ASSESSING THE SOCIOECONOMIC GRADIENT OF WALKING SPEED AS A MEASURE OF GENERAL HEALTH AMONG OLDER ADULTS USING THE CANADIAN LONGITUDINAL STUDY ON AGING

by

Samantha Radford

Submitted in partial fulfilment of the requirements
for the degree of Master of Science

at

Dalhousie University
Halifax, Nova Scotia
April 2021

TABLE OF CONTENTS

LIST OF TABLES

LIST OF FIGURES

ABSTRACT

Background: As the Canadian population ages understanding inequality in health among older adults is critical, and identifying good measures of health to assess the socioeconomic gradient of health among older adults is essential. Walking speed is an objective measure of health and attracting increasing attention as a potentially useful measure of general health among older adults. The goal of this project was to explore the use of walking speed as a measure of health in the assessment of the socioeconomic gradient among older adults in Canada.

Methods: With a sample of 25,064 observations (50.60% female) from the first follow-up data of the Canadian Longitudinal Study on Aging Comprehensive, we used separate Ordinary Least Squares (OLS) regression models to assess associations between walking speed and other measures of health (frailty, number of chronic conditions, activities of daily living, and self-rated health) and to examine the association between walking speed and socioeconomic status adjusting for demographic, anthropometric, health behaviour, social, and geographic variables. Walking speed was measured by a 4-meter timed walk.

Results: The mean walking speed of the sample was 0.98 m/s (SD =0.18). Walking speed was clinically and statistically significantly associated with frailty. Walking speed exhibited an independent, statistically significant socioeconomic gradient with the highest income category walking on average 0.06 m/s (99% CI: 0.039, 0.082) faster than the lowest income category.

Policy Implications: Our findings suggest that walking speed is a useful measure of health in the assessment of health inequality among older adults. Walking speed can be considered as a simpler alternative to frailty and an objective measure alternative to the popular subjective measure of self-rated health. Identifying the usefulness of walking speed, this study filled an important gap in the health measurement and health inequality literature and expands an option for policy makers and researchers to accurately depict the distribution of health in the aging population.

LIST OF ABBREVIATIONS USED

WHO	World Health Organization
ICF	International Classification of Function, Disability and Health
CSDH	Commission on Social Determinants of Health
HUI	Health Utilities Index
SOP	Standard Operating PR
ADL	Activities of Daily Living

ACKNOWLEDGEMENTS

I have received a tremendous amount of support throughout this process from my committee members, friends, and family.

I would like to thank my supervisor Dr. Yukiko Asada, for her patience, support, and trust in me throughout this process. Your attention to detail that challenged me to always do better combined with your genuine kindness, allowed me to grow into a more confident young researcher. Dr. Susan Kirkland and Dr. Melissa Andrew, thank you for your invaluable insights and for always joining meetings with a smile. It has been a wonderful experience working with a team of compassionate and brilliant women. Your contributions to my thesis have resulted in a final product that I am very proud of.

I would also like to thank my friends, and family for their support over the last three years. I am equally proud of my research as I am to have made lifelong friends as part of this process. Caroline and Ben, I would not be here without your unconditional support, you made this a journey one that I will cherish forever!

Finally, to my mom, dad, and sister, thank you for always believing in me. Your love and support has allowed me to seek passion in what I do and I am so grateful to have you by my side.

CHAPTER 1 INTRODUCTION

The notion that health is unequally distributed in the population should come as no surprise. For years we have been aware that socioeconomic factors influence the distribution of health, and socioeconomic factors are not equally distributed. We know that people who are advantaged by money and prestige are more likely to be in good health.[1] A sense of unfairness provoked by this observation is what motivates health inequality analyses. With a rapidly aging population, it is becoming increasingly important that we understand the distribution of health among older adults in order to identify the burden of illness and gaps in services and policy.[2] As a first step for policy implementation, identifying good measures of health to assess the socioeconomic gradient of health is important. Currently, self-rated health (SRH), also referred to as self-reported, self-perceived, or self-assessed health, is commonly used to measure general health status in health inequality analyses.[3] However, there are concerns regarding how people's perception of their own health vary by socioeconomic status (SES) and age.[4]

Walking speed is a physical capability measure that shares some favourable attributes with SRH and poses as a potentially useful objective measure of general health in health inequality analyses. This study utilized data collected in the Canadian Longitudinal Study on Aging (CLSA) to investigate whether walking speed exhibits a socioeconomic gradient.

CHAPTER 2 BACKGROUND AND OBJECTIVES

2.1 The socioeconomic gradient in health

Understanding the socioeconomic gradient in health is important for population health research and policy implementation.[5] Worldwide there is a well-established graded relationship between SES and health status. The literature shows that people with lower SES, often measured by income, education, or occupation, are more likely to have poorer health than people with higher SES.[5–9] Canada is no exception. Despite the publicly funded universal health care systems, this relationship remains in Canada.[5] Indicators of SES, such as income, education, and occupation, are highlighted in most frameworks describing the social determinants of health.[7,10] Two well-known conceptual frameworks of health used by the World Health Organization (WHO) are the International Classification of Function, Disability and Health (ICF) and the Commission on Social Determinants of Health (CSDH) conceptual framework (Figure 1). The ICF introduces a biopsychosocial model of disability that aims to combine existing medical and social models of disability. The medical model of disability perceives disability as a direct consequence of disease, trauma, or health condition that requires medical treatment to be corrected. The social model of disability perceives disability as a product of an unaccommodating environment created by attitudes of one's social environment. The ICF conceptualizes function and disability by emphasizing the need to consider contextual factors as well as health conditions to be able to understand one's health. More specifically, this model includes personal contextual factors (e.g., education and profession) and environmental contextual factors (e.g., legal and social structures) to classify disability and function.[11] The inclusion of socioeconomic factors in this model as the personal contextual factors confirms the important role that socioeconomic status plays in measuring health.

The CSDH conceptual framework developed by Solar and Irwin clearly illustrates the role of SES in the context of social determinants of health.[7] In this framework, Solar and Irwin identify the difference between factors that influence inequalities in general (structural determinants) and factors that influence health (intermediary determinants).

Socioeconomic position is identified as a structural determinant of health that is influenced by greater socioeconomic and political contexts but also influences intermediary determinants, such as living/working conditions, health behaviours, and psychosocial factors. Due to its pivotal role in determining health status, SES is at the forefront of many policy action plans.[5,7] Identifying the socioeconomic gradient of health is used as a way to target areas in need of health services and policy interventions.

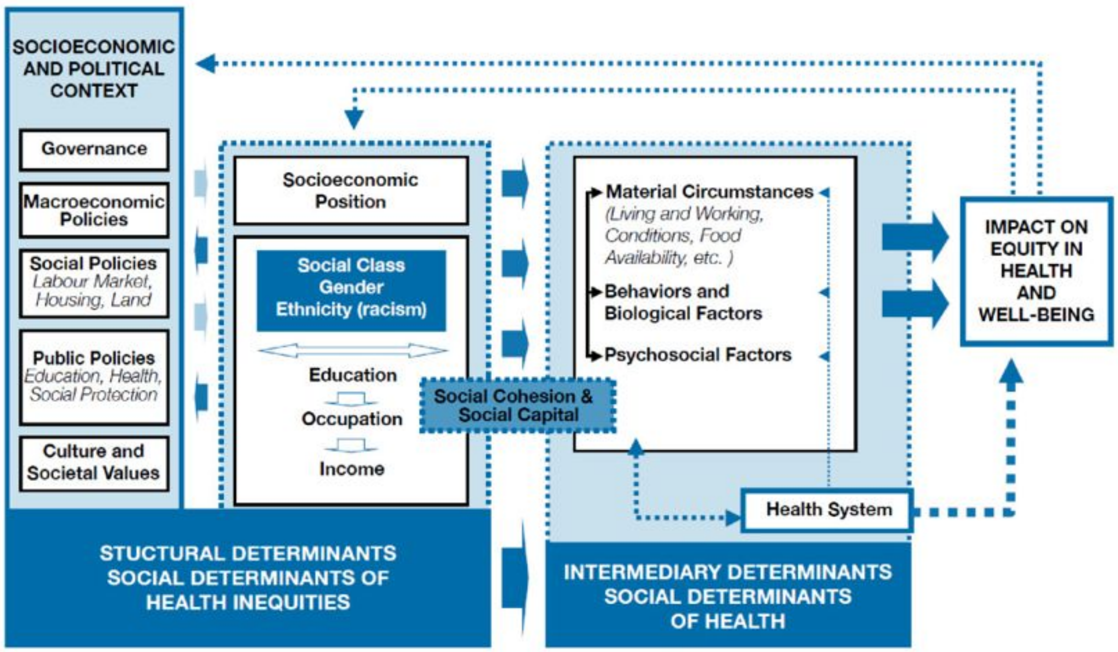


Figure 1: CSDH conceptual framework[7]

