” OR DE “Bangladeshis” OR DE “Blacks” OR DE “Bosnians” OR DE “British” OR DE “Cambodians” OR DE “Canadians” OR DE “Caribbeans” OR DE “Chamorros” OR DE “Chinese” OR DE “Cubans” OR DE “Cypriots” OR DE “Czechs” OR DE “Dominicans” OR DE “Dutch” OR DE “Eastern Europeans” OR DE “Estonians” OR DE “Europeans” OR D … | **Expanders**- Apply equivalent subjects<br>**Search modes**- Boolean/Phrase | 7,860 |
| S10 | (health N3 (determinant* or equity or equities or inequit* or inequal* or equality or equalities or disparit*)) | **Expanders**- Apply equivalent subjects<br>**Search modes**- Boolean/Phrase | 1,884 |
| S9 | ((social or socioeconomic or economic or population*) N3 (determinant* or factor* or risk* or equity or equities or inequit* or inequal* or equality or equalities or disparit*)) | **Expanders**- Apply equivalent subjects<br>**Search modes**- Boolean/Phrase | 5,223 |
| S8 | DE “Socioeconomic Levels” OR DE “Income Levels” OR DE “Living Standards” OR DE “Poverty Levels” OR DE “Social Classes” | **Expanders**- Apply equivalent subjects<br>**Search modes**- Boolean/Phrase | 5,823 |
| S7 | S4 OR S5 OR S6 | **Expanders**- Apply equivalent subjects<br>**Search modes**- Boolean/Phrase | 3,794 |
| S6 | (mobilit* N5 limit*) | **Expanders**- Apply equivalent subjects<br>**Search modes**- Boolean/Phrase | 554 |
| S5 | ((walk* or gait or ambulat* or locomot*) N5 (speed* or pace* or difficult*)) | **Expanders**- Apply equivalent subjects<br>**Search modes**- Boolean/Phrase | 1,870 |
| S4 | DE "Walking" | **Expanders**- Apply equivalent subjects<br>**Search modes**- Boolean/Phrase | 2,247 |
| S3 | S1 OR S2 | **Expanders**- Apply equivalent subjects<br>**Search modes**- Boolean/Phrase | 169,569 |
| S2 | (elderly or senior or seniors or "older adult" or "older adults" or geriatric or geriatrics or retir* or "old people” or older-age or “old age" or "older people") | **Expanders**- Apply equivalent subjects<br>**Search modes**- Boolean/Phrase | 169,568 |
| S1 | DE “Older Adults” | **Expanders**- Apply equivalent subjects<br>**Search modes**- Boolean/Phrase | 133,497 |

# APPENDIX E: STUDY IN SYSTEMATIC REVIEW

Characteristics of the included studies ($n$ = 57)

| First author surname, Year & Country | Age range [mean] years | Sample size | % Female | Dataset name | Relevant mobility tools & Outcomes | Title | Analysis type & Results |
|---|---|---|---|---|---|---|---|
| Al Snih, 2008 USA | ≥60 [69.2] | 4,456 | 49.2 | NHANES III | 8ft UGT Walk time (s) | Ethnic differences in physical performance in older Americans: data from the Third National Health and Nutrition Examination Survey (1988-1994) | BAS: Non-Hispanic Whites had better mobility than Mexicans and Blacks (SE = 0.07, p<0.001). MAS: younger age (β= 0.07, p<0.0001), male (β= 0.29, p<0.01), higher education (β= -0.37, p<0.1), and being Non-Hispanic White vs Black (β= 0.45, p<0.001) or vs Mexican (β= 0.39, p<001) were associated with better mobility. No statistically significant effect of marital status (β= -0.22, p>0.05). |
| Aoyagi, 2001 USA | ≥65 [72.3] | 10,247 | 100.0 | MBJS | 6 MWT Gait speed (m/s) | Comparison of performance-based measures among native Japanese, Japanese-Americans in Hawaii and Caucasian women in the United States, ages 65 years and over: A cross-sectional study | BAS: Usual walking speed was about 10% slower among Caucasians than native Japanese, whereas Japanese-Americans in Hawaii walked about 11% faster than native Japanese. |
| Asher, 2012 UK | ≥65 [74.3] | 3,145 | 54.1 | HSE 2005 | 2.4 MWT Gait speed (m/s) | Most older pedestrians are unable to cross the road in time: a cross-sectional study | BAS: younger age (OR= 6.63, p< 0.001), males (OR= 2.40, p<0.001), and higher education (OR= 5.20, p<0.001) were associated with better mobility. MAS: younger age (OR= 3.65, p<0.001) and being male (OR= 2.64, p<0.001) were associated with better mobility. |
| Barrera, 2017 Chile | [73.0] | 86 | 100.0 | NA | TUG, Walk time (s) | Associations between socioeconomic status, aging and functionality among older women | BAS: Illiterate or primary education participants (Median TUG score=7.8) had significantly lower mobility than secondary (M=6.4) and higher education (M=6.1) p<0.05. |

| | | | | | | | |
|---|---|---|---|---|---|---|---|
| Bendall, 1989<br>UK | 65–90<br>[71.5] | 125 | 53.6 | NA | Sensor, 100 MWT<br>Gait speed (m/s) | Factors affecting walking speed of elderly people | BAS: There was a negative correlation between gait speed and age in men ($r = -0.32$, $p<0.01$) and women ($r = -0.28$, $p<0.05$). However, men had higher gait speed than women ($p<0.001$). |
| Binotto, 2019<br>Brazil | ≥60 | 421 | 30.2 | NA | 4.6 MWT<br>Gait speed (m/s) | Gait speed-associated factors in elderly subjects undergoing exams to obtain the driver's license Portuguese, English, Spanish | MAS: younger age ($\beta= -0.01$, $p<0.001$) and being a man ($\beta= 0.07$, $p=0.026$) were associated with better mobility when controlled for body mass index and hand grip. |
| Blanco, 2012<br>USA | [77.7] | 213 | 65.3 | EAS | Sensor, 3.7 MWT<br>Gait speed (m/s) | Racial differences in gait velocity in an urban elderly cohort | BAS: Caucasian ($\beta= -8.87$, $p<0.01$) had better mobility than African Americans. There was no significant gender difference in mobility ($p=0.10$). MAS: Being Caucasian ($\beta= -7.49$, $p=0.015$) was associated with better mobility adjusted for age, gender, BMI, education, and chronic diseases. |
| Bohannon, 1996<br>USA | 50–79<br>[64.3] | 156 | 50.6 | NA | 7.6 MWT<br>Gait speed (m/s) | Walking speed: Reference values and correlates for older adults | BAS: Being a woman significantly correlated with lower gait speed ($r= -0.254$, $p<0.01$). There was no significant correlation between age and gait speed ($r= -0.026$, $p>0.05$). MAS: Being a man ($R= 0.362$, $p<0.001$) was associated with better mobility, adjusted for weight and strength of hip flexion. |
| Bohannon, 2008<br>USA | ≥50<br>[68.7] | 1,923 | 49.3 | NHANES | 8 ft WT<br>Gait speed (m/s) | Population representative gait speed and its determinants | BAS: There was a significant correlation between lower mobility and older age ($r= -0.354$, $p<0.001$) and being a woman ($r= -0.060$, $p=0.025$). MAS: Younger age was associated with better mobility ($\beta = -0.015$, $p=0.002$), adjusted for knee extension force, waist circumference, stature, and gender. |

| | | | | | | | |
|---|---|---|---|---|---|---|---|
| Boulifard, 2019<br>USA | ≥65<br>[74.8] | 6,983 | 54.2 | HRS | 2.5 MWT<br>Gait speed (m/s) | Home-based gait speed assessment: Normative data and racial/ethnic correlates among older adults | BAS: younger persons (M/SD = 8.53/2.55 vs 7.12/2.32, $p<0.05$), male (M = 8.32/2.56 vs 7.56/2.48, $p<0.05$), and Caucasians (t = -12.8, $p<0.001$) had better mobility. MAS: younger age (B= -0.9, $p<0.001$), men (B= -4.44, $p<0.001$), higher income (B = 1.1, $p<0.001$), higher education (B = 0.6, $p<0.001$), urbanicity (B= -1.0, $p=0.004$) and being Caucasian (B = -9.6, $p<0.001$) were associated with better mobility; adjusted for urbanicity, chronic disease, and health behaviours. |
| Brunner, 2009<br>UK | 50–74<br>[61.1] | 6,345 | 29.3 | Whitehall II study | 2.4 MWT<br>Gait speed (m/s) | Social inequality in walking speed in early old age in the Whitehall II study | BAS: Younger people, men, married, higher incomes, and Caucasians had better mobility ($p<0.05$), but there was no significant effect of social status ($p>0.05$). Average age- and ethnicity-adjusted walking speed was approximately 13% higher in the highest employment grade compared to the lowest. Based on the relative index of inequality (RII), the difference in walking speed across the social hierarchy was 0.15 m/s in men and 0.17 in women, corresponding to an age-related difference of 18.7 years in men and 14.9 years in women. |
| Buchner, 1996<br>USA | 60–90<br>[75.3] | 409 | 60.0 | NA | 15.2 MWT<br>Gait speed (m/s) | Evidence for a non-linear relationship between leg strength and gait speed | BAS: Younger age ($r=-0.49$, $p<0.05$) and being a man ($r= 0.10$, $p<0.05$) correlated with better mobility. |
| Busch, 2015<br>Brazil | ≥60 | 1,112 | 60.3 | SABE 2010 | 3 MWT<br>Gait speed (m/s) | Factors associated with lower gait speed among the elderly living in a developing country: a cross-sectional population-based study. | BAS: Younger people ($p<0.001$) and people with higher education ($p<0.001$) had better mobility. There was no significant association between gender ($p=0.987$) and race ($p=0.939$) with mobility. MAS: Factors associated with lower gait speed were being older (OR = 3.56, $p<0.001$), being illiterate (OR = 3.20, $p=0.017$), having difficulty in one or more IADL (OR = 2.74, $p<0.001$), presence of CVD (OR = 2.15, $p=0.006$) and being active as a protection factor (OR = 0.56, $p=0.027$). |

| | | | | | | | |
|---|---|---|---|---|---|---|---|
| Butler, 2009<br>Australia | 75–98<br>[80.1] | 684 | 65.2 | NA | 6 MWT<br>Gait speed (m/s) | Age and gender differences in seven tests of functional mobility | BAS: Older participants performed significantly worse than the younger participants in all of the functional mobility tests ($p < 0.001$), with the older women performing worse than the older men in all of the tests ($p < 0.05$). A significant correlation was found between age and gait speed scores ($r= -0.30$, $p<0.001$). |
| Carvalho de Abreu, 2021<br>Brazil | ≥60<br>[70.3] | 233 | 64.4 | NA | Sensor, 8 MWT<br>Gait speed (m/s) | Functional performance of older adults: A comparison between men and women | BAS: There was no significant gender difference in gait speed ($t = 1.97$, $p = 0.162$). |
| ChilesShaffer, 2020<br>USA | ≥60<br>[75.5] | 1,112 | 51.8 | BLSA | 6 MWT<br>Gait speed (m/s) | The roles of body composition and specific strength in the relationship between race and physical performance in older adults | MAS: FOR MEN, younger age ($\beta= -0.02$, $p<0.001$), higher income ($\beta= 0.06$, $p<0.05$), and being Caucasian ($\beta= -0.10$, $p<0.001$) were associated with better mobility, but effects of education ($\beta= 0.01$, $p>0.05$) and height ($\beta= 0.03$, $p>0.05$) were not significant in the model.<br>MAS: FOR WOMEN, younger age ($\beta= -0.01$, $p<0.001$), height ($\beta= 0.52$, $p<0.001$), and being Caucasian ($\beta= -0.14$, $p<0.001$) were associated with better mobility, but effects of education ($\beta= 0.02$, $p>0.05$) and higher income ($\beta= 0.03$, $p>0.05$) were not significant in the model. |
| Coelho-Junior, 2021<br>Brazil | 50–102<br>[68.0] | 2,804 | 80.7 | NA | TUG, 3 MWT<br>Walk time (s), Gait speed (m/s) | Age- and gender-related changes in physical function in community-dwelling Brazilian adults aged 50 to 102 years | BAS: Older age correlated with higher TUG scores/mobility decline ($r = 0.30$, $p<0.001$) in both males and females. |
| Dommershuijsen, 2022<br>Netherlands | ≥50<br>[67.7] | 4,656 | 55.2 | Rotterdam study | Sensor, 5.8 MWT<br>Gait speed (m/s) | Gait speed reference values in community-dwelling older adults - cross-sectional analysis from the Rotterdam Study | BAS: For both men and women, younger age and higher education were associated with better mobility ($p<0.05$). However, sex did not affect gait speed after accounting for age and height. |