The importance of SES is paramount in the context of aging populations. The aging of the Canadian population is accelerating. It is predicted that by 2068 the proportion of Canadians over the age of 65 will be 21-29%, compared to 17% in 2018 and 14% in 2009.[12,13] Studies use various measures of health to understand the socioeconomic gradient of health. However, at this time it is unclear which measure of health is well-suited to understand the socioeconomic gradient among older adults. This is concerning because without an adequate measurement, older adults' health cannot be understood, preventing policy interventions from providing older adults with resources and services. Before any steps can be taken to ensure the health of older adults, a measure of health is needed that can capture the socioeconomic gradient of health. Self-rated health (SRH) is the most common measure of health used in the assessment of the socioeconomic gradient of health in the general population. However, there is reason to believe using SRH for older adults might be problematic.[3,4,9,14]

2.2 Self-rated health

SRH is a subjective measure of health that asks individuals to assess their own general health status, with the question "In general, would you say your health is excellent, very good, good, fair, or poor?" The extensive use of SRH in population health research can be explained by its strengths. SRH is simple, easy to administer and widely available in population survey data, making it a useful and accessible measure for population health analyses.[3] As well, SRH is associated with a number of social determinants of health including SES, [4,15–18] age,[4,19] health behaviours,[20,21] and social participation.[22–26] Additionally, SRH is shown to be associated with a number of dimensions of health including biomarkers (e.g., blood pressure, BMI, waist-hip ratio, total cholesterol, fibrinogen, glycated hemoglobin, white blood cell count, C-reactive protein), specific chronic health conditions, number of chronic health conditions, and mental health.[16–18,27,28] Lastly, there are a significant number of publications showing associations between SRH and future health outcomes. The most commonly studied future health outcome is mortality,[29–31] but also studied are functional limitation, chronic conditions, and mental health.[32–35] The subjective nature of SRH allows us to consider aspects of health that are otherwise immeasurable. There is evidence that the perception of one's health varies by socioeconomic status and age.[4] Therefore, to understand the limitations of SRH, below we focus on how SRH is associated with SES and age by reverting back to Solar and Irwin's conceptual framework.

2.2.1 Variability in SRH by SES

As illustrated in Solar and Irwin's conceptual framework above (Figure 1), the health of an individual is likely determined by a wide range of health behaviours and social factors. Solar and Irwin classify two different types of factors, structural and intermediary. As introduced above, structural factors are those that influence inequalities in health, such as SES, and are influenced by the larger socioeconomic and political context. Structural factors influence intermediary factors, which more directly influence health, such as smoking or social participation. Numerous studies have established that SRH has a socioeconomic gradient, meaning that for an incremental increase in SES there is a level increase in SRH.[4,15–18] This SES distribution pattern in SRH has attracted attention in population health inequality research. However, there is variation in results when the socioeconomic gradient in SRH is compared to a more objective measure of health.[4,15,17] A study using a Canadian sample aimed to identify how the distributions of SRH and the Health Utilities Index (HUI) differ across income levels. The HUI is a validated, health-related quality of life measure based on eight dimensions of health (vision, hearing, speech, ambulation, dexterity, emotion, cognition, and pain).[36] The authors found that although both measures clearly had a socioeconomic gradient, SRH overestimated the difference in health between income levels compared to the HUI.[15] Contradicting results were found in a population-based study using a U.S. sample that analyzed the difference in biological risk, determined by 14 different biomarkers, and SES in levels of SRH. This study showed that levels of biological risk varied by SES within the same SRH category. This finding was particularly pronounced in very good and excellent SRH categories. Among people who rated their health as very good or excellent, those with higher SES were more likely than those with lower SES to have biomarkers that also indicated their health was good.[17] This finding suggested that SRH may underestimate the difference in "true" or latent health between levels of SES. In sum, these findings caution the use of SRH when assessing the socioeconomic gradient of health. The socioeconomic gradient in SRH may not reflect the socioeconomic gradient in latent health. The inconsistent study results make it difficult to know whether the observed socioeconomic gradient in SRH would be an over or underestimation of the socioeconomic gradient in latent health.

2.2.2 Variation in SRH by age

Age is another social determinant of health, although it is an intermediary factor as opposed to a structural factor. There is evidence that as people age they become more optimistic about their health, suggesting that compared to their latent health older people are more likely than their younger counterparts to rate their health as good. For example, in a Canadian study with participants aged from 20 to 80 years and older, the authors found that those in the oldest age category (80+) had the lowest mean HUI score.[4] The oldest category also had the greatest discrepancy between the HUI score and SRH. Older adults were likely to report their health as good even when younger counterparts with the same HUI score would rate their health lower. This difference suggests that the SRH of older adults is likely to overestimate their latent health.[4] These results are consistent with another Canadian study that looked at different reporting trends of SRH between younger and older adults.[19]

2.2.3 Explanation of variance in SRH by SES and age

The influence of SES and age on SRH can be partially explained by reporting behaviour. SRH measures both latent health and reporting behaviour. Latent health is a person's "true" health.[4] Reporting behaviour is the perception of own health, in other words the systematic measurement error that makes up the difference between SRH and latent health.[4] To help contextualize these components of SRH, Jylha offers a framework to illustrate the thought process likely used by people to decide where they fall on the Likert scale of general health, from poor to excellent.[37] The framework suggests three steps of consideration. First, the individuals assess their health based on previous diagnoses, function, symptoms, lifestyle, and known genetic traits, all considered in the context of self, as opposed to in general. Secondly, they assess their context based on age, peers, and any changes in their health status. Finally, they decide where they fit on the provided scale by assigning one option as normal and selecting based on their comparison to normal.[37] Through this process, the two aspects of SRH emerge: latent health (diagnoses, function) and reporting behaviour (comparison to peers and 'normal').[4] Reporting behaviour, especially those related to SES and age, casts doubt on the use of SRH in the assessment of SES in an aging population.

Using Jylha's framework we can further discuss the relationship between SES, age, and SRH. Regardless of age or SES all people engage in reporting behaviour, it is within specific age categories and SES levels that reporting behaviour may be systematically different compared to other ages and SES levels. For example, people in different SES groups may have different understandings of health in general, which will influence the way they perceive their own health. Researchers who examined how SRH can predict future health by SES speculated that people with higher SES may know more about their health, giving them a more comprehensive sense of how they compare to normal or good health.[38] Similarly, as people age the diversity of health among people who surround them increases and potentially changes their expectations and definition of normal or good health.[29,39,40] As the reference point for normal or good health changes, it becomes more likely that people will rate their health as good in older age despite a decline in latent health. For example, for people aged 82 years, if their friends can no longer live independently or are no longer alive, their functional challenges and chronic conditions that still afford independent living might appear to be pretty good health.

In summary, despite the attractive features of SRH, including the simplicity, availability and association with health determinants, current health, and future health, evidence on the variation in reporting behaviour by age and SES questions the use of SRH in the assessment of the socioeconomic gradient of health among older adults.

2.3 An alternative measure of health: walking speed

Moving away from the unwanted consequences of reporting behaviour presented by SRH and all subjective measures, we look to an objective measure walking speed, that may be an alternative measure for the assessment of the socioeconomic gradient in health among older adults. Objective measures are less frequently used in large population surveys because they are usually more difficult to measure. They are more often used in smaller studies, clinical examinations, and clinical trials.[41] Physical capability measures are gaining attention as measures of health and function of older adults.[42] Physical capability measures are objective measures of physical health often used in clinical settings to assess function of older adults. Common physical capability measures are grip strength, chair rises, balance, and walking speed. There is some evidence to support that all physical capability measures (i.e., grip strength, walking speed, chair rises, and standing balance) are associated with a number of health outcomes (e.g., cardiovascular disease, hospitalization/institutionalization, cognitive decline).[43] Of these measures, arguably, grip strength is most studied, but walking speed is gaining increasing attention as a potentially useful measure of *general* health of older adults.[42,43] In the studies that include chair rises and balance evidence of association with other health outcomes is weaker and less consistent compared to walking speed and grip strength.[43] Recently, a study shed light on challenges of using grip strength in the context of health inequality research. This study found that grip strength was not associated with socioeconomic status after controlling for age, sex, and body size.[44]

Walking speed is a measure used worldwide to monitor function and independence of community-dwelling older adults.[43,45] As a complex body function, walking requires a combination of body systems (i.e., the central nervous system, peripheral nervous system, perceptual system muscles, bone and joints, and energy production and delivery) to work together.[46] Walking speed is also commonly used in a battery of other measures of physical capability such as balance and chair stands, to assess physical function.[47,48] Yet, studies show walking speed is almost as useful alone as a battery of multiple measures.[47,48] Walking speed, often measured by a 4-meter timed walk, is found to have good test-retest reliability.[49] Reasons why walking speed is being investigated as a measure of general health include: (1) it is associated with common social determinants of health, (2) it is associated with physical function and risk of disease, and (3) it predicts future health outcomes. In addition, walking speed is easy to measure making it a convenient to use. Despite these features, to date, the relationship between walking speed and SES has not been investigated extensively. A noteworthy limitation of walking speed as a measure of general health is that it excludes those who cannot walk. This must be taken into consideration if used to measure the health of a population.