| | | | | | | | |
|---|---|---|---|---|---|---|---|
| Fang, 2020<br>China | 60–89<br>[73.5] | 113 | 56.0 | NA | Sensor, 2 minWT<br>Gait speed (m/s) | Three-dimensional thoracic and pelvic kinematics and arm swing maximum velocity in older adults using inertial sensor system. | BAS: Younger people (F= 68.903, p<0.001) had better mobility but no significant effect of gender (p=0.65) or age*gender interaction (p=0.56). |
| Fiser, 2010<br>USA | 60–88<br>[72.5] | 49 | 49.0 | NA | SPPB, HGS<br>Gait speed (m/s) | Energetics of walking in elderly people: factors related to gait speed | BAS: Women had slower habitual walking speeds (1.04 ± 0.04 vs 1.21 ± 0.04 m/s, p = .006) than men. |
| *Gomes, 2023<br>Brazil | ≥60<br>[68.0] | 476 | 65.1 | COMO VAI | TUG, 4 MWT<br>Walk time (s), Gait speed (m/s) | Changes in physical performance among community-dwelling older adults in six years | BAS: Being male (p = 0.023), living without a partner/separated (p = 0.035), higher education (p = 0.019), and alcohol consumption in the prior month (p = 0.045) were associated with decreased GS, while older age (p<0.001), having lower socioeconomic status (p<0.004), physical inactivity (p = 0.017), and being overweight (p = 0.007) were associated with increased TUG time. |
| Granic, 2018<br>USA | ≥60<br>[74.0] | 577 | 72.3 | HARI | 4 MWT<br>Gait speed (m/s) | Factors associated with physical performance measures in a multiethnic cohort of older adults | BAS: European Americans walked faster than > African American > Hispanic, and > Afro-Caribbean (p<0.001). MAS: Younger age, being a man, and higher education were associated with better mobility (p<0.01) among the multiracial cohort. |
| Ibrahim, 2017<br>Malaysia | ≥60<br>[68.7] | 2,084 | 51.8 | LRGS TUA | TUG<br>Walk time (s) | 'Timed Up and Go' test: age, gender and cognitive impairment stratified normative values of older adults. | BAS: Younger people (p<0.001) and men (p<0.001) had better mobility. MAS: younger age (β = 0.76, p<0.001) and being a man (β = 0.89, p<0.001) were associated with better mobility, adjusted for cognitive status. |
| *Idland, 2013<br>Norway | 75–92<br>[79.5] | 113 | 100.0 | NA | TUG<br>Walk time (s) | Predictors of mobility in community-dwelling women aged 85 and older. | BAS: Younger people had less mobility decline (β =0.34, p<0.001) after nine years of follow-up; education level had no significant effect (β = -0.05, p = 0.60). MAS: Being of younger age was associated with less mobility decline (β = 0.35, p < 0.001) when adjusted for living alone, step climbing score, walking habits, general health, and BMI. |

| | | | | | | | |
|---|---|---|---|---|---|---|---|
| Iwakura, 2022<br>Japan | ≥65<br>[72.0] | 392 | 70.4 | NA | TUG<br>Walk time (s) | Lower-limb muscle strength and major performance tests in community-dwelling older adults | MAS: After controlling for height and weight, younger age was associated with better TUG score/mobility (β =0.264, p<0.001), but there was no statistical gender effect (β = -0.049, p = 0.319). |
| *Jerome, 2015<br>USA | 60–89<br>[72.3] | 362 | 51.0 | BLSA | 6 MWT<br>Gait speed (m/s) | Gait characteristics associated with walking speed decline in older adults: results from the Baltimore Longitudinal Study of Aging | MAS: After three years of follow-up, younger age was associated with less mobility decline (OR = 1.03 [95% CI: 1.00, 1.07); the model was adjusted for initial gait speed, sex, race, height, weight, and follow-up time. |
| Kamiya, 2019<br>Japan | ≥75<br>[80.3] | 109 | 12.8 | NA | 10 MWT, 6 minWT<br>Gait speed (m/s), Walk distance (m) | The 6-Minute Walk Test: Difference in explanatory variables for performance by community-dwelling older adults and patients hospitalized for cardiac disease | BAS: Oder age had a significant negative correlation with 6minWT (r = -0.367 [95% CI: -0.519, -0.192]) and 10 MWT scores (r = -0.220 [95% CI: -0.392, -0.033]). MAS: Younger age (β = -0.270, p=0.001) was significantly associated with better mobility; the effect of being a man was not significant (β =0.210, p=0.051); the model was adjusted for gait speed, grip strength, BMI, and cognition. |
| Lin, 2021<br>Taiwan | ≥65<br>[75.0] | 301 | 55.1 | Yilan study | 6 MWT<br>Gait speed (m/s) | Using hand grip strength to detect slow walking speed in older adults: the Yilan study | BAS: Younger people (p<0.001), men (p<0.001), and people with higher education (p=0.001) had better mobility. Younger age correlated with better mobility (r = -0.42, p<0.001) MAS: younger age (β = -0.23, p<0.001), men (β = -0.13, p<0.001), and higher education (β = -0.15, p<0.05) were associated with better mobility. |
| Lunar, 2019<br>Philippines | ≥60<br>[67.6] | 180 | 60.0 | NA | 10 MWT, 6 minWT<br>Gait speed (m/s), Walk distance (m) | Mobility performance among community-dwelling older Filipinos who lived in urban and rural settings: A preliminary study | BAS: T-test analysis showed that urban residents had better mobility than their rural counterparts (p<0.001). |
| Makizako, 2017<br>Japan | ≥65<br>[73.6] | 10,092 | 52.5 | NCGG-SGS | 2.4 MWT<br>Gait speed (m/s) | Age-dependent changes in physical performance and body composition in community-dwelling Japanese older adults | BAS: Younger age was significantly correlated with better mobility in men (r= -0.37) and women (r = -0.48), both p<0.001. MAS: Older age was associated with poor mobility, β = 0.62, 95% CI = 0.66 to 0.57 |

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| | | | | | | | in men and β = 0.95, 95% CI= 0.99 to 0.90 in women for walking speed. |
| Mantel, 2019<br>USA | ≥60<br>[75.2] | 60 | 68.3 | NA | Sensor, 3.7 MWT<br>Gait speed (m/s) | An investigation of the predictors of comfortable and fast gait speed in community-dwelling older adults | BAS: Younger people (r = -0.48, p<0.001) had better mobility, and there was no statistically significant correlation with gender (r = -0.22, p>0.05). |
| Milanović, 2013<br>Serbia | 60–80<br>[66.5] | 1,288 | 53.9 | NA | 8ft UGT<br>Walk time (s) | Age-related decrease in physical activity and functional fitness among elderly men and women. | BAS: Younger people [60 to 69 years] had better mobility than the older age range 70 to 80 years, in men (-16%, p<0.05) and women (-9%, p<0.05). |
| Mohammed, 2021<br>India | 65–83<br>[73.6] | 100 | 47.0 | NA | TUG<br>Gait speed (m/s) | Influence of age, gender, and body mass index on balance and mobility performance in Indian community-dwelling older people | BAS: Younger age (r = 0.81, p<0.0001) correlated with better mobility, and there was no statistically significant effect of gender (d = 0.295, p=0.14). |
| Payne, 2017<br>South Africa | ≥40<br>[61.7] | 5,058 | 54.0 | HAALSI | 5 MWT<br>Gait speed (m/s) | Physical function in an aging population in rural South Africa: Findings from HAALSI and cross-national comparisons with HRS sister studies | BAS: Younger people and men had better mobility (p<0.05). MAS model 1: younger age (β = -0.0035, p<0.01), men (β = 0.032, p<0.01), and being married vs. never married (β = -0.049, p<0.01) or widowed (β = -0.026, p<0.05) were associated with better mobility, but there was no statistically significant effect of education on mobility (β = 0.019, p>0.05) when controlled for HIV and CVD status. |
| Plouvier, 2016<br>France | 55–69<br>[61.4] | 736 | 40.1 | CONSTANCES | 3 MWT<br>Gait speed (m/s) | Socioeconomic disparities in gait speed and associated characteristics in early old age | MAS: Compared to managers/executives, gait speed was reduced in less skilled categories among men (OR 1.21 [0.72–2.05] for Intermediate/Tradesmen, 1.95 [0.80–4.76] for Clerks, Sale/service workers, 2.09 [1.14–3.82] for Blue collar/Craftsmen) and among women (OR 1.12 [0.55–2.28] for Intermediate/Tradesmen, 2.33 [1.09–4.97] for Clerks, 2.48 [1.18–5.24] for Sale/service workers/Blue collar/Craftsmen); adjusted for age and health centre. Among men, occupational exposure to carrying heavy loads explained a large |

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| | | | | | | | part of socioeconomic disparities. Among women, obesity and occupational exposure to repetitive work contributed independently to the disparities. |
| Ramírez-Vélez, 2020<br>Columbia | ≥60<br>[69.0] | 4,211 | 53.0 | SABE | SPPB, 3 MWT<br>Gait speed (m/s) | Normative values for the short physical performance battery (SPPB) and their association with anthropometric variables in older Colombian adults. The SABE Study, 2015 | BAS: Younger people (β= -0.280, p<0.001) and men (d = 0.391, p<0.001) had better mobility. MAS: age (β= -0.248, p<0.001) was a significant contributor to walking speed after controlling for body mass, height, BMI, calf circumference, ethnicity, socioeconomic status, and urbanicity. |
| Rikli, 1999<br>USA | 60–94<br>[73.3] | 7,183 | 70.3 | NA | 8 ftUGT, 6 MinWT<br>Walk time(s), Walk distance (m) | Functional fitness normative scores for community-residing older adults, ages 60–94. | BAS: ANOVA and post hoc comparison indicated a significant main effect for age and gender, such that younger people (p<0.007) and men (p<0.0001) had better mobility. |
| Ruggero, 2013<br>Brazil | 65–92<br>[71.4] | 385 | 64.4 | FIBRA Network | 4.6 MWT<br>Gait speed (m/s) | Gait speed correlates in a multiracial population of community-dwelling older adults living in Brazil: a cross-sectional population-based study | BAS: Younger people (OR 3.91, p<0.001) and people with higher education (OR 1.74, p=0.039) had better mobility, but there was no significant effect of gender and income level (OR 1.29, p<0.359). MAS: A younger age was associated with better mobility (OR 3.81, p<0.001), adjusted for physical activity level, chronic conditions, and concern of falling. |
| Schrack, 2012<br>USA | 32–96<br>[68.1] | 420 | 48.1 | BLSA | 6 MWT<br>Gait speed (m/s) | The role of energetic cost in the age-related slowing of gait speed | MAS: younger age (β= -0.2017, p<0.001) and being a man (β= 1.030, p=0.02) were associated with better mobility, controlled for height, male sex by height, energy expenditure, smoking status, chronic diseases, and balance performance. |
| Seino, 2014<br>Japan | ≥65<br>[74.0] | 4,683 | 53.7 | See list‡ | 5 and 10 MWT<br>Gait speed (m/s) | Reference values and age and sex differences in physical performance measures for community-dwelling older Japanese: a pooled analysis of six cohort studies | BAS: The t-test showed that the younger age group and men had better mobility (p<0.001). MAS: In multiple linear regression analyses, age (b=20.40, p<0.001) and sex (b=20.09, p<0.001) were significantly associated with usual gait speed. |

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| Shubert, 2006<br>USA | | 65–103<br>[80.9] | 195 | 70.0 | NA | 10 MWT<br>Gait speed (m/s) | Are scores on balance screening tests associated with mobility in older adults? | MAS: younger age (OR=0.92, p=0.04) was associated with better mobility, with no significant gender effect (OR=1.71, p=0.26), adjusted for 360-degree turn and tandem stance. |
| †Sialino, 2019<br>Netherlands | | 55–65<br>[60.3] | 3,469 | 50.6 | LASA | 6MWT<br>Gait speed (m/s) | Sex differences in physical performance by age, educational level, ethnic groups and birth cohort: The Longitudinal Aging Study Amsterdam | BAS: Mixed model analysis showed that women had a lower age- and height-adjusted gait speed (-0.03 m/s; 0.063–0.001) compared to men. MAS: Older people and women had consistently lower gait speed across different educational levels and Turkish/Moroccan ethnic groups and birth cohorts. |
| *Sialino, 2021<br>Netherlands | | 55–81<br>[66.1] | 2,407 | 50.0 | LASA | 6 MWT<br>Gait speed (m/s) | The sex difference in gait speed among older adults: How do sociodemographic, lifestyle, social and health factors contribute? | BAS: Men had less mobility decline compared to women after 15 to 25 years of follow-up (Md=0.076m/s, p<0.001). MAS: Having a lower educational level, living alone and having more chronic diseases, pain and depressive symptoms among women compared to men contributed to observed lower gait speed in women (P<0.05). In men, being a smoker, having lower physical activity, and having a smaller personal network size compared to women contributed to a lower gait speed among men (p<0.05). |
| Smolar, 2012<br>USA | | ≥60<br>[73.5] | 148 | 69.4 | NA | 4 MWT<br>Gait speed (m/s) | Gait speed in community-dwelling African-American and Afro-Caribbean older adults | BAS: European Americans had better mobility than Blacks (β= -0.179, p=0.001). MAS: Younger age (β= -0.014, p<0.001) and being Caucasian (β= -0.128, p=0.02) were associated with better mobility, but there were no significant effects of gender (β=0.062, p=0.23) and education (β=0.005, p=0.40), adjusted for HbA1c, physical activity and BMI. |
| Sprague, 2023 | Tanzania | ≥65<br>[80.5] | 231 | 70.1 | IDEA | 10 MWT<br>Gait speed (m/s) | Correlates of gait speed among older adults from 6 countries: Findings from the COSMIC collaboration | BAS: Younger people (r=-0.43, P<0.001) and people with higher education (p=0.03) had better mobility, but there was no significant gender effect (p=0.09). |
| | Nigeria | ≥65<br>[76.9] | 1,122 | 51.4 | ISA | 3 and 4 MWT<br>Gait speed (m/s) | | BAS: Younger people (r=-0.27, p<0.001) and men (p<0.001) had better mobility, but there was no significant education effect (p=0.65). |

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| | South Korea | ≥65 [73.3] | 491 | 55.4 | KLOSCAD | 10 MWT Gait speed (m/s) | | BAS: Younger people (r=-0.36, p<0.001) and people with higher education (p=0.045) had better mobility, but there was no significant gender effect (p=0.25). |
| | Japan | ≥65 [73.6] | 1,913 | 58.1 | SGS | 5 MWT Gait speed (m/s) | | BAS: Younger people (r=-0.42, p<0.001), women (p<0.001), and people with higher education (p<0.001) had better mobility |
| | Singapore | ≥65 [72.4] | 1,698 | 59.1 | SLAS-II | 6 MWT Gait speed (m/s) | | BAS: Younger people (r=-0.32, p<0.001), men (p<0.001), and people with higher education (p<0.001) had better mobility. |
| | Australia | ≥65 [78.8] | 995 | 55.2 | Sydney MAS | 6 MWT Gait speed (m/s) | | BAS: Younger people (r=-0.32, p<0.001), men (p=0.009), and people with higher education (p<0.001) had better mobility. |
| Staples, 2020 USA | | ≥60 [76.0] | 111 | 78.4 | NA | TUG, 10 MWT Walk time (s), Gait speed (m/s) | Examination of the correlation between physical and psychological measures in community-dwelling older adults | BAS for TUG: Younger people had better mobility (r=0.413, p<0.01). MAS for TUG: A younger age (β=0.285, p=0.002) was significantly associated with better mobility, adjusted for grip strength and depression. BAS for 10MWT: Younger people had better mobility (r=-0.266, p<0.01). MAS for TUG: A younger age (β=-0.235, p=0.010) and lower level of education (β=0.194, p=0.027) were significantly associated with better mobility, adjusted for grip strength and depression. |
| Tanaka, 2022 Japan | | ≥65 [75.1] | 387 | 57.6 | NA | Motion sensor Gait speed (m/s) | Effects of age and gender on spatiotemporal and kinematic gait parameters in older adults | BAS: Age group effects were found in the walking speed (F=14.165, p<0.001, η2 = 0.131), such that the younger age group had better mobility but no significant gender differences. |
| Tangen, 2020 Norway | | ≥70 [ 74.0] | 105 | 45.7 | NA | TUG, 4 MWT Walk time (s), Gait speed (m/s) | Measuring physical performance in highly active older adults: associations with age and gender? | BAS: Higher age was correlated with lower mobility in men (TUG: r=0.19, p>0.05, 4MWT: r=-0.27, p<0.05) and women (TUG: r=0.48, p<0.001, 4MWT: r=-0.40, p<0.001). MAS: After controlling for age, the effect of gender was not significant (p=0.292) for 4MWT and (p=0.075) for TUG. |

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| Thaweewannakij, 2013<br>Thailand | ≥60 | 1,030 | 68.9 | NA | TUG, 10 MWT, 6 minWT<br>Walk time (s), Gait speed (m/s), Walk distance (m) | Reference values of physical performance in Thai elderly people who are functioning well and dwelling in the community | BAS: The findings demonstrated that the mobility of male participants was significantly better than that of female participants in every age decade (P<0.05). MAS: The findings indicated significant age-related functional decline for both male (P<0.05) and female (P<001) participants in all mobility tests, adjusted for weight and height. |
| Thompson, 1995<br>USA | 65–79<br>[71.5] | 175 | 68.6 | NA | TUG<br>Walk time (s) | Performance of community-dwelling elderly on the timed up-and-go test | BAS: MANOVA result showed that men had better mobility than women (F=10.21, p<0.01), but age had no significant effect (F=0.50, p>0.05). |
| †Thorpe, 2011<br>USA | 70–79<br>[73.4] | 2,969 | 51.3 | Health ABC | 6 MWT<br>Gait speed (m/s) | Race, socioeconomic resources, and late-life mobility and decline: findings from the Health, Aging, and Body Composition study | BAS: The t-test showed that Caucasians had less mobility decline after five years of follow-up (p<0.001). MAS: Gender disaggregate logistic regression models showed that younger age, higher income, higher education, homeownership, and being Caucasian were associated with less mobility decline (p<0.05). |
| *Vasunilashorn, 2009<br>Italy | ≥65<br>[71.6] | 542 | 51.5 | InCHIANTI | 400 MWT<br>Gait speed (m/s) | Use of the Short Physical Performance Battery Score to predict loss of ability to walk 400 meters: analysis from the InCHIANTI study | MAS: A younger age was associated with a higher tendency for completing 400MWT (OR=1.10, p<0.01), but there were no significant effects of gender (OR=1.42, p=0.30) and education (OR=0.98, p=0.72), adjusted for SPPB, BMI, cognition, and number of chronic diseases. |
| Watson, 2010<br>USA | 70–79<br>[75.2] | 909 | 50.6 | ABC Cognitive Vitality Substudy | 20 MWT<br>Gait speed (m/s) | Executive function, memory, and gait speed decline in well-functioning older adults | BAS: In baseline, younger people (p<0.001), men (p<0.001), people with higher education (p<0.001), and Caucasians (p<0.001) had better mobility. |
| Welmer, 2013<br>Sweden | ≥60<br>[74.2] | 3,212 | 63.8 | SNSAC | 2.4 and 6 MWT<br>Gait speed (m/s) | Education-related differences in physical performance after age 60: A cross-sectional study assessing variation by age, gender and occupation. | BAS: Lower gait speed was found in older participants, in women, in manual workers, and in people with lower levels of education (p<0.05). MAS: Multivariate regression showed higher education attainment was associated with better mobility (p<0.001), controlling for age, gender, chronic diseases and lifestyle-related variables. |

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| Wheaton, 2016 | USA | 55–85 [66.5] | 14,125 | 55.0 | HRS | 2.5 MWT Gait speed (m/s) | Female disability disadvantage: A global perspective on sex differences in physical function and disability. | MAS: Being a man was associated with better mobility (B= -0.07, p<0.001), adjusted for age, education, and marital status. |
| | Taiwan | 55–85 [66.4] | 1,051 | 48.0 | SEBAS | 3 MWT Gait speed (m/s) | | MAS: Being a man was associated with better mobility (B= -0.13, p<0.01), adjusted for age, education, and marital status. |
| | China | 55–85 [66.4] | 7,438 | 57.0 | CHARLS | 3 MWT Gait speed (m/s) | | MAS: Being a man was associated with better mobility (B= -0.03, p<0.05), adjusted for age, education, and marital status. |
| | Bolivia | 55–85 [65.5] | 449 | 47.0 | THLHP | 2.5 MWT Gait speed (m/s) | | MAS: Being a man was associated with better mobility (B= -0.05, p<0.01), adjusted for age. |
| Wu, 2021 China | | 60–80 [65.8] | 211 | 70.1 | NA | 6 MWT Gait speed (m/s) | Associations between functional fitness and walking speed in older adults | MAS: A younger age was associated with faster usual walking speed (B= -0.012, p<0.001), adjusted for 8ft UG, 2-min step, chair sit-and-reach test, and gender. |
| Yaoxin, 2022 China | | ≥65 [72.9] | 595 | 59.2 | NA | TUG Walk time (s) | Mediating effect of lower extremity muscle strength on the relationship between mobility and cognitive function in Chinese older adults: A cross-sectional study | BAS: Younger people (F = 54.7, p<0.001) and people with higher education (F = 14.0, p<0.001) had better mobility, but there was no significant effect of gender (t = -0.32, p=0.767) or job type (F = 2.38, p=0.09). |

**Dataset:** BLSA: Baltimore Longitudinal Study of Aging. CHARLS: China Health and Retirement Longitudinal Study. COMO VAI: Consórcio de Mestrado Orientado para Valorização da Atenção ao Idoso. CONSTANCES: Cohorte des consultants des Centres d'examens de santé. EAS: Einstein Aging Study. FIBRA Network Study: Frailty among Brazilian Older Adults. HAALSI: Health and Aging in Africa: A Longitudinal Study of an INDEPTH Community in South Africa. HARI: Florida Atlantic University Healthy Aging Research Initiative. ‡HATOYAMA: Hatoyama Cohort Study. Health ABC: Health, Aging, and Body Composition Study. HRS: Health and Retirement Study. HSE-2005: Health Survey for England 2005. IDEA: Identification and Intervention for Dementia in Elderly. InCHIANTI: Invecchiare in Chianti study. ISA: Ibadan Study of Aging. ‡ITABASHI-02: Itabashi Cohort Study 2002. ‡ITABASHI-11: Itabashi Cohort Study 2011. KLOSCAD: Korean Longitudinal Study on Cognitive Aging and Dementia. ‡KUSATSU Kusatsu Longitudinal Study. LRGS TUA: Longitudinal Study on Neuroprotective Model for Healthy Longevity. LASA: Longitudinal Aging Study Amsterdam. MBJS: Mitsugi Bone and Joint Study. ‡NANGAI: Nangai Cohort Study. NCGG-SGS: National Center for Geriatrics and Gerontology-Study of Geriatric Syndromes. NHANES: National Health and Nutrition Examination Survey. NHANES III: Third National Health and Nutrition Examination Survey. SABE: Salud, Bienestar y Envejecimiento. SEBAS: Social Environment and Biomarkers of Ageing Study. SGS: Sasaguri Genkimon Study. SLAS-II: Singapore Longitudinal Study of Aging-II. SNSAC: Swedish National Study on Aging and Care. SPPB: Short Physical Performance Battery. Sydney MAS: Sydney Memory and Ageing Study. THLHP: Tsimane Health & Life History Project. ‡YOITA: Yoita Longitudinal Study.