2.3.1 Measuring walking speed

Walking speed is usually measured by a timed walk of a short distance, often 4 meters. Walking speed can be measured in any office or clinic setting without the need of a trained health professional. With this ease of the measurement, walking speed can be collected in a large sample of individuals. There is substantial variation in the methods used to measure and analyze walking speed in clinical and research settings.[50,51] There are three types of variation in the measurement: (1) the distance walked (2.4-20 m, the most common between 3-7 m[48,51]), (2) whether starting from static or moving position, and (3) the pace of the walk (normal vs. maximum). Variation of the measurement and inconsistent reporting of procedures make it difficult to compare results across different studies.[50] Moreover, in analyses walking speed is sometimes dichotomized into healthy/normal speed and unhealthy/at risk speed, with varying cut points, adding further difficulty in the study comparison. The same healthy-unhealthy cut points have been applied to both sexes.[40,52] The two most commonly used cut points are 0.8m/s and 1.0m/s.[40,53,54] However, the clinical relevance of these cut points has not been determined.

There are two approaches for determining clinically meaningful change (i.e., distribution-based method and anchor-based method) in walking speed.[55–57] Both methods calculate *minimal* meaningful change and *substantial* meaningful change. The first method is the distribution-based method that uses a statistical measure of variability (i.e., effect size or standard error of measurement) to interpret results. The existing literature has identified the following cut points for minimal meaningful change in walking speed using effect size: 0.04 to 0.06m/s,[56] 0.03 m/s,[55] and 0.05 m/s.[57] Effect size cut points for substantial meaningful change in walking speed in the current literature are 0.10 to 0.14m/s,[56] 0.08 m/s,[55] and 0.12 m/s.[57] A limitation of this approach is that it relies on the distribution of the sample data. The second approach is the anchor-based approach that uses the individual or care providers' perception of change as an external reference to measure the magnitude of change in walking speed. Examples of external references are ability to climb stairs and ability to walk a certain distance (e.g., one block). In this method, a meaningful change is identified as, for example, the change in walking speed that corresponds to the ability and inability to walk one block. For the anchor-based method the identified minimal meaningful change estimates are 0.04 m/s,[56] 0.03 to 0.05 m/s,[55] and 0.03 m/s.[57] The substantial meaningful change estimates are 0.06 to 0.07 m/s,[56] 0.08 m/s,[55] and 0.08 to 0.11 m/s.[57] To further illustrate the application of this method we use the five-level Likert scale employed by Kwon et al.(2009)[55] (i.e., no difficulty, a little difficulty, some difficulty, a lot of difficulty, and unable to do the activity). Using this Likert scale a one-level decline/improvement indicates a minimal meaningful change, and a two-level decline/improvement indicates a substantial meaningful change. Therefore, if participant A walked 0.04 m/s faster than participant B, the faster participant A's ability to walk one block would be one level of difficulty less in a 5-level Likert scale (e.g., a little difficulty) compared to the slower participant B's difficulty (e.g., some difficulty) and we would refer to this as a minimal meaningful difference in walking speed. Applying this anchor-based approach to walking speed gives the difference in walking speed between individuals a more tangible meaning compared to statistical significance. See Appendix 2 for a more detailed explanation of these methods.

Despite the variability and difficulty in study comparison, walking speed is an objective measure of health that is easy to administer, inexpensive, safe, and reliable, thus, considered as an appropriate measure for use in clinical and research settings.[40,58]

2.3.2 Determinants of walking speed

There is little explanation for what causes faster and slower walking speed. The existing literature suggests that walking speed is a complex mechanism determined by a number of overlapping intermediary determinants of health as defined in the Solar-Irwin framework.[45,59] The most well-established determinant of walking speed is age. Age is negatively associated with walking speed.[59–61] As the understanding of walking speed transitions from an indicator of functional health and independence to a marker of general health, a question arises as to whether social determinants of health found to be associated with other measures of general health, such as SRH, are associated with walking speed. A multi-cohort study examining risk factors associated with years of functioning lost, measured by decreased walking speed, found both physical inactivity and smoking to be statistically significant risk factors of decreased walking speed by age 65 and 80.[45] By age 85 male smokers compared to former smokers and those who never smoked lost an average of 3.5 years (95% CI:1.5 to 7.2) of functioning. Female smokers on average lost 3 years (95% CI: 1.1 to 5.5) of functioning. For insufficient physical activity compared to sufficient physical activity, the average years of function lost for men by age 85 was 16.7 years (95% CI: 10.5 to 25.8) and for women 16.3 years (95% CI: 10.7 to 24.8).[45] In both age groups, alcohol intake was not a significant predictor for men or women. There is a need for more research in understanding the relationship between walking speed and health behaviours.

Social participation is associated with walking speed. In a cross-sectional study, where social participation was the outcome, the authors found walking speed to be strongly and positively associated with social participation. Those who walked a 6.15 meter course at less than 1.0 m/s had more than 3 times the odds of reporting limited social participation than those who walked faster than 1.0 m/s while adjusting for age, sex, physical activity, and medical conditions (OR: 3.1, 99% CI: 1.5 to 6.2).[62] Walking speed was not the outcome in this study, and this study was a cross-sectional study, unable able to establish temporal order. It is thus not possible to draw a conclusion that social participation was a determinant of walking speed, however, it does raise curiosity about the potential relationship.

2.3.3 Walking speed and current health

Walking speed is a popular measure of functional limitation often used in the context of frailty.[40,48,63] More specifically, walking speed has been used internationally to identify sarcopenia, the loss in skeletal muscle mass and function associated with aging.[64] Walking speed is used in guidelines published by the National Institute for Health and Care Excellence (NICE) in the United Kingdom for assessing and managing older adults with comorbidities.[65] In the guidelines walking speed is recommended as a single marker of frailty, with a timed 4 meter walk of more than 5 seconds indicating frailty. This method of detecting frailty is suggested as a realistic assessment to be used by a general practicioner.[65]

Outside of the frailty literature, slow walking speed has been identified as a potentially useful marker of increased dependency and increased risk of disease.[66] One recent study conducted with a sample of older adults in Peru found an association between slower walking speed and increased number of chronic conditions; 0.2 m/s decrease in walking speed was associated with more than three chronic conditions in an unadjusted model.[66] Though it remained statistically and clinically significant, the beta coefficients decreased in models adjusted for sociodemographic (e.g., education, access to health services, use of spare time) and clinical factors (e.g., self-perceived health, nutritional status, geriatric syndromes).[66]

Until recently the walking speed literature focused on older adults. A recent cohort study conducted in New Zealand aimed to assess the association between walking speed and physical function and accelerated aging at age 45.[67] After controlling for leg length, body composition, childhood SES and sex, the authors found a statistically significant association between slower usual walking speed and lower physical functions, such as physical limitations (β:-0.21; 95% CI: -0.21 to -0.15), maximum hand grip strength (β:0.17; 95% CI: 0.06 to 0.28), one legged balance (β:0.17; 95% CI: 0.10 to 0.23), visual motor coordination (β:0.12; 95% CI: 0.06 to 0.19), (β:0.21; 95% CI: 0.15 to 0.28), and 2 min step-test (β:0.18; 95% CI: 0.11 to 0.24). To measure accelerated aging they developed a pace of aging index using 19 biomarkers measured at four collection periods between age 26 and 45. The authors found that those in the lowest quintile of walking speed (mean: 1.21 m/s) were associated with faster aging measured by the developed index (β:-0.33, 95% CI: -0.40 to -0.27) and facial aging (β:-0.18; 95% CI: -0.25 to -0.12), after they controlled for leg length, body composition childhood SES, and sex. Controlling for the same variables, the authors found that walking speed was also associated with brain structure, and neurocognitive functions. Facial aging was determined by eight panelists' evaluation of standardized photos of participants.[67]

2.3.4 Walking speed as a predictor of future health

There is an abundance of research focusing on walking speed and future health outcomes in community-dwelling older adults.[40,42,43,68,69] The most commonly studied future health outcome is mortality, and studies found a consistent association between slower absolute walking speed at baseline and mortality, independent of age and sex.[40,42,68,69] However, one meta-analysis on walking speed and risk of mortality found the risk ratio of all-cause mortality and lowest versus highest baseline walking speed was insignificant for females (1.45, 95% CI: 0.95 to 2.20). This meta-analysis included studies with follow-up periods ranging from 1.8 to 9 years and adults over the age of 65.[68] Adjustments varied between individual studies and meta-analyses, and there was no uniform treatment of confounders.[40,42,43,68,69] In addition to morality, there is strong evidence to suggest that walking speed is a good predictor of Activities of Daily Living (ADL). A systematic review that aimed to identify the predictors of ADL included twelve studies that assessed walking speed. The average follow-up period for the twelve studies was 5.4 years, ranging from 1 to 14 years, and all participants were 65 and older. All 12 studies found that walking speed was predictive of future ADL.[70] Aside from mortality and ADL, there are a number of other future health outcomes found to be associated with walking speed, including: physical disability, falls, hospitalization/institutionalization, cognitive decline, and cardiovascular disease (CVD).[40,43,68,71,72] Cancer has also been investigated, however, there was no significant association with walking speed.[69] The current literature suggests that there is strong evidence that walking speed is associated with future mortality and physical function, and there is a need for further research on walking speed and other future health outcomes.

2.3.5 Socioeconomic gradient in walking speed

The characteristics of walking speed explained above suggest that walking speed can be considered as a good marker for many dimensions of health. If, and if so, to what degree, walking speed is graded by SES is then an important question. Studies investigating this question are emerging, and this is an area in the literature that demands more attention.

We identified 11 studies that analyzed the socioeconomic gradient in walking speed, and all of them suggested that walking speed has a socioeconomic gradient.[45,73–81] A variety of common socioeconomic status indicators were used among these studies including education, income, occupation, and wealth. However, there are a number of limitations in this literature that present concern and warrant further research. The limitations are: (1) the age range, (2) the model adjustment, and (3) the absence of Canadian data. The age range in the 11 existing studies is 45 to 95 years old, however, most studies only analyzed 10 to 15 years of this range, and only one study[45] analyzed ages 45 to 90, using 37 combined cohorts. In total only three studies[45,73,79] included data of participants under age 60 and only five[45,75,77,80,81] included data of those over the age of 80. In general the 11 studies controlled for differing variables, only three included chronic conditions,[45,75,76] and three included health behaviours.[75,76,82] The most consistently controlled for variables were age and sex, used in all 11 studies. None of the studies found a statistically significant difference between the socioeconomic gradient in males and females. These studies are from a range of countries, however, none used Canadian data. Although walking speed and SES have been addressed in the literature, there is need for a study that covers middle to late life and includes multiple structural and intermediary factors from the Solar and Irwin social determinants of health framework, and it is useful to study this relationship in a Canadian population to inform policies in Canada.

2.4 Summary of the current literature

In summary, the current literature suggests that SRH, the most commonly employed measure of health used to understand the distribution of health in many countries including Canada shows variation in reporting behaviour by age and SES. As the Canadian population ages, it is important that we rely on a measure of health that is not influenced by reporting behaviours to inform health policy. Walking speed, an objective measure of physical capabilities that presents as a potentially useful measure of general health in older adults. The next step needed to explore the usefulness of walking speed as a measure of health in older adults is to expand the current literature assessing the socioeconomic gradient in walking speed among older adults. More specifically, there is a need to understand how the socioeconomic gradient in walking speed differs in the midlife and older age groups and what social determinants of health are statistically and clinically significant in the relationship within a Canadian sample.

2.5 Objectives

The overall goal of this study was to explore the use of walking speed as a measure of health in the assessment of the socioeconomic gradient among older adults in Canada. To meet this overall goal, this study set the following four objectives:

1. To describe how walking speed differs by socioeconomic status and other determinants.
2. To confirm the known associations between walking speed and other dimensions of health, such as functional limitation, the frailty index and number of chronic conditions.
3. To assess the association between walking speed and self-rated health.
4. To identify whether the socioeconomic gradient exists in walking speed, and if so, how the magnitude differs across age groups and between sexes.

CHAPTER 3 METHODS

3.1 Data and study population

This study employed data from the Canadian Longitudinal Study on Aging (CLSA), a national, population-based study, collecting biological, medical, psychological, behavioral, and socioeconomic information from over 50,000 Canadians between the ages of 45 and 85 years old at baseline.[83] The CLSA data are being collected every three years for at least 20 years or until death.[83] We used first follow-up data collected in 2015 to 2018, with the exception of three variables only available in the baseline data (sex, cultural/racial background, and education) as well as province and rural/urban variables to avoid missing observations in follow-up data. We used a cohort called the CLSA Comprehensive that included 30,097 adults at baseline who participated in in-home computer-assisted face-to-face interviews and clinical and physical examinations at one of the 11 data collection sites (DCS): Vancouver, Surrey, Victoria, Calgary, Winnipeg, Hamilton, Ottawa, Montreal, Sherbrooke, Halifax, and St. Johns.[83] The target population of the CLSA was community-dwelling adults between 45 to 85 years of age. The sampling frames for the CLSA Comprehensive were provincial health care databases and random digit dialing. The sampling strategy used for the provincial health care databases was originally created by Statistics Canada for the Canadian Community Health Survey (CCHS) Healthy Aging.[84] In addition, potential participants needed to reside within a 25-50 km radius of a DCS. Exclusion criteria included: individuals unable to complete the interview in English or French; individuals living in long-term care facilities at the baseline; individuals with cognitive impairments at the baseline; individuals residing in the three territories, other remote regions, federal First Nations reserves and other First Nations settlements; temporary visa holders; and full-time members of the Canadian Armed Forces.[84]

The CLSA first follow-up Comprehensive data set consisted of 27,765 observations; a total of 2,701 observations were excluded from this study due to missing data, resulting in a final sample of 25,064 observations. We removed all observations from the initial sample of 27,765 that were missing the outcome variable, walking speed (n = 2,266). In addition, when an independent variable had missing less than 5% of the initial sample of 27,765, we removed observations missing the independent variable (n = 435). When an independent variable had missing greater than 5% of the initial sample of 27,765, we created a missing category or added the missing observations to another category (i.e., income, number of chronic conditions, cultural/racial background, and social support availability) (n = 4,127).

3.2 Variables

3.2.1 Walking speed

In the CLSA walking speed was measured using a 4-meter timed walk (see Appendix 1 for the CLSA 4-meter timed walk standard operating procedure [SOP][84]). Walking speed is commonly analyzed as a continuous or binary variable in the current literature.[40,42] For this study we used walking speed as a continuous variable to be able to assess if there is a socioeconomic gradient in walking speed with more precision than a binary variable would allow. Walking speed for older adults typically ranges from 0.15m/s to 1.30 m/s.[40] The CLSA allowed participants to use assistive devices (e.g., cane, walker) to stand, as stated in the SOP (Appendix 1). There is no record of whether participants used an assistive device to complete the 4-meter walk test. There is, however, record of if an assistive device was used for the timed get up and go test. The timed get up and go test requires the participant to start sitting, when the timer starts the participants must stand up out of the chair, walk 3 meters, turn around and walk back to sit back down in the chair. Only 1.38% of participants in this study sample used an assistive device for the timed get up and go test. The proportion of devices used for the walk test is likely smaller because it is a less complex task. We included participants who may have used and assistive device in our analysis. The current literature is largely silent about the use of assistive devices during the assessment of walking speed.[40,42,43,48] The exception is a multi-population cohort study. This study excluded walking speed data with an assistive device because walking speed was used as a proxy for physical function and the inclusion was thought to reduce the reliability of results.[82]

The existing literature that assesses the association between walking speed and the social determinants of health, health behaviours, and future health focuses on statistical significance to interpret findings. Statistically significant results do not mean they are clinically meaningful, and with a large sample size, like the CLSA, results are often statistically significant, and statistical significance may not be meaningful. To interpret results meaningfully, we opted to use the anchor-based approach to avoid the reliance on the distribution of the sample data. The studies using the anchor-based approach identify a meaningful change in walking speed in comparison to Health-Related Quality of Life[85] or self-reported walking speed decline or walking difficulty.[55–57] This approach uses the individual or care providers perception of change as an external reference to measure the magnitude of change in the measure of interest. Based on the results of three publications[55–57] that asses meaningful walking speed using the anchor-based method we used the average minimal meaningful change estimate of 0.04 m/s and the average substantial meaningful change estimate of 0.09 m/s, to assist in interpreting OLS regression results. We adopted the most commonly used anchors (i.e., ability to climb one flight of stairs and ability to walk 3 to 4 blocks) and the simplest response options (i.e., no difficulty, a little difficulty, some difficulty, a lot of difficulty, and unable to do the activity) used by Kwon et al (2009),[55] to explain the meaningful change in walking speed.[55] As introduced previously applying the anchor-based method can be interpreted as follows, if participant A walked 0.04 m/s faster than participant B, the faster participant A's ability to climb a flight of stairs would be one level of difficulty less in a 5-level Likert scale (e.g., a little difficulty) compared to the slower participant B's difficulty (e.g., some difficulty). See Appendix 2 for further explanation of clinical significance.