**Mobility test:** HGS: Habitual Gait Speed. TUG: Timed-Up and Go. UGT: Up and Go test. MWT: Metre walk test. minWT: Minute walk test. **Study design:** (no symbol) Cross-sectional analysis. * Longitudinal analysis. † Both Cross-sectional and Longitudinal analyses. **Country:** UK: United Kingdom. USA: United States of America. **NA:** Not applicable. **Analysis type:** BAS: Bivariate Analysis. MAS: Multivariate Analysis (only the sociodemographic predictors were reported).

## APPENDIX F: SUMMARY OF DESIGN OF THE STUDIES IN THE SYSTEMATIC REVIEW

Summary of study design and results (none of the included studies addressed religion)

| First author surname, Year | Title | Age | | Gender | | Marital status | | Race | | Income | | Education | | Occupation | | Residence | | House ownership | | Social status | |
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| | | CSA | LA | CSA | LA | CSA | LA | CSA | LA | CSA | LA | CSA | LA | CSA | LA | CSA | LA | CSA | LA | CSA | LA |
| Al Snih, 2008 | Ethnic differences in physical performance in older Americans: data from the Third National Health and Nutrition Examination Survey (1988-1994) | MAS | | MAS | | N | | TDS; MAS | | | | MAS | | | | | | | | | |
| Aoyagi, 2001 | Comparison of performance-based measures among native Japanese, Japanese-Americans in Hawaii and Caucasian women in the United States, ages 65 years and over: A cross-sectional study | | | | | | | TDS | | | | | | | | | | | | | |
| Asher, 2012 | Most older pedestrians are unable to cross the road in time: a cross-sectional study | BAS; MAS | | BAS; MAS | | | | | | | | BAS | | | | | | | | | |
| Barrera, 2017 | Associations between socioeconomic status, aging and functionality among older women | | | | | | | | | | | TDS | | | | | | | | | |
| Bendall, 1989 | Factors affecting walking speed of elderly people | BAS | | TDS | | | | | | | | | | | | | | | | | |
| Binotto, 2019 | Gait speed associated factors in elderly subjects undergoing exams to obtain the driver's | MAS | | MAS | | | | | | | | | | | | | | | | | |

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| | license Portuguese, English, Spanish | | | | | | | | | | | | | | | | | | | | |
| Blanco, 2012 | Racial differences in gait velocity in an urban elderly cohort | | | N | | | | TDS: BAS: MAS | | | | | | | | | | | | | |
| Bohannon, 1996 | Walking speed: Reference values and correlates for older adults | N | | BAS;MAS | | | | | | | | | | | | | | | | | |
| Bohannon, 2008 | Population representative gait speed and its determinants | BAS; MAS | | BAS | | | | | | | | | | | | | | | | | |
| Boulifard, 2019 | Home-based gait speed assessment: Normative data and racial/ethnic correlates among older adults | TDS; MAS | | TDS; MAS | | | | TDS; MAS | | MAS | | MAS | | | | MAS | | | | | |
| Brunner, 2009 | Social inequality in walking speed in early old age in the Whitehall II study | TDS | | TDS | | TDS | | TDS | | TDS | | | | | | | | | | N | |
| Buchner, 1996 | Evidence for a non-linear relationship between leg strength and gait speed | BAS | | BAS | | | | | | | | | | | | | | | | | |
| Busch, 2015 | Factors associated with lower gait speed among the elderly living in a developing country: a cross-sectional population-based study. | TDS; MAS | | N | | | | N | | | | TDS; MAS | | | | | | | | | |
| Butler, 2009 | Age and gender differences in seven tests of functional mobility | BAS | | TDS | | | | | | | | | | | | | | | | | |
| Carvalho de Abreu, 2021 | Functional performance of older adults: A comparison between men and women | | | N | | | | | | | | | | | | | | | | | |
| ChilesShaffer, 2020 | The roles of body composition and specific strength in the relationship | MAS | | | | | | MAS | | MAS | | N | | | | | | | | | |

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| | between race and physical performance in older adults | | | | | | | | | | | | | | | | | | | | |
| Coelho-Junior, 2021 | Age- and gender-related changes in physical function in community-dwelling Brazilian adults aged 50 to 102 years | TDS; BAS | | | | | | | | | | | | | | | | | | | |
| Dommershuijsen, 2022 | Gait speed reference values in community-dwelling older adults - cross-sectional analysis from the Rotterdam Study | TDS | | N | | | | | | | | TDS | | | | | | | | | |
| Fang, 2020 | Three-dimensional thoracic and pelvic kinematics and arm swing maximum velocity in older adults using inertial sensor system. | TDS | | N | | | | | | | | | | | | | | | | | |
| Fiser, 2010 | Energetics of walking in elderly people: factors related to gait speed | N | | TDS | | | | | | | | | | | | | | | | | |
| Gomes, 2023 | Changes in physical performance among community-dwelling older adults in six years | | C | | C | | C | | N | | | | C | | | | | | | | TDS |
| Granic, 2018 | Factors associated with physical performance measures in a multiethnic cohort of older adults | MAS | | MAS | | | | TDS | | | | MAS | | | | | | | | | |
| Ibrahim, 2017 | 'Timed Up and Go' test: age, gender and cognitive impairment stratified normative values of older adults. | TDS; MAS | | TDS; MAS | | | | | | | | | | | | | | | | | |
| Idland, 2013 | Predictors of mobility in community-dwelling women aged 85 and older. | | BAS; MAS | | | | | | | | | | N | | | | | | | | |

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| Iwakura, 2022 | Lower-limb muscle strength and major performance tests in community-dwelling older adults | MAS | | N | | | | | | | | | | | | | | | | | |
| Jerome, 2015 | Gait characteristics associated with walking speed decline in older adults: results from the Baltimore Longitudinal Study of Aging | | MAS | | | | | | | | | | | | | | | | | | |
| Kamiya, 2019 | The 6-Minute Walk Test: Difference in explanatory variables for performance by community-dwelling older adults and patients hospitalized for cardiac disease | BAS; MAS | | N | | | | | | | | | | | | | | | | | |
| Lin, 2021 | Using hand grip strength to detect slow walking speed in older adults: the Yilan study | TDS; BAS; MAS | | TDS; MAS | | | | | | | | TDS; MAS | | | | | | | | | |
| Lunar, 2019 | Mobility performance among community-dwelling older Filipinos who lived in urban and rural settings: A preliminary study | | | | | | | | | | | | | | | TDS | | | | | |
| Makizako, 2017 | Age-dependent changes in physical performance and body composition in community-dwelling Japanese older adults | BAS; MAS | | N | | | | | | | | | | | | | | | | | |
| Mantel, 2019 | An investigation of the predictors of comfortable and fast gait speed in community-dwelling older adults | BAS | | N | | | | | | | | | | | | | | | | | |
| Milanović, 2013 | Age-related decrease in physical activity | TDS | | | | | | | | | | | | | | | | | | | |

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| | and functional fitness among elderly men and women. | | | | | | | | | | | | | | | | | | | | |
| Mohammed, 2021 | Influence of age, gender, and body mass index on balance and mobility performance in Indian community-dwelling older people | BAS | | N | | | | | | | | | | | | | | | | | |
| Payne, 2017 | Physical function in an aging population in rural South Africa: Findings from HAALSI and cross-national comparisons with HRS sister studies | TDS; MAS | | TDS; MAS | | MAS | | | | | | N | | | | | | | | | |
| Plouvier, 2016 | Socioeconomic disparities in gait speed and associated characteristics in early old age | | | | | | | | | | | | | MAS | | | | | | | |
| Ramírez-Vélez, 2020 | Normative values for the short physical performance battery (SPPB) and their association with anthropometric variables in older Colombian adults. The SABE Study, 2015 | TDS; BAS; MAS | | TDS; MAS | | | | | | | | | | | | | | | | | |
| Rikli, 1999 | Functional fitness normative scores for community-residing older adults, ages 60–94. | TDS | | TDS | | | | | | | | | | | | | | | | | |
| Ruggero, 2013 | Gait speed correlates in a multiracial population of community-dwelling older adults living in Brazil: a cross-sectional population-based study. | BAS; MAS | | N | | | | | | N | | BAS | | | | | | | | | |
| Schrack, 2012 | The role of energetic cost in the age- | MAS | | MAS | | | | | | | | | | | | | | | | | |

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|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | related slowing of gait speed | | | | | | | | | | | | | | | | | | | | |
| Seino, 2014 | Reference values and age and sex differences in physical performance measures for community-dwelling older Japanese: a pooled analysis of six cohort studies | TDS; MAS | | TDS; MAS | | | | | | | | | | | | | | | | | |
| Shubert, 2006 | Are scores on balance screening tests associated with mobility in older adults? | MAS | | N | | | | | | | | | | | | | | | | | |
| Sialino, 2019 | Sex differences in physical performance by age, educational level, ethnic groups and birth cohort: The Longitudinal Aging Study Amsterdam | MAS | | TDS; MAS | | | | | | | | | | | | | | | | | |
| Sialino, 2021 | The sex difference in gait speed among older adults: How do sociodemographic, lifestyle, social and health factors contribute? | | | | TDS; MAS | | | | | | | | N | | | | | | | | MAS |
| Smolar, 2012 | Gait speed in community-dwelling African-American and Afro-Caribbean older adults | MAS | | N | | | | TDS; BAS; MAS | | | | N | | | | | | | | | |
| Sprague, 2023 [Tanzania] | Correlates of gait speed among older adults from 6 countries: Findings from the COSMIC collaboration | BAS | | N | | | | | | | | TDS | | | | | | | | | |
| Sprague, 2023 [Nigeria] | | BAS | | TDS | | | | | | | | N | | | | | | | | | |
| Sprague, 2023 [South Korea] | | BAS | | N | | | | | | | | TDS | | | | | | | | | |
| Sprague, 2023 [Japan] | | BAS | | TDS | | | | | | | | TDS | | | | | | | | | |
| Sprague, 2023 [Singapore] | | BAS | | TDS | | | | | | | | TDS | | | | | | | | | |
| Sprague, 2023 [Australia] | | BAS | | TDS | | | | | | | | TDS | | | | | | | | | |

| | | | | | | | | | | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| Staples, 2020 | Examination of the correlation between physical and psychological measures in community-dwelling older adults | BAS; MAS | | | | | | | | | | MAS | | | | | | | | | |
| Tanaka, 2022 | Effects of age and gender on spatiotemporal and kinematic gait parameters in older adults | TDS | | N | | | | | | | | | | | | | | | | | |
| Tangen, 2020 | Measuring physical performance in highly active older adults: associations with age and gender? | BAS | | N | | | | | | | | | | | | | | | | | |
| Thaweewannakij, 2013 | Reference values of physical performance in Thai elderly people who are functioning well and dwelling in the community | TDS; MAS | | TDS; MAS | | | | | | | | | | | | | | | | | |
| Thompson, 1995 | Performance of community dwelling elderly on the timed up and go test | N | | TDS | | | | | | | | | | | | | | | | | |
| Thorpe, 2011 | Race, socioeconomic resources, and late-life mobility and decline: findings from the Health, Aging, and Body Composition study | | MAS | | | | | | TDS; MAS | | MAS | | MAS | | | | | | MAS | | |
| Vasunilashorn, 2009 | Use of the Short Physical Performance Battery Score to predict loss of ability to walk 400 meters: analysis from the InCHIANTI study | | MAS | | N | | | | | | | | N | | | | | | | | |
| Watson, 2010 | Executive function, memory, and gait speed decline in well-functioning older adults | TDS | | TDS | | | | TDS | | | | TDS | | | | | | | | | |

| | | | | | | | | | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| Welmer, 2013 | Education-related differences in physical performance after age 60: A cross-sectional study assessing variation by age, gender and occupation. | TDS | | TDS | | | | | | | | TDS; MAS | | TDS | | | | | | |
| Wheaton, 2016 [USA] | Female disability disadvantage: A global perspective on sex differences in physical function and disability. | | | MAS | | | | | | | | | | | | | | | | |
| Wheaton, 2016 [Taiwan] | | | | MAS | | | | | | | | | | | | | | | | |
| Wheaton, 2016 [China] | | | | MAS | | | | | | | | | | | | | | | | |
| Wheaton, 2016 [Bolivia] | | | | MAS | | | | | | | | | | | | | | | | |
| Wu, 2021 | Associations between functional fitness and walking speed in older adults | MAS | | | | | | | | | | | | | | | | | | |
| Yaoxin, 2022 | Mediating effect of lower extremity muscle strength on the relationship between mobility and cognitive function in Chinese older adults: A cross-sectional study | TDS; BAS | | N | | | | | | | | TDS; BAS | | N | | | | | | |

Younger age, men, married, urban area, higher income, higher education, non-manual job, religious, higher social status, homeowner, or Caucasian = test of differences = statistically significant higher mobility = TDS
Younger age, men, married, urban area, higher income, higher education, non-manual job, religious, higher social status, homeowner, or Caucasian = bivariate association/correlation = statistically significant higher mobility = BAS
Younger age, men, married, urban area, higher income, higher education, non-manual job, religious, higher social status, homeowner, or Caucasian = multivariate association = statistically significant higher mobility = MAS
Older age, women, not married, rural area, lower income, lower education, manual job, irreligious, lower social status, non-homeowner, non-Caucasian = test of differences = statistically significant higher mobility = TDS
Older age, women, not married, rural area, lower income, lower education, manual job, irreligious, lower social status, non-homeowner, non-Caucasian = bivariate association/correlation = statistically significant higher mobility = BAS
Older age, women, not married, rural area, lower income, lower education, manual job, irreligious, lower social status, non-homeowner, non-Caucasian = multivariate association = statistically significant higher mobility = MAS
Result not statistically significant = N
Result of different mobility tests conflicting = C
CSA = cross-sectional analysis. LA = longitudinal analysis.

## APPENDIX G: RISK OF BIAS ASSESSMENT FOR ALL STUDIES IN THE SYSTEMATIC REVIEW

| Author, Year | Title | Joanna Briggs Institute's appraisal checklist for analytic cross-sectional studies | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|
| | | Item 1 | Item 2 | Item 3 | Item 4 | Item 5 | Item 6 | Item 7 | Item 8 | Score | Risk |
| Al Snih, 2008 | Ethnic differences in physical performance in older Americans: data from the Third National Health and Nutrition Examination Survey (1988-1994) | Yes | Yes | Yes | Yes | Yes | Yes | Yes | Yes | 8 | Low |
| Aoyagi, 2001 | Comparison of performance-based measures among native Japanese, Japanese-Americans in Hawaii and Caucasian women in the United States, ages 65 years and over: A cross-sectional study | Yes | Yes | Yes | Yes | Yes | Yes | Yes | Yes | 8 | Low |
| Asher, 2012 | Most older pedestrians are unable to cross the road in time: a cross-sectional study | Unclear | Unclear | Unclear | Yes | Yes | No | Yes | Yes | 4 | Medium |
| Barrera, 2017 | Associations between socioeconomic status, aging and functionality among older women | Unclear | Yes | Yes | Yes | Yes | No | Yes | Yes | 6 | Low |
| Bendall, 1989 | Factors affecting walking speed of elderly people | Unclear | No | Yes | Yes | Yes | Yes | Yes | Yes | 6 | Low |
| Binotto, 2019 | Gait speed associated factors in elderly subjects undergoing exams to obtain the driver's license Portuguese, English, Spanish | Yes | No | Yes | Yes | No | No | Yes | No | 4 | Medium |
| Blanco, 2012 | Racial differences in gait velocity in an urban elderly cohort | Yes | Yes | Yes | Yes | Yes | Yes | Yes | Yes | 8 | Low |
| Bohannon, 1996 | Walking speed: Reference values and correlates for older adults | Yes | No | Yes | Yes | Unclear | Yes | Yes | Yes | 6 | Low |
| Bohannon, 2008 | Population representative gait speed and its determinants | Yes | Yes | Yes | Yes | Yes | Yes | Yes | Yes | 8 | Low |
| Boulifard, 2019 | Home-based gait speed assessment: Normative data and racial/ethnic correlates among older adults | Yes | Yes | Yes | Yes | Yes | Yes | Yes | Yes | 8 | Low |
| Brunner, 2009 | Social inequality in walking speed in early old age in the Whitehall II study | No | Yes | Yes | Yes | Yes | Yes | Yes | Unclear | 6 | Low |
| Buchner, 1996 | Evidence for a non-linear relationship between leg strength and gait speed | Yes | Yes | Yes | Yes | Yes | Yes | Yes | Yes | 8 | Low |
| Busch,, 2015 | Factors associated with lower gait speed among the elderly living in a developing country: a cross-sectional population-based study. | Yes | Yes | Yes | Yes | Yes | Yes | Yes | Unclear | 7 | Low |
| Butler, 2009 | Age and gender differences in seven tests of functional mobility | Unclear | Yes | Yes | Yes | Unclear | No | Yes | Yes | 5 | Medium |
| Carvalho de Abreu, 2021 | Functional performance of older adults: A comparison between men and women | Yes | Yes | Yes | Yes | Yes | Yes | Yes | Unclear | 7 | Low |

| | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|
| ChilesShaffer, 2020 | The roles of body composition and specific strength in the relationship between race and physical performance in older adults | Yes | Yes | Yes | Yes | Yes | Yes | Yes | Yes | 8 | Low |
| Coelho-Junior, 2021 | Age- and gender-related changes in physical function in community-dwelling Brazilian adults aged 50 to 102 years | Yes | Yes | Yes | Yes | Unclear | Unclear | Yes | Yes | 6 | Low |
| Dommershuijsen, 2022 | Gait speed reference values in community-dwelling older adults - cross-sectional analysis from the Rotterdam Study | Yes | Yes | Yes | Yes | No | No | Yes | Yes | 6 | Low |
| Fang, 2020 | Three-dimensional thoracic and pelvic kinematics and arm swing maximum velocity in older adults using inertial sensor system. | Yes | Yes | Yes | Yes | No | No | Yes | Yes | 6 | Low |
| Fiser, 2010 | Energetics of walking in elderly people: factors related to gait speed | Yes | Yes | Unclear | Yes | No | No | Unclear | Yes | 4 | Medium |
| Gomes, 2023 | Changes in physical performance among community-dwelling older adults in six years | Yes | Yes | Yes | Yes | No | No | Yes | Yes | 6 | Low |
| Granic, 2018 | Factors associated with physical performance measures in a multiethnic cohort of older adults | Yes | Yes | No | Yes | Yes | Yes | Yes | Yes | 7 | Low |
| Ibrahim, 2017 | 'Timed Up and Go' test: age, gender and cognitive impairment stratified normative values of older adults. | Yes | Yes | Yes | Yes | Yes | Yes | Yes | Yes | 8 | Low |
| Idland, 2013 | Predictors of mobility in community-dwelling women aged 85 and older. | Yes | Yes | Yes | Yes | Yes | Yes | Yes | Yes | 8 | Low |
| Iwakura, 2022 | Lower-limb muscle strength and major performance tests in community-dwelling older adults | Yes | Yes | Yes | Yes | Yes | Unclear | Yes | Yes | 7 | Low |
| Jerome, 2015 | Gait characteristics associated with walking speed decline in older adults: results from the Baltimore Longitudinal Study of Aging | Yes | Yes | Yes | Yes | Yes | Unclear | Yes | Yes | 7 | Low |
| Kamiya, 2019 | The 6-Minute Walk Test: Difference in explanatory variables for performance by community-dwelling older adults and patients hospitalized for cardiac disease | Unclear | Yes | Yes | Yes | Unclear | Unclear | Yes | Yes | 5 | Medium |
| Lin, 2021 | Using hand grip strength to detect slow walking speed in older adults: the Yilan study | Yes | Yes | Yes | Yes | Yes | Yes | Yes | Yes | 8 | Low |
| Lunar, 2019 | Mobility performance among community-dwelling older Filipinos who lived in urban and rural settings: A preliminary study | Yes | Yes | Yes | Yes | Yes | Yes | Yes | Yes | 8 | Low |
| Makizako, 2017 | Age-dependent changes in physical performance and body composition in community-dwelling Japanese older adults | Yes | Yes | Yes | Yes | No | No | Yes | Yes | 6 | Low |

| | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|
| Mantel, 2019 | An investigation of the predictors of comfortable and fast gait speed in community-dwelling older adults | Yes | Yes | Yes | Yes | Yes | Yes | Yes | Yes | 8 | Low |
| Milanović, 2013 | Age-related decrease in physical activity and functional fitness among elderly men and women. | Yes | Yes | Yes | Yes | Yes | Yes | Yes | Yes | 8 | Low |
| Mohammed, 2021 | Influence of age, gender, and body mass index on balance and mobility performance in Indian community-dwelling older people | Yes | Yes | Yes | Yes | No | No | Yes | Yes | 6 | Low |
| Payne, 2017 | Physical function in an aging population in rural South Africa: Findings from HAALSI and cross-national comparisons with HRS sister studies | Yes | Yes | Yes | Yes | Yes | Yes | Yes | Yes | 8 | Low |
| Plouvier, 2016 | Socioeconomic disparities in gait speed and associated characteristics in early old age | Yes | Yes | Yes | Yes | Yes | Yes | Yes | Yes | 8 | Low |
| Ramírez-Vélez, 2020 | Normative values for the short physical performance battery (SPPB) and their association with anthropometric variables in older Colombian adults. The SABE Study, 2015 | No | Yes | Yes | Yes | Yes | Unclear | Yes | Yes | 6 | Low |
| Rikli, 1999 | Functional fitness normative scores for community-residing older adults, ages 60–94. | Yes | Yes | Yes | Yes | Yes | Yes | Yes | Yes | 8 | Low |
| Ruggero, 2013 | Gait speed correlates in a multiracial population of community-dwelling older adults living in Brazil: a cross-sectional population-based study. | Yes | Yes | Yes | Yes | Unclear | Unclear | Yes | Yes | 6 | Low |
| Schrack, 2012 | The role of energetic cost in the age-related slowing of gait speed | Yes | Yes | Yes | Yes | Yes | Yes | Yes | Yes | 8 | Low |
| Seino, 2014 | Reference values and age and sex differences in physical performance measures for community-dwelling older Japanese: a pooled analysis of six cohort studies | Yes | Yes | Yes | Yes | Yes | Yes | Yes | Yes | 8 | Low |
| Shubert, 2006 | Are scores on balance screening tests associated with mobility in older adults? | Yes | Yes | Yes | Yes | Yes | Yes | Yes | Yes | 8 | Low |
| Sialino, 2019 | Sex differences in physical performance by age, educational level, ethnic groups and birth cohort: The Longitudinal Aging Study Amsterdam | Unclear | Yes | Yes | Yes | Yes | Yes | Yes | Yes | 7 | Low |
| Sialino, 2021 | The sex difference in gait speed among older adults: How do sociodemographic, lifestyle, social and health factors contribute? | Unclear | Yes | Yes | Yes | Yes | Yes | Yes | Yes | 6 | Low |
| Smolar, 2012 | Gait speed in community-dwelling African-American and Afro-Caribbean older adults | Yes | Yes | Yes | Yes | Yes | Yes | Yes | Yes | 8 | Low |
| Sprague, 2023 | Correlates of gait speed among older adults from 6 countries: Findings from the COSMIC collaboration | Yes | Yes | Yes | Yes | No | No | Yes | Yes | 6 | Low |

| | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|
| Staples, 2020 | Examination of the correlation between physical and psychological measures in community-dwelling older adults | Yes | Yes | Yes | Yes | Unclear | Unclear | Yes | Unclear | 5 | Medium |
| Tanaka, 2022 | Effects of age and gender on spatiotemporal and kinematic gait parameters in older adults | Yes | Yes | Yes | Yes | No | No | Yes | Yes | 6 | Low |
| Tangen, 2020 | Measuring physical performance in highly active older adults: associations with age and gender? | Yes | Yes | Yes | Yes | Yes | Yes | Yes | Yes | 8 | Low |
| Thaweewannakij, 2013 | Reference values of physical performance in Thai elderly people who are functioning well and dwelling in the community | Yes | Yes | Yes | Yes | Unclear | Unclear | Yes | Yes | 6 | Low |
| Thompson, 1995 | Performance of community dwelling elderly on the timed up and go test | Yes | Yes | Yes | Yes | Yes | Yes | Yes | Yes | 8 | Low |
| Thorpe, 2011 | Race, socioeconomic resources, and late-life mobility and decline: findings from the Health, Aging, and Body Composition study | Yes | Yes | Yes | Yes | Yes | Yes | Yes | Yes | 8 | Low |
| Vasunilashorn, 2009 | Use of the Short Physical Performance Battery Score to predict loss of ability to walk 400 meters: analysis from the InCHIANTI study | Unclear | Yes | Yes | Yes | Yes | Unclear | Yes | Yes | 6 | Low |
| Watson, 2010 | Executive function, memory, and gait speed decline in well-functioning older adults | Yes | Yes | Yes | Yes | Yes | Yes | Yes | Yes | 8 | Low |
| Welmer, 2013 | Education-related differences in physical performance after age 60: A cross-sectional study assessing variation by age, gender and occupation. | Yes | Yes | Yes | Yes | Yes | Yes | Yes | Yes | 8 | Low |
| Wheaton, 2016 | Female disability disadvantage: A global perspective on sex differences in physical function and disability. | Yes | Yes | Yes | Yes | Yes | Yes | Yes | Yes | 8 | Low |
| Wu, 2021 | Associations between functional fitness and walking speed in older adults | Yes | Yes | Yes | Yes | Yes | Yes | Yes | Yes | 8 | Low |
| Yaoxin, 2022 | Mediating effect of lower extremity muscle strength on the relationship between mobility and cognitive function in Chinese older adults: A cross-sectional study | Yes | Yes | Unclear | Yes | Yes | Yes | Yes | Yes | 7 | Low |

Item 1: Were the criteria for inclusion in the sample clearly defined? Item 2: Were the study subjects and the setting described in detail? Item 3: Was the exposure measured in a valid and reliable way? Item 4: Were objective, standard criteria used for measurement of the condition? Item 5: Were confounding factors identified? Item 6: Were strategies to deal with confounding factors stated? Item 7: Were the outcomes measured in a valid and reliable way? Item 8: Was appropriate

## APPENDIX H: DATA EXTRACTION SHEET

| 1 | 2 | 3 | 4 | 5 | 6 | 7 | 8 | 9 | 10 |
|---|---|---|---|---|---|---|---|---|---|
| S/N | Authors/ Year/ Country | Study design (dropdown) | Sample size | Age range | Descriptive Statistics/Sociodemographic Characteristics | | | | |
| | | | | | Mean ± SD | | *f* (%) | | |
| | | | | | Age | Income | Gender | Race | Location |
| | | cohort, case-control, cross-sectional, or longitudinal | | 60-64<br>65-69<br>70-74<br>75-79<br>≥80<br>N/G | Years | Annual personal income, N/G | Females, Males, N/G | *Race, N/G | Rural, Urban, N/G |
| | | | | | | | | | |

| 11 | 12 | 13 | 14 | 15 | 16 | 17 |
|---|---|---|---|---|---|---|
| | | | PBT for primary outcome | Primary outcome | Secondary outcome/ instrument | Inferential Statistics |
| | *f* (%) | | | | | |
| Occupation | Education | S. status | | | | |
| Skilled nonmanual, Unskilled nonmanual, Skilled manual, Unskilled manual, N/G | Informal, Primary. Secondary, Tertiary, N/G | High, Middle, Low, N/G | TUG, BW, 10MWT, SPPB, 6MWT, HGS | Walking speed, or distance, or Test time | | |
| | | | | | | |

| 18 | 19 | 20 | 21 | 22 | 23 | 24 | 25 | 26 | 27 |
|---|---|---|---|---|---|---|---|---|---|
| Correlation/association/OR/RR of primary outcome based on: | | | | | | | | p-value | Effect size |
| Age | Gender | Income | Race | Location | Occupation | Education | Social status | | |
| | | | | | | | | | |

N/G = not given. PBT = performance-based test. S. status = social status. TUG = Timed Up and Go. SPPB = Short Physical Performance Battery. 6MWT = Six-Minute Walk Test. 10MWT = Ten-Minute Walk Test. HGS = Habitual Gait Speed. BW = Backward Walking. *Race = American Indian, Asian, Black, Native Hawaiian or Other Pacific Islander, and White.

## APPENDIX I: INFORMED CONSENT FORM

Lethbridge sample


## PARTICIPANT CONSENT FORM

**Title of Study:** Perspectives of Canadian older adults on sociodemographic determinants of mobility decline in older population: A qualitative study.

**Principal Investigator/Supervisor:** [Dr. Oluwagbohunmi Awosoga, Associate Professor, University of Lethbridge]

**Co-investigator/Graduate student:** [Ogochukwu Onyeso, Doctoral Candidate, University of Lethbridge, 403 635 5176]

**Why am I being asked to take part in this research study?**

We want to talk to older adults like you to learn how they feel about the decline in their walking speed/distance and the personal or community-related factors that can lead to difficulty moving around as people age. If you are at least 65 years old and have experienced a reduction in your walking pace or the distance you can cover, we invite you to participate in our interview.

This form contains information about the study. Before you read it, a study team member will explain the study to you in detail. You are free to ask questions about anything you do not understand. You will be given a copy of this form for your records.

**What is the reason for doing the study?**

This research wants to understand personal and community-related factors that may lead to difficulty moving around among older Canadians. We are looking at ways people can be supported to remain healthy and mobile even in older age. The study hopes to raise a voice in support of creating changes in our society that will benefit older people by removing barriers to maintaining adequate mobility. The outcome will provide ideas to caregivers, family members, health workers, and the government on how they can support older adults to maintain mobility. There will be about 20 individually interviewed participants in this study.

**What will I be asked to do?**

The interview will be 45 minutes of interaction in person, via Zoom, or by phone call. We will give you some possible days and times, and you can pick the one that works best for you. You are welcome to meet us at the University of Lethbridge or tell us where we can meet you if you choose an in-person interview. The interview will include you and the people doing the study. We will talk to you and ask you some questions using a guide. During the interview, we may ask you about your gender, location of residence, marital status, religion, race, education level, income level, house type, whether you own a home, employment type, and information on disability. You do not have to provide any information you do not want to, and you can stop anytime, even during the interview. If there is a question you do not want to answer, you can say so. We will record the interview and write it down to study later. We will send you a copy of the interview if you wish to have it. With your consent, allow storage of anonymized study information in a secure data repository to facilitate future research.

**How long will I be in this study?**

Taking part in this will require about 45 minutes of your time on the day we agree upon.

**What are the risks and discomforts?**

The interview should not make you feel unsafe, but if you start to feel upset, you can reach out for help. You can email the Health Centre at the University of Lethbridge at health.centre@uleth.ca, or you can call them at 403-329-2484. They can help you with your feelings and mental health. It is not possible to know all of the risks that may happen in a study, but the researchers have taken all reasonable safeguards to minimize any known risks to a study participant.

**What are the benefits to me?**

Taking part in this study might not give you any immediate rewards. But it will help the researchers learn important things. They want to understand how your personal and community factors influence your mobility. The information they gather will be used to create better ways to help older adults. They want to recommend support and programs to help Canadians change or avoid avoidable things that may negatively affect their mobility in old age.

**Do I have to take part in the study?**

Participating in this study is up to you. If you join and later want to leave, it will not affect you in any way. You can leave anytime while the research is ongoing. During the interview, you can decide which questions to answer or not. If you choose to leave the study, any info we gathered from you will be erased. However, participants can only request the withdrawal of their data before it is anonymized (one week after the interview).

**Will I be paid to be in the research?**

You do not have to join if you do not want to, but if you do, you will not be paid. Still, to show our appreciation, we will give you a $20 gift card whether you decide to stop participating or continue with the study.

**What happens if I am injured because of this research?**

"If you become ill or injured as a result of being in this study, you will receive necessary medical treatment at no additional cost to you. By signing this consent form, you are not giving up any of your legal rights or releasing the investigator(s), institution(s) and/or sponsor(s) from their legal and professional responsibilities."

**Will my information be kept private?**

During the study, we will be collecting data about you. We will do everything we can to make sure that this data is kept private. No data relating to this study that includes your name will be released outside of the researcher's office or published by the researchers. After the study is done, study data (recording and transcript) will be stored in a secure data repository [University of Lethbridge], and can only be accessed by our research team. They will then be destroyed after 5 years. Any personal information ( i.e., your name, address, telephone number) that could identify you will be removed or changed before data analysis.

**What if I have questions?**

If you have any questions about the research now or later, please contact [403-635-5176 or 403-332-4058]. For greater than minimal risk, call 403-329-2484, for mental health services.

If you have any questions regarding your rights as a research participant, you may contact the University of Alberta Research Ethics Office at reoffice@ualberta.ca. This office has no affiliation with the study investigators.

**How do I indicate my agreement to be in this study?**

By signing below, you understand:

- That you have read the above information and have had anything that you do not understand explained to you to your satisfaction
- That you will be taking part in a research study
- That you may freely leave the research study at any time
- That you do not waive your legal rights by being in the study
- That the legal and professional obligations of the investigators and involved institutions are not changed by your taking part in this study.

**SIGNATURE OF STUDY PARTICIPANT**

| _____ | _____ | _____ |
|---|---|---|
| Name of Participant | Signature of Participant | Date |

**SIGNATURE OF PERSON OBTAINING CONSENT**

| _____ | _____ |
|---|---|
| Name of Person Obtaining Consent | Contact Number |
| _____ | _____ |
| Signature | Date |

**SIGNATURE OF THE WITNESS**

| _____ | |
|---|---|
| Name of Witness | |
| _____ | _____ |
| Signature of Witness | Date |

Under the International Conference on Harmonization, Good Clinical Practice (ICH GCP 4.8.9), where it is known that the participant cannot read (e.g., visually impaired or illiterate), the signature of an impartial witness independent of the trial must be obtained. The witness must be present for the consent process. The witness signature reflects that they believe the participant was presented with sufficient information to assure a truly informed consent.

A copy of this consent form has been given to you to keep for your records and reference.

Nigerian sample


## PARTICIPANT CONSENT FORM

**Study name:**

Perspectives of Nigerian older adults on sociodemographic determinants of mobility decline in the older population.

**Researcher:**

Ogochukwu Onyeso
PhD Candidate,
Faculty of Health Sciences
University of Lethbridge
ok.onyeso@uleth.ca, 0806-090-5846

**Purpose of the research:**

The study aimed to explore the perspectives of Nigerian older adults on sociodemographic determinants of mobility decline in the older population. This study will also explore your lived experiences with mobility decline trajectory.

**What you will be asked to do in the research:**

Participants will grant a 45-minute interview on their perception of mobility decline among older adults and their ideas about the sociodemographic implications.

**Risks and discomforts:**

There is minimal anticipated risk of emotional discomfort. However, some of the questions you will be asked as part of this study may make you uncomfortable. You may refuse to answer any of these questions, take a break, or stop your participation in this study at any time. If you feel discomfort or emotional disturbances during or after the interview, you will be entitled to over-

the-phone counselling sessions with the researcher. You can call +2348060905846. The research will link you with other online mental health services if needed.

**Benefits of the research and benefits to you:**

There are no direct benefits to you from taking part in this study. Although you may not directly benefit from taking part in this study, the researcher wishes to submit a policy intervention paper based on the research findings. Moreover, the interview might help you to have a reflection on your life course, ageing, and mobility experiences and the possible sociodemographic implications.

**Voluntary participation:**

Your participation in the research is completely voluntary, and you may choose to stop participating at any time without penalty. You are free to decline to answer any question you do not wish to answer for any reason. In appreciation for your time, all participants will receive a **₦5000** gift card. The card will be mailed to your address, or the card numbers will be sent to your phone as a text message.

**Withdrawal from the study:**

You may stop participating in the study at any time, for any reason, if you decide. Your decision to stop participating, or to refuse to answer questions, will not affect your relationship with the researcher, the University of Lethbridge, or any other group associated with this project. All associated data collected will be immediately destroyed if you choose to withdraw from this study.

**Confidentiality:**

Your individual responses will be kept confidential. No one will be able to identify you or your answers, and no one will know whether you participated in the study. Extracted and non-identifying raw data will be stored in a secure password-protected Excel database, and only the researcher can access it. Your signed consent form will also be stored in a locked file cabinet housed at the Faculty of Health Sciences.

**Use and Dissemination of the Data:**

Study findings will be disseminated in aggregate form to the interviewees and the recruitment partners through discussions, presentations, and infographics. Hence, there will be no information

that could identify your individual response from the data collected. Further dissemination will occur in peer-reviewed journals to the academic and research community, and a final thesis will be published in the University of Lethbridge Thesis Portal – publicly available through the University of Lethbridge library.

**Retention of Collected Data:**

Collected data will be entered into a password-protected encrypted Excel database. The password will only be available to the principal investigator (Ogochukwu Onyeso) and my research supervisor (Olu Awosoga, PhD). A storage device containing the audio files, paper transcripts, and consent forms will be stored in a locked file cabinet at the Faculty of Health Sciences, and only the principal researcher will have access to the cabinet keys. The proposed retention period for collected data will be five (5) years following the study end date to allow for the possibility of additional publications.

**Questions about the research?**

For further information about the study or study results, please contact me at 403-635-5176 or ok.onyeso@uleth.ca. If you have any concerns about this research I have not addressed, please get in touch with my research supervisor at: olu.awosoga@uleth.ca.

Questions regarding your rights as a participant in this research may be addressed to The Ethical Review Committee of the Faculty of Health Sciences and Technology, Nnamdi Azikiwe University, Nnewi Campus, who approved the research protocol.

**Legal Rights and Signatures:**

I _____, consent to participate in Perspectives of Nigerian older adults on sociodemographic determinants of mobility decline in older population study conducted by Ogochukwu Onyeso.

**Written Consent:** I have understood the nature of this project and wish to participate. I am not waiving any of my legal rights by signing this form. My signature below indicates my consent.

**Signature _____ Date _____ Participant: _____**

**Signature _____ Date _____ Witness: _____**

## APPENDIX J: INTERVIEW GUIDE


Interview Guide

**Introduction:** Thank you for taking the time to meet with me today. Let me remind you that this interview will contribute information for research on personal and community factors that affect the ability to move around among older persons. You have signed an informed consent form, but, as a reminder, you are free not to answer any questions or withdraw from the interview at any time. This interview will take about 45 minutes. With your permission, I will be making an audio or video recording of the interview and may take notes. Do you have any questions before we begin?

Date of interview: _____Location _____ Mode of interview _____ Recording mechanism: _____ Start time: _____ End time: _____

| **Interview Questions** |
|---|
| Can you tell me about your mobility experiences (ability to walk within the community) over the years?<br><br>Cue: the importance of mobility to you. |
| What is your experience with the decline in your walking (speed and distance) as you got older?<br><br>Cue: onset, cause, feelings, and actions/intervention. |
| What role might sociodemographic factors have in your experiences of mobility difficulty?<br><br>Cue: age, gender, marital status, tribe/race, location/ neighbourhood, economic status, occupation, religion, education, and house type/living arrangement |
| We are now rounding up. Which among the factors we discussed would have improved your current mobility status if experienced differently at any stage in your life? |
| What kind of support from others (individuals, family, community, and government) will enhance older adults' mobility? |
| What other important questions do you think I should have asked but did not? Any further contribution or recommendation you want to make? |

For any inquiry you can contact me by phone#: 403 635 5176 or email: ok.onyeso@uleth.ca

**Demographic Questions**

Gender: Male [ ] Female [ ]

Age:_____

Location: Urban [ ] Rural [ ]

Marital status: Married [ ] Single [ ] Divorced [ ] Widowed [ ]

Religion: Christian [ ] Muslim [ ] Buddhist [ ] No religion [ ] Others [ ]

Race: White [ ] Black [ ] Asian [ ] Indigenous American [ ]

Education: Elementary [ ] High school [ ] University/College Diploma [ ] Postgraduate [ ]

Income level: High [ ] Middle [ ] Low [ ]

House type: detached/semi-detached house [ ] apartment [ ]

House ownership: Yes [ ] No [ ]

Lifetime main job: _____

Health (compare with mates): Poor [ ] Same [ ] Better [ ]

Disability: Yes [ ] No [ ]

Walking aid: Yes [ ] No [ ]

Type of walking aid _____

Major personality trait: Introvert [ ] Extrovert [ ] Ambivert [ ]

Loneliness: Yes [ ] No [ ]

Social isolation: Yes [ ] No [ ]

Social capital (friends/family/places you need to visit) Yes [ ] No [ ]

Cognition impairment: Yes [ ] No [ ]

## APPENDIX K: CONFIDENTIALITY AGREEMENT

University of Lethbridge

FIAT LUX

---

## CONFIDENTIALITY AGREEMENT

---

**Perspectives of Canadian older adults on sociodemographic determinants of mobility decline in older population: A qualitative study**

---

I, ____Ogochukwu Onyeso_____, the Principal/Co-investigator, agree to:

1. keep all research information shared with me confidential by not discussing or sharing the research information in any form or format (e.g., laptops, USB sticks, transcripts, surveys) with anyone other than the research team members also working on our project.

2. keep all research information in any form or format (e.g., laptops, USB sticks, transcripts, surveys) secure while it is in my possession.

3. after consulting with the Researcher, erase or destroy all research information in any form or format regarding this project.

Researcher (PI or Co-PI)

| Ogochukwu Onyeso |  | 2023-09-07 |
|---|---|---|
| Print name | Signature | Date |

University of Lethbridge

## CONFIDENTIALITY AGREEMENT

**Perspectives of Nigerian older adults on sociodemographic determinants of mobility decline in older population: A qualitative study**

I, ____Ogochukwu Onyeso_____, the Principal/Co-investigator, agree to:

1. keep all research information shared with me confidential by not discussing or sharing the research information in any form or format (e.g., laptops, USB sticks, transcripts, surveys) with anyone other than the research team members also working on our project.

2. keep all research information in any form or format (e.g., laptops, USB sticks, transcripts, surveys) secure while it is in my possession.

3. after consulting with the Researcher, erase or destroy all research information in any form or format regarding this project.

Researcher (PI or Co-PI)

| Ogochukwu Onyeso |  | 2023-09-07 |
|---|---|---|
| Print name | Signature | Date |

## APPENDIX L: PARTICIPANT RECRUITMENT POSTER

(Canadian Sample)

University of Lethbridge

FIAT LUX

**Research Participants Wanted**

Study: **Perspectives of Canadian older adults on sociodemographic determinants of mobility decline in older population**

**This research wants to understand personal and community-related factors that may lead to difficulty moving around among older Canadians. We are looking at ways people can be supported to remain healthy and mobile even in older age.**

- Are you an older adult who is 65 years or older?
- Do you experience some difficulty with moving around in the community?
- Have you lived in Canada for at least 20 years?
- Are you able to communicate in English?

**Participants are asked to share their experiences with researchers; interviews will be in-person for about 45 minutes. You would answer a series of questions using an interview guide.**

**For more information, contact Ogochukwu Onyeso, Graduate student researcher.**

**Phone#: 403 635 5176 or email: ok.onyeso@uleth.ca**

***This study has been approved by the University of Alberta Health Research Ethics Board.**

**Ethics ID: Pro00134818**

## APPENDIX M: LETTER OF INITIAL CONTACT


### Letter of Initial Contact

**Subject**: Invitation to Participate in Research Study: Perspectives of Canadian older adults on sociodemographic determinants of mobility decline in the older population

Dear [Participant's Name],

I hope this letter finds you well. We are excited to extend an invitation to you to participate in a research study titled " **Perspectives of Canadian older adults on sociodemographic determinants of mobility decline in older population**."

This research wants to understand personal and community-related factors that may lead to difficulty moving around among older Canadians. We are looking at ways people can be supported to remain healthy and mobile even in older age. The study hopes to raise a voice in support of creating changes in our society that will benefit older people by removing barriers to maintaining adequate mobility.

If you meet the following inclusion criteria, we would be thrilled to have you join our study:

- You are 65 years of age or older.
- You have experienced some difficulty with moving around in the community.
- You have lived in Canada for at least 20 years.
- You can communicate in English.

Your participation would involve sharing your experiences with our researchers for about 45 minutes. You would also be required to fill out a personality questionnaire and answer a series of

questions using an interview guide. We hope to conduct an in-person interview at the University of Lethbridge or any other location convenient to you. Your valuable insights will contribute significantly to our research, which has the potential to enhance the well-being of older adults in our community.

As a gesture of appreciation for your time and contribution, all participants, regardless of their decision to continue or withdraw from the study, will receive a $20 gift card.

If you are interested in participating or have any questions about the study, please feel free to contact us at [403-635 5176]. Your participation is entirely voluntary, and your privacy and confidentiality will be strictly maintained. The University of Alberta Health Research Ethics Board has approved this study; Ethics ID: Pro00134818.

We look forward to your positive response and hope you consider participating in this important research endeavour.

Thank you for your time and consideration.