3.2.2 Other dimensions of health

We compared walking speed to four other measures of health: the frailty index, functional limitations (Activities of Daily Living [ADL]), number of chronic conditions, and SRH. These associations informed our understanding of walking speed as an indicator of general health among older adults.

Frailty Index: We created the frailty index based on the work of Rockwood and Mitnitski, and Searle et al.[86,87] According to Rockwood and Mitnitski frailty is a "nonspecific state of increasing risk, which reflects multisystem physiological change. It is highly age associated."[86] The method they developed and that we used for this study to calculate a frailty index score uses "the proportion of potential deficits that are present in a given individual."[86] The calculated frailty index ranges from 0 to 1, 0 being not frail and 1 being frail. The score was calculated by a summation of deficits divided by the number of potential deficits. Deficits with missing information were omitted from the denominator.

Searle et al. considers deficits to be "symptoms, signs, disabilities, and disease."[87] To identify deficits or variables to be included in the frailty index, we used the six criteria developed by Searl et al. and operationalized by Blodgett 2014: (1) variables must be deficits associated with health and age conceptually; (2) the deficit should not have too many missing data (missing in more than 5% of the study population); (3) the deficit should be common (present in at least 1% of the study population); (4) the deficit should not be overly common in late age (deficit was present in 80% or more of individuals by age of 70); (5) the deficit must increase in prevalence along with age; and (6) the selected deficits must cover a broad range of body systems.[88] Applying these criteria, Asada et al. created the frailty index for the CLSA baseline data (personal communication). This thesis work was guided by their steps. The first step was to identify variables that are deficits associated with health and age conceptually. We selected 97 variables from our study subset of the CLSA first follow-up data (see Appendix 3 for list of variables). Because this study compared the frailty index and walking speed, we excluded variables related to walking speed when constructing the frailty index. Next, we assessed the eligibility of these variables based on missingness and prevalence. Variables were selected if they were missing for 5% or less of the study population, if they were present in at least 1% of the study population, if they were present in less than 80% of individuals by age of 70, and the prevalence increased with age.[88] Once these criterion were applied, we were left with 37 variables exceeding the minimum of 30 variables required.[87] Finally, we ensured these variables covered a broad range of body systems.[88] The frailty index variable used in the regression analysis was categorized to improve interpretability. The categories are: ≤0.1, >0.1 and ≤ 0.2, >0.2 and ≤0.3, >0.3 and ≤0.4, >0.4 and ≤0.5, and >0.5. This method of categorization is used in the current frailty index literature.[89,90]

Functional limitation: We used Activities of Daily Living (ADL) to measure functional limitation. In the CLSA, ADL is measured using questions from an existing tool called the Older Americans Resources and Services (OARS).[91] The OARS shows high convergent validity with a Pearson correlation of r = 0.89 to self-care capacity tools used by physical therapists. The inter-rater reliability of OARS ADL questions was confirmed with spearman correlation of rho = 0.84.[92] We created a dichotomous ADL variable (i.e., no difficulty and difficulty or inability to conduct one or more ADL). This categorization is consistent with existing studies that assess the association between walking speed and ADL, and define ADL difficulty or disability as having difficulty or inability to perform at least one ADL.[93–96] See Appendix 4 for variable details.

Number of chronic conditions: Self-reported heart disease, hypertension, cancer, diabetes, chronic lower respiratory diseases, and arthritis were counted to calculate the number of chronic conditions. We selected these chronic conditions, because they are prevalent in more than 10% of the Canadian population over 65 (heart disease, hypertension, arthritis, and diabetes),[97] are a leading cause of death among older adults in Canada (cancer, chronic lower respiratory diseases, heart disease, and diabetes),[98] and/or associated with walking speed in the existing literature (heart disease, in particular).[43,69]

SRH: The CLSA measures SRH by asking the question: "In general, would you say your health is excellent, very good, good, fair, or poor?" The question is preceded with the comment: "By health, we mean not only the absence of disease or injury but also physical, mental, and social well-being."[99] The response categories are: excellent, very good, good, fair, or poor.

3.2.3 Socioeconomic status (SES)

SES was measured by two variables, education and household income. Measuring SES in older adults presents a challenge. Occupation, education, and income are common measures of SES in a general population, however, there is a longstanding debate as to whether these measures remain accurate as people age.[100] It is common for income to significantly decrease or increase as people age and enter retirement and start receiving pension. Therefore, income measured in late life may not be a good reflection of SES, at least from a life course perspective, leading to a misclassification and potentially underestimating the relationship between SES and health.[101] Alternative to income, wealth based on assets has been used for older adults.[100] However, assets are difficult to measure, especially by self-report survey data and were not available in the current data set.[102] Education is another appealing measure of SES among older adults, because it generally remains consistent from mid to late life. Education is positively associated with measures of wealth.[102] For these reasons, we used education and household income as primary measures of SES. To adjust for the household size, we included the household size variable along with the household income variable in our models. See Appendix 5 for variable details.

3.2.4 Determinants of walking speed

The determinants of walking speed variables are known social determinants of health,[7] selected based on their known associations with walking speed[43,45,59–62] and/or general health status, measured by SRH.[20,103–107] For variables that are only known to be associated with general health, we aimed to assess if they are also associated with walking speed. See Appendix 6 for details of all determinants of walking speed variables described below.

Demographic and anthropometric variables: Age, age-squared, sex, height, height-squared, and weight. Squared terms for age and height were included to control for the nonlinear nature of these variables. Weight and height were physically measured.

Social variables: Cultural/racial background, marital status, social support availability. The cultural/racial background categories were collapsed with guidance from the Ontario Anti-racism directorate.[108] The cultural/racial background categories are: white, black, East/South Asian, other racial or cultural origin or not reported, and multiple racial or cultural origins. Middle Eastern and Latino were collapsed in the other racial or cultural origin or not reported category due to small cell size. The CLSA categorizes marital status as married or common-law, widowed or divorced or separate, and single, never been married or never lived with a partner. To measure social support availability the CLSA employs the MOS Social Support Survey, a 19-item questionnaire that includes 4 subscales: tangible support, affection, positive interaction, and emotional or informational support.[109] We dichotomized this variable using a cut point created in a sample of Canadians over 65.[110]

Health behaviours: Smoking, alcohol consumption, daily fruit and vegetable consumption, and physical activity. We used physical activity as measured in the CLSA by the Physical Activity Scale for the Elderly (PASE) a valid and reliable tool.[111] Adequate test-retest reliability was determined with a correlation coefficient of 0.75. Convergent validity was determined with a Spearmen correlation coefficient to two other measures of physical activity, (1) physical activity ratio (PAR) (r=0.68) and (2) total energy expenditure (TEE) (r=0.58). PASE includes a battery of questions to assess the intensity of physical activities in the following domains: walking, recreational activities, exercise, housework, yard work, and caring for others.[112] We dichotomized PASE into normal physical activity and low physical activity using cut points created in a sample of community dwelling older adults.[113]

Geographic variables: We included rurality and province to capture geography-related factors that may be important in walking speed. The CLSA measures rurality using urban/rural classifications based on the Statistics Canada's Postal Code Conversion File (PCCF). The PCCF combines postal code information from the Canada Posts Corporation (CPC) with Statistics Canada's standard geographic regions.[114–116] Province was included to control for potential differences in provinces that cannot be measured.

3.3 Analysis

To meet the first objective, *to describe how walking speed differs by socioeconomic status and other determinants*, we calculated the mean and standard deviation of walking speed by income and education and for each determinant of walking speed. Additionally, we described walking speed by sex and by income using a kernel density plot. This descriptive analysis informed us of the distribution of walking speed among the sample.