Sincerely,

Ogochukwu Onyeso | Doctoral Candidate
University of Lethbridge
Email: ok.onyeso@uleth.ca
Tel: (403) 635-5176

## APPENDIX N: ETHICS APPROVAL LETTERS

### Ethics Approval for the Qualitative Study in Canada

UNIVERSITY OF ALBERTA

**Ethics Application has been Approved**

| | |
|---|---|
| ID: | Pro00134818 |
| Title: | Perspectives of Canadian older adults on sociodemographic determinants of mobility decline in older population: A qualitative study |
| Study Investigator: | Oluwagbohunmi Awosoga |
| Description: | This is to inform you that the above study has been approved.<br><br>Click on the link(s) above to navigate to the workspace.<br><br>Please do not reply to this message. This is a system-generated email that cannot receive replies. |

University of Alberta
Edmonton Alberta
Canada T6G 2E1

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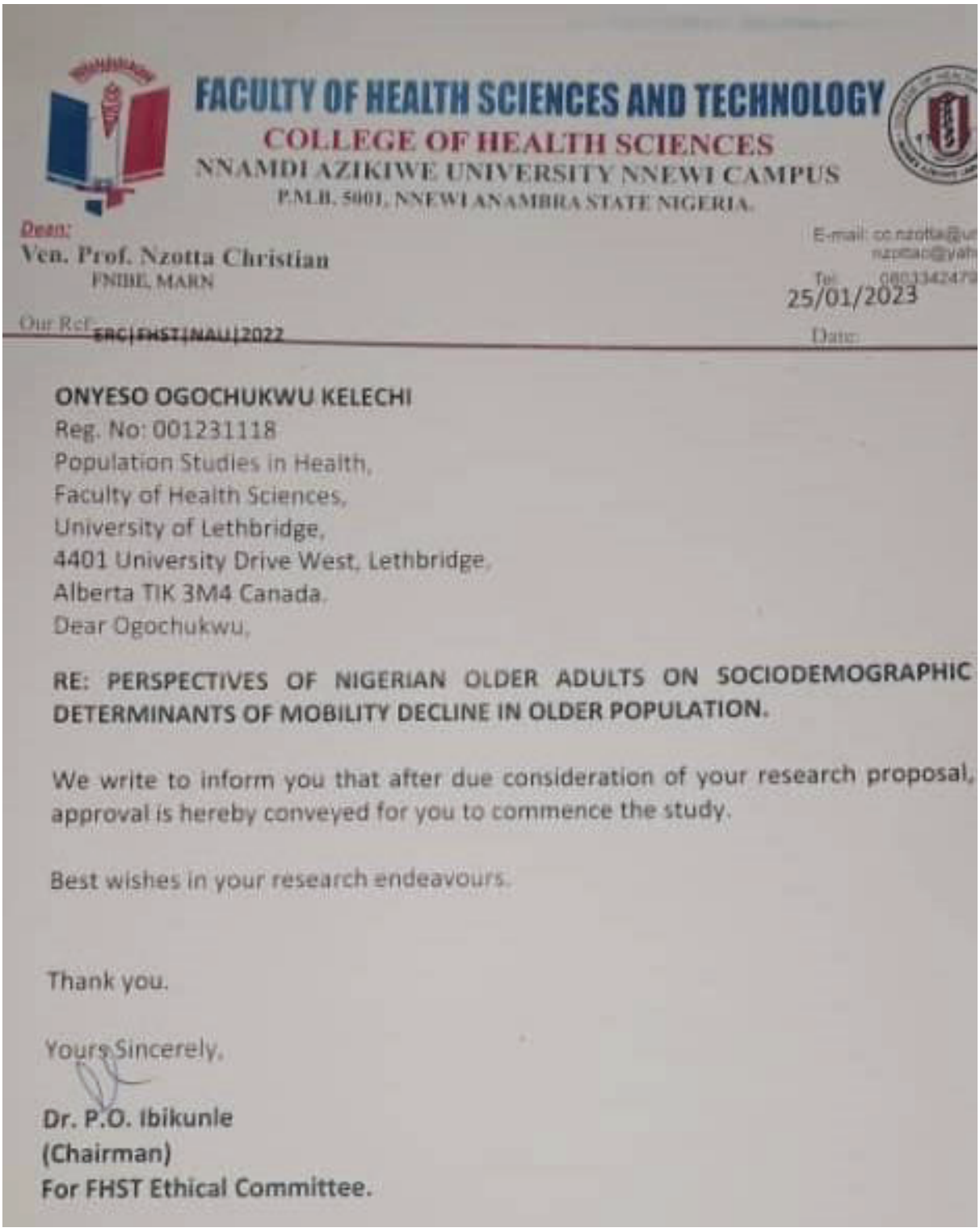
**Ethics Approval for the Qualitative Study in Nigeria**



FACULTY OF HEALTH SCIENCES AND TECHNOLOGY
COLLEGE OF HEALTH SCIENCES
NNAMDI AZIKIWE UNIVERSITY NNEWI CAMPUS
P.M.B. 5001, NNEWI ANAMBRA STATE NIGERIA.

Dean:
Ven. Prof. Nzotta Christian
FNIBE, MARN

E-mail: cc.nzotta@u... nzottacc@yah...
Tel: 08033424...

Our Ref: ~~ERC/FHST/NAU/2022~~

25/01/2023
Date:

ONYESO OGOCHUKWU KELECHI
Reg. No: 001231118
Population Studies in Health,
Faculty of Health Sciences,
University of Lethbridge,
4401 University Drive West, Lethbridge,
Alberta TIK 3M4 Canada.
Dear Ogochukwu,

**RE: PERSPECTIVES OF NIGERIAN OLDER ADULTS ON SOCIODEMOGRAPHIC DETERMINANTS OF MOBILITY DECLINE IN OLDER POPULATION.**

We write to inform you that after due consideration of your research proposal, approval is hereby conveyed for you to commence the study.

Best wishes in your research endeavours.

Thank you.

Yours Sincerely,

**Dr. P.O. Ibikunle**
**(Chairman)**
**For FHST Ethical Committee.**

## Ethics Approval for Secondary Analysis of The Canadian Longitudinal Study On Ageing

ARISE: Your Ethics Application is Approved Pro00129371

UNIVERSITY OF ALBERTA

**Ethics Application has been Approved**

| | |
|---|---|
| ID: | Pro00129371 |
| Title: | SOCIODEMOGRAPHIC DETERMINANTS OF MOBILITY DECLINE AMONG COMMUNITY-DWELLING OLDER ADULTS CANADA |
| Study Investigator: | Oluwagbohunmi Awosoga |
| Description: | This is to inform you that the above study has been approved.<br>Click on the link(s) above to navigate to the workspace.<br>Please do not reply to this message. This is a system-generated email that cannot receive replies. |

University of Alberta
Edmonton Alberta
Canada T6G 2E1

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## APPENDIX O: SOCIOECONOMIC COMPARISON OF STUDY SETTINGS

Selected Demographic and Socioeconomic Variations Between Canada and Nigeria

| **Parameters** | **Canada** | **Nigeria** |
|---|---|---|
| Capital | Ottawa | Abuja |
| WHO region | North America | Africa |
| Population size | 39,939,056 | 223,150,896 |
| Population density | 4.2/km$^2$ | 218/km$^2$ |
| World Bank income classification | High income | Lower-middle income |
| Gini index | 31.7 (Medium) | 35.1 (Medium) |
| Human development index | 0.935 (Very High) | 0.547 (Low) |
| Gross national income per capita | $53,300 | $ 2,120 |
| Life expectancy | 81 years | 54 years |

Sources: World Bank. (2022). World development indicators.
Available from: https://databank.worldbank.org/home.aspx

## APPENDIX P: STUDY TIMELINE

Study Timeline - Gantt Chart

| Major Milestones | 2021 | 2022 | 2023 | 2024 | 2025 | Remark |
|---|---|---|---|---|---|---|
| **Phase I: Project Development** | | | | | | |
| Supervisory committee setup | | | | | | √ |
| Introductory meeting | | | | | | √ |
| Literature review | | | | | | √ |
| Systematic review protocol publication | | | | | | √ |
| Proposal submission and defence | | | | | | √ |
| Application for ethics approval | | | | | | √ |
| Application for the use of a secondary database | | | | | | √ |
| Familiarization interviewee recruitment partners | | | | | | √ |
| Comprehensive examinations | | | | | | √ |
| **Phase 2: Data Collection and Analysis** | | | | | | |
| Qualitative/Interview and analyses | | | | | | √ |
| Secondary data analyses | | | | | | √ |
| **Phase 3: Completion** | | | | | | |
| Knowledge translation | | | | | | √ |
| Thesis write-up and editing | | | | | | √ |
| Final thesis defense | | | | | | √ |
| Application to graduate | | | | | | √ |

## APPENDIX Q: COPYRIGHT PERMISSION

World Health Organization Permission to Adapt the International Classification of Functioning, Disability and Health Model Diagram

**ID: 202505317 Your request is granted – Auto Permission**

---

**From** admin@who.appiancloud.com <admin@who.appiancloud.com> on behalf of

WHO Permission Team <no-reply@who.appiancloud.com>

**Date** Tue 4/1/2025 11:05 AM

**To** Onyeso, Ogochukwu <ok.onyeso@uleth.ca>

---

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WHO Permissions team

**World Health Organization**

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11. Entire Agreement, Amendment. This Agreement is the entire agreement between you and WHO with respect to its subject matter. WHO is not bound by any additional terms that may appear in any communication from you. This Agreement may only be amended by mutual written agreement of you and WHO.

12. Headings. Paragraph headings in this Agreement are for reference only.

13. Dispute resolution. Any dispute relating to the interpretation or application of this Agreement shall, unless amicably settled, be subject to conciliation. In the event of failure of the latter, the dispute shall be settled by arbitration. The arbitration shall be conducted in accordance with the modalities to be agreed upon by the parties or, in the absence of agreement, with the rules of arbitration of the International Chamber of Commerce. The parties shall accept the arbitral award as final.

14. Privileges and immunities. Nothing in or relating to this Agreement shall be deemed a waiver of any of the privileges and immunities enjoyed by WHO under national or international law and/or as submitting WHO to any national court jurisdiction.

***

| Field | Value |
|---|---|
| Title | Mr |
| First name | Ogochukwu |
| Family name | Onyeso |
| Organisation/affiliation | University of Lethbridge |
| Website address | |
| Type of organisation / affiliation | Academic |
| Is your request in support of a submission for regulatory approval (i.e. EMA / FDA)? | |

| | |
|---|---|
| Please select the relevant name from the STM publisher list | |
| Provide Type of organisation / affiliation | |
| Country | Canada |
| Email | ok.onyeso@uleth.ca |
| Full title of WHO material requested | Towards a Common Language for Functioning, Disability and Health ICF |
| Full link to WHO material you wish to reuse | https://cdn.who.int/media/docs/default-source/classification/icf/icfbeginnersguide.pdf?sfvrsn=eead63d3_4&download |
| ISBN / WHO reference number | WHO/EIP/GPE/CAS/01.3 |
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| Type of reuse | Academic/Training |
| Please provide information on where WHO's material will be used | I wish to adapt the ICF diagram as a conceptual framework for my PhD thesis, which I will submit to the University of Lethbridge in Alberta, Canada. |
| Publishing format | PDF; Other; Website |
| How are you planning to distribute your material and to whom? | I wish to adapt the ICF diagram as a conceptual framework for my PhD thesis. I will be submitting the thesis to the University Library. |
| What is your planned publication or distribution date? | 14. Apr, 2025 |

| | |
|---|---|
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| If yes, please provide additional information | |
| Will there be any advertising associated with the material? | No |
| If yes, please provide additional information | |
| Health topic that most corresponds to your request | Disability |
| Additional information about your request | I wish to adapt the ICF diagram as a conceptual framework for my PhD thesis. |

## APPENDIX R: NOTES