To meet the second objective, *to confirm the known associations between walking speed and other dimensions of health, such as functional limitation, the frailty index, and number of chronic conditions*, we ran correlations between all dimensions of health and walking speed. We created box plots to assess the distribution of walking speed across the levels of each dimension of health and we ran separate Ordinary Least Square (OLS) regression models for each dimension of health variable. Each model included the continuous variable of walking speed as the dependent variable and age and one of the dimensions of health (i.e., ADL, the frailty index, or the number of chronic conditions) as independent variables. Age and age-squared were included in all models because age is known to be strongly associated with walking speed, and we are interested in the relationship between walking speed and other dimensions of health after removing the influence of age. Age-squared was included to adjust for the slightly nonlinear nature of the variable.

To meet the third objective, *to assess the association between walking speed and self-rated health,* we followed the same method used for the analysis of the second objective. We ran an OLS regression model with walking speed as the dependent variable and SRH as the independent variable, along with age and age-squared. SRH was included because as a common measure of general health with a known socioeconomic gradient we wished to examine its association with walking speed.

To meet the final objective, *to identify whether the socioeconomic gradient exists in walking speed, and if so, how the magnitude differs across age groups and between sexes*, we ran an OLS regression model with the continuous variable of walking speed as the dependent variable and SES, and determinants of walking speed, as independent variables. We built the model sequentially by adding variables as blocks (i.e., demographic and anthropometric variables, socioeconomic variables, social variables, health behaviour variables, and geographic variables). In this way, we gained insight as to how these variables are associated with walking speed. We included age-squared and height-squared to control for the nonlinear nature of the variables. Other dimensions of health were not included in the final model because they were highly correlated with walking speed. We did, however, run a sensitivity analysis including the other dimensions of health and found that the key findings remained the same.

For analyses of the second, third, and fourth objectives, we conducted age-sex-stratified analyses to assess whether the associations examined differed by age and sex. Age was categorized into the following groups, 45-54, 55-64, 65-75, and 75 and older. Stratifying the analysis by these age groups allowed us to determine when age associations began. Because walking speed is most commonly used to assess function in older adults, much of the existing research on associations with other dimensions of health is conducted in samples of adults aged 60 and older. Comparing all age groups and both sex groups separately to the crude association we were able to establish how the relationships changed based on these factors as well as allow us to discuss patterns among these groups with the existing literature.

All analyses were run with sample weights provided by the CLSA Comprehensive data to provide population estimates.[117] The Taylor Linearization method was used to estimate standard errors, accounting for the complex survey design of the CLSA.[118] Stata 15 was used for all analyses. [119]

3.4 Data access and ethical considerations

Data access was granted for this study by the CLSA (application ID # 1909013) and this study was approved by the Dalhousie University Research Ethic Board (File No. 2020-5054).

CHAPTER 4 RESULTS

4.1 Descriptive characteristics

A total of 25,064 participants (50.60% female) were included in this analysis, after 2,701 observations were removed due to missing data. Of the missing sample 2,266 observations were missing walking speed, 2,429 observations were missing walking speed or a dimension of health variable, and 2,701 were missing walking speed or a dimension of health variable or another independent variable. The missing sample had poorer health compared to the analytical sample. Of the missing sample 22.10% reported fair or poor health, compared to 9.57% of the analytical sample. Additionally, 25.95% of the missing sample and 15.26% of the analytical sample reported having difficulty or inability to complete one or more ADL. The missing sample had a greater portion of people who made less than $20,000 annually (8.77% missing sample, 4.07% analytical sample). The distribution of missing walking speed data was similar across provinces in the missing and analytical samples, with the exception of Nova Scotia. Nova Scotia made up 24.21% of the missing sample and 8.47% of the analytical sample.

The average age of the analytical sample was 61.9 years old (see Table 1 for characteristics of the sample). A majority of the participants lived in urban areas (92.40%), were white (90.45%), married or common-law (75.47%) and reported high social support availability (89.09%). Overall, the sample was well educated and affluent, 80.89% reported having a post-secondary degree or diploma, and 42.86% reported an annual household income of $100,000 or more. There was an incremental increase in walking speed across the levels of education, with a substantially meaningful difference between the first two categories (i.e., less than secondary school and secondary school graduation), and an overall increase in walking speed of 0.12 m/s. The only clinically meaningful difference found between income categories was a 0.06 m/s increase from $20,000 to less than $50,000 and $50,000 to less than $100,000. Overall, there was a 0.15 m/s increase in walking speed from the lowest to highest income category. In general participants perceived themselves as healthy; 41.77% rated their health as very good, 19.28% as excellent, and only 1.24% reported poor health. Most of the sample reported no difficulty or inability to preform ADL (86.76%). The dimension of health variables ADL difficulty, the frailty index, number of chronic conditions, and SRH all showed the expected graded relationship in walking speed from slower in the poorer health levels to faster in the better health levels (Figures 2, 3, 4, 5).

Table 1 Sample characteristics (weighted)

(n= 25064)			**Walking Speed (m/s)**			**Frailty Index**		
	N	**%**	**Mean**	**SD**		**Mean**	**SD**	
Education					*			*
Less than secondary school graduation	1169	4.21	0.87	0.19		0.19	0.11	
Secondary school graduation, no post-secondary education	2239	8.46	0.96	0.18		0.13	0.09	
Some post-secondary	1791	6.44	0.95	0.19		0.13	0.09	
Post-secondary degree/diploma	19865	80.89	0.99	0.17		0.11	0.08	
Total	25064	100	0.98	0.18		0.11	0.08	
Household income					*			*
< $20,000	1019	3.42	0.89	0.23		0.18	0.12	
$20,000 to < $50,000	4913	16.52	0.92	0.20		0.16	0.10	
$50,000 to < $100,000	8621	32.41	0.98	0.17		0.12	0.08	
$100,000 to < $150,000	4778	21.20	1.01	0.16		0.09	0.06	
$150,000 or more	4289	21.66	1.04	0.14		0.08	0.05	
Missing	1444	4.80	0.91	0.21		0.14	0.11	
Total	25064	100	0.98	0.18		0.11	0.08	
Self-rated general health					*			*
Poor	377	1.24	0.82	0.23		0.25	0.12	
Fair	2023	7.52	0.89	0.20		0.20	0.11	
Good	7338	30.19	0.96	0.18		0.14	0.08	
Very good	10595	41.77	1.00	0.17		0.10	0.07	
Excellent	4731	19.28	1.03	0.16		0.07	0.06	
Total	25064	100	0.98	0.18		0.11	0.08	
ADL difficulty					*			*
No reported difficulty or inability	21239	86.76	1.00	0.17		0.10	0.07	

Table 1 Sample characteristics (weighted)

(n= 25064)			Walking Speed (m/s)			Frailty Index		
	N	%	Mean	SD		Mean	SD	
1 or more	3825	13.24	0.90	0.22		0.21	0.10	
Total	25064	100	0.98	0.18		0.11	0.08	
# of chronic conditions					*			*
0 conditions	6674	32.11	1.03	0.15		0.06	0.04	
1 condition	7707	31.87	1.00	0.17		0.10	0.05	
2 conditions	5504	19.45	0.95	0.19		0.15	0.07	
3 conditions	2849	9.35	0.92	0.20		0.21	0.08	
4 conditions	1076	3.31	0.87	0.23		0.27	0.10	
5 or 6 conditions	263	0.77	0.83	0.25		0.35	0.12	
Missing	991	3.14	0.95	0.23		0.15	0.10	
Total	25064	100	0.98	0.18		0.11	0.08	
Cultural/racial background					*			*
White	22936	90.45	0.99	0.18		0.11	0.08	
Black	156	0.64	0.88	0.17		0.11	0.08	
East/South Asian	297	1.59	0.99	0.16		0.10	0.06	
South Asian	206	0.94	0.92	0.16		0.12	0.07	
Other racial or cultural origin OR not reported	1317	5.65	0.97	0.17		0.12	0.08	
Multiple racial or cultural origins	152	0.75	0.97	0.15		0.10	0.07	
Total	25064	100	0.98	0.18		0.11	0.08	
Marital/partner status					*			*
Married/common-law	17301	75.47	0.99	0.16		0.11	0.07	
Widowed/divorced/separ ated	5525	16.05	0.93	0.23		0.15	0.12	
Single, never married or never lived with a partner	2238	8.48	0.98	0.19		0.12	0.08	
Total	25064	100	0.98	0.18		0.11	0.08	
High Social Support Availability					*			*
Yes	21734	89.09	0.99	0.17		0.11	0.08	
No or no response	3330	10.91	0.92	0.21		0.15	0.10	
Total	25064	100	0.98	0.18		0.11	0.08	

Table 1 Sample characteristics (weighted)

(n= 25064)	N	%	Walking Speed (m/s) Mean	SD		Frailty Index Mean	SD	
Smoking status					*			*
Current smoker	1799	7.45	0.97	0.18		0.13	0.08	
Former smoker	10703	39.85	0.97	0.18		0.13	0.09	
Never smoked	12562	52.70	0.99	0.17		0.10	0.08	
Total	25064	100	0.98	0.18		0.11	0.08	
Alcohol consumption					*			*
Regular drinker - at least once a month	19183	78.54	1.00	0.17		0.11	0.08	
Occasional drinker	2928	10.75	0.95	0.19		0.14	0.10	
Did not drink in the last 12 months	2953	10.72	0.93	0.21		0.14	0.11	
Total	25064	100	0.98	0.18		0.11	0.08	
Fruit and vegetable servings					*			*
Two or fewer	5940	22.49	0.96	0.18		0.12	0.09	
Three or four	8725	34.79	0.98	0.18		0.11	0.08	
Five or six	7422	30.08	0.99	0.18		0.11	0.08	
Seven or more	2977	12.64	1.01	0.17		0.11	0.08	
Total	25064	100	0.98	0.18		0.11	0.08	
PASE: Low Physical Activity					*			*
Normal level of physical activity	13484	60.07	1.01	0.16		0.09	0.06	
Low level of physical activity	11580	39.93	0.94	0.20		0.15	0.10	
Total	25064	100	0.98	0.18		0.11	0.08	
Urban/rural residence					*			0.099
Urban	23013	91.40	0.98	0.18		0.11	0.08	
Rural	2051	8.61	1.01	0.17		0.11	0.08	
Total	25064	100	0.98	0.18		0.11	0.08	
Province at recruitment					*			*
Alberta	2516	12.34	0.92	0.15		0.10	0.07	
British Columbia	5342	30.16	1.01	0.14		0.11	0.07	

Table 1 Sample characteristics (weighted)

(n= 25064)	N	%	Walking Speed (m/s) Mean	SD	Frailty Index Mean	SD
Manitoba	2626	8.19	0.95	0.21	0.11	0.09
Newfoundland and Labrador	1837	2.12	0.96	0.31	0.12	0.15
Nova Scotia	2123	2.94	1.05	0.30	0.11	0.13
Ontario	5569	13.38	0.97	0.22	0.12	0.11
Quebec	5051	30.88	0.99	0.15	0.12	0.07
Total	25064	100	0.98	0.18	0.11	0.08
Age (mean (SD))	61.94 (9.60)					
Weight (kg) (mean (SD))	79.84 (17.91)					
Height (cm) (mean (SD))	168.97 (9.76)					

N is not weighted

* One-way ANOVA p-value < 0.001

% missing included in high social support variable: 2.31% (578)

% missing included in cultural/racial background variable: 4.44% (1,114)

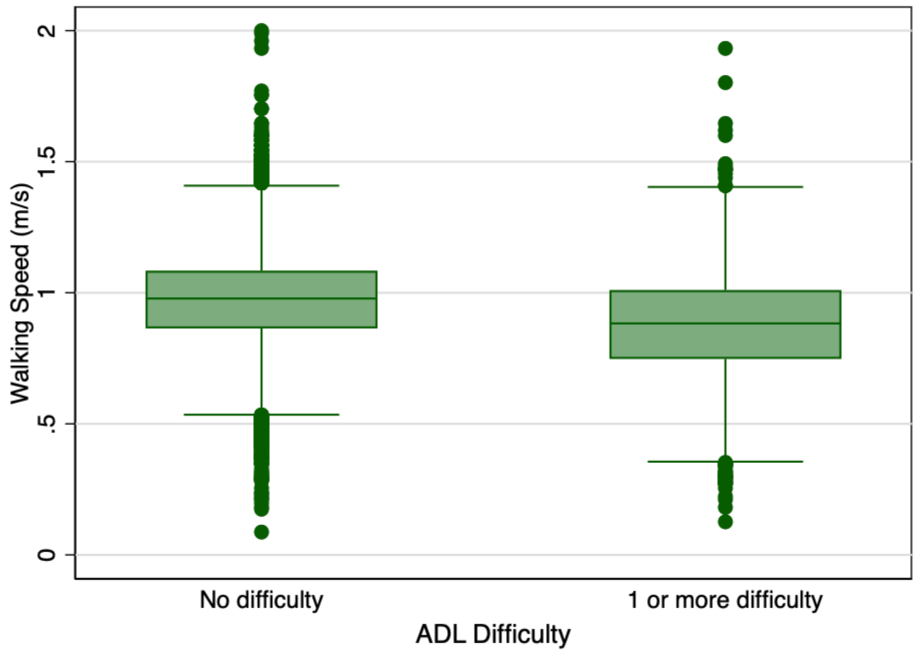


Figure 2: Box plot of walking speed by ADL level

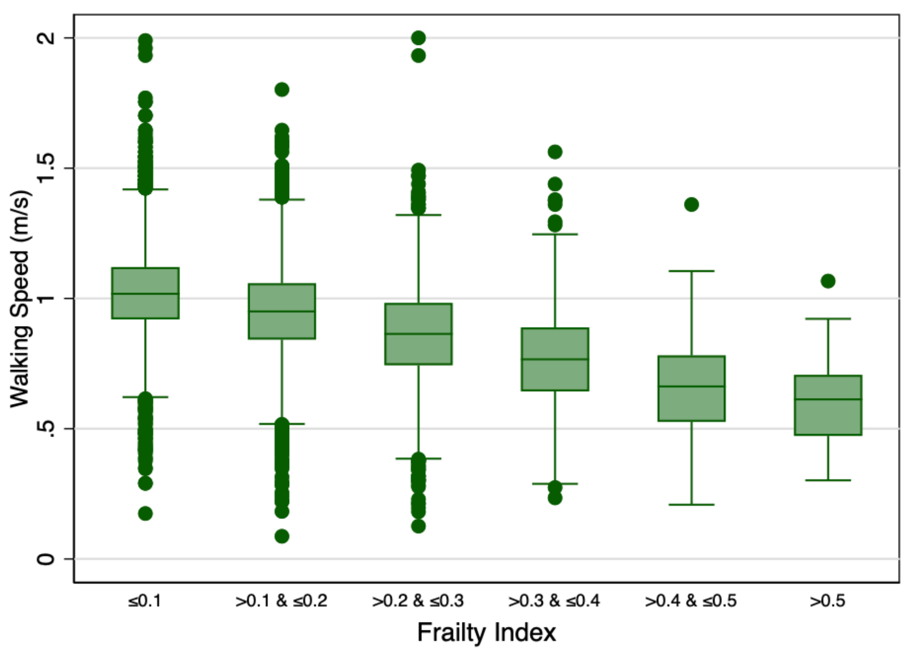


Figure 3: Box plot of walking speed by frailty level

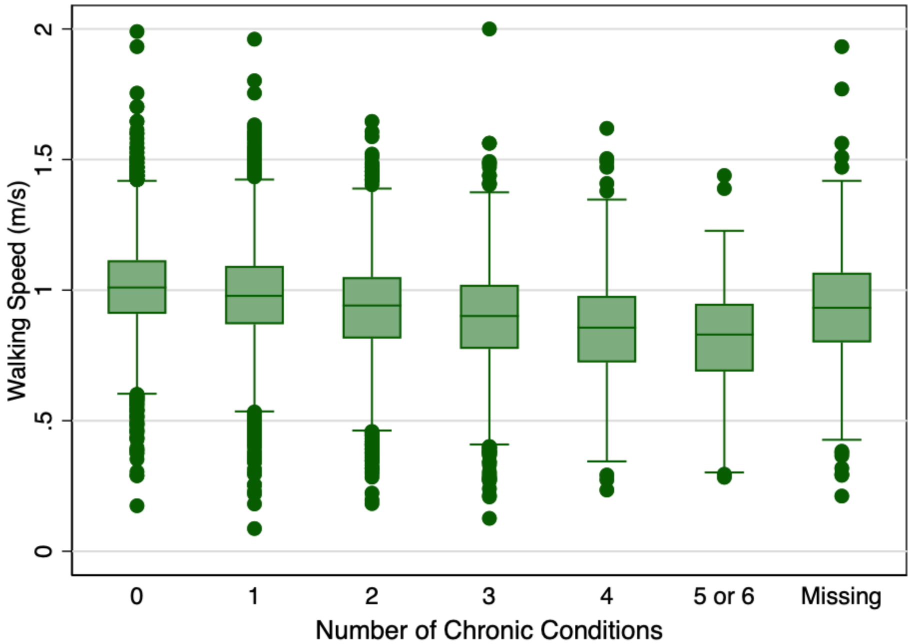


Figure 4: Box plot of walking speed by number of chronic conditions

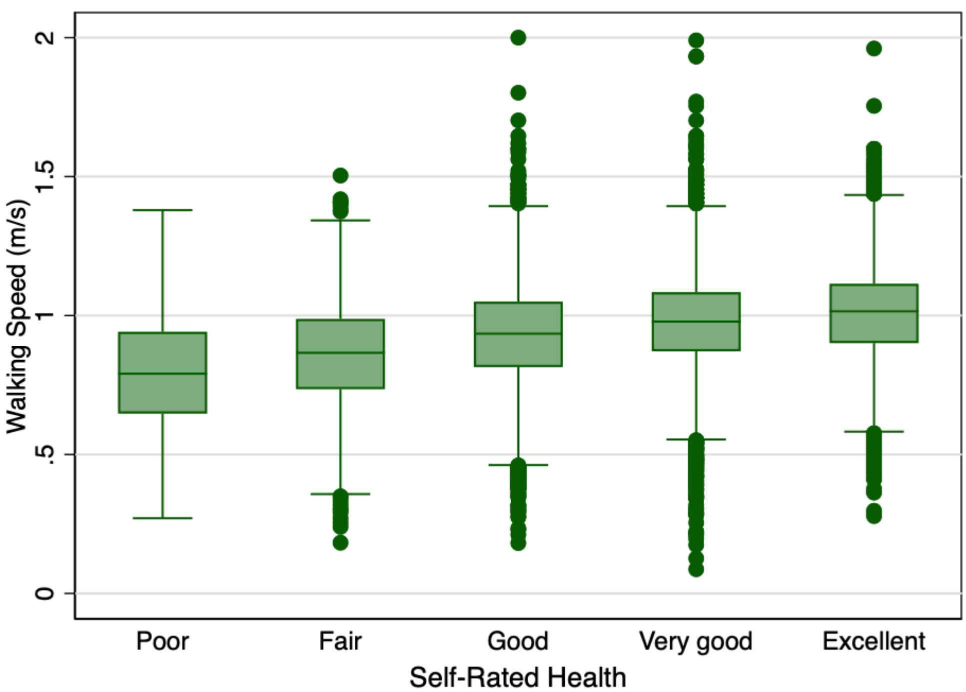


Figure 5: Box plot of walking speed by SRH level

The analytical sample had an unweighted frailty index score of 0.13, a minimum score of 0, and a maximum score of 0.66. These results were comparable to a study that determined construct validity in a frailty index created using an accumulation of deficits approach, in the baseline CLSA tracking cohort.[120] The CLSA tracking cohort includes about 20,000 Canadian adults that participated in computer-assisted telephone interviews. This study had a mean, minimum, and maximum frailty index score of 0.14, 0.003, and 0.68, respectively. The less-frail results found in the current study could be explained by the elimination of people without walking speed and the difference in number of deficits used to create the index. The validated index used 90 variables, compared to 37 used in this study.

The kernel density plot in Figure 6 illustrated the similarity in the distribution of walking speed between males and females. The distribution of walking speed by household income, presented in Figure 7 suggested that before adjusting for any additional covariates walking speed depicted a socioeconomic gradient.

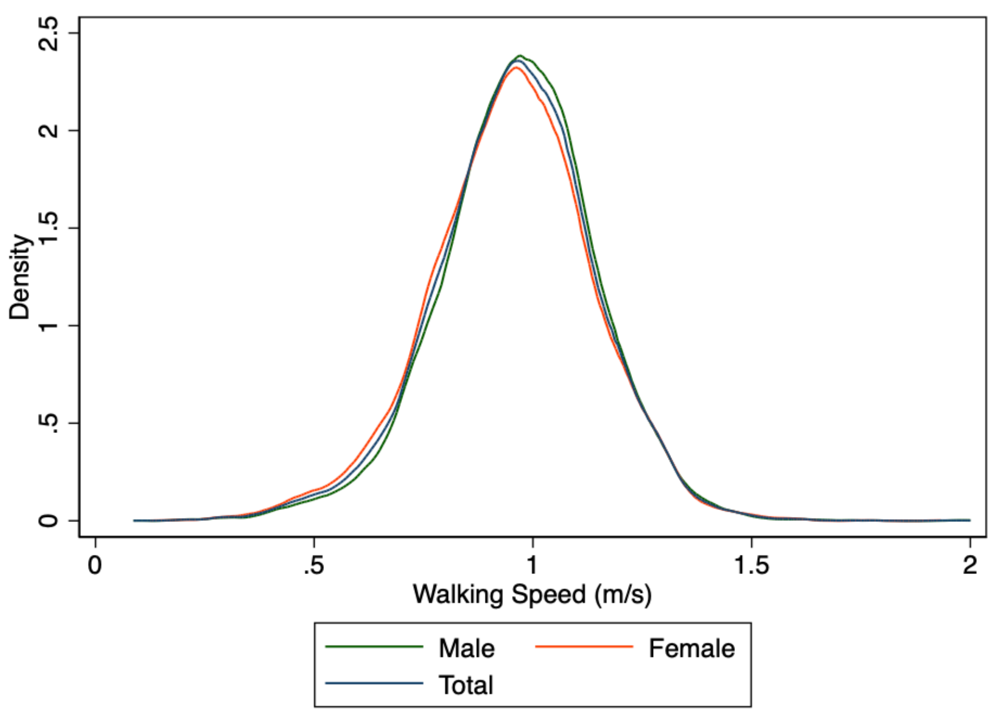


Figure 6: Distribution **of walking speed by sex**

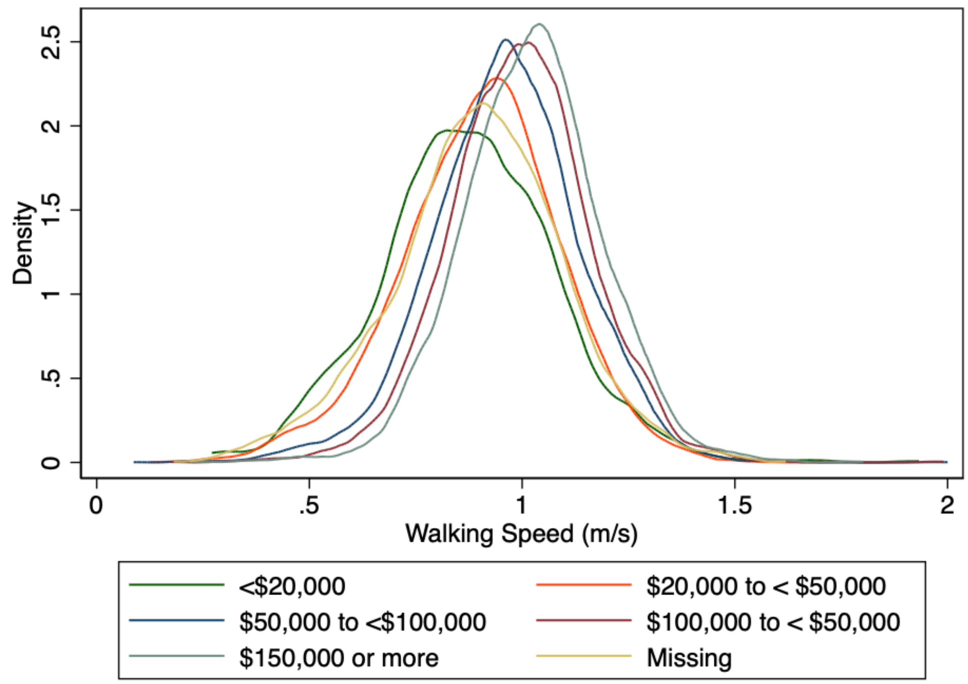


Figure 7: Distribution of walking speed by household income category

4.2 Dimensions of health and walking speed

The correlation between walking speed and the frailty index (Table 2 and 3) was about twice that of walking speed and the other dimensions of health. Pearson and Spearman correlations were used because the Pearson correlation was calculated using real values and depicts linear relationships, whereas the Spearman correlation was calculated using ranks and depicts a monotonic relationship. Walking speed and the frailty index were included in the correlation calculation as continuous variables so we examined the association with the Pearson correlation (Table 2). The remaining dimensions of health were categorical variables so the correlation was assessed with the Spearman correlation (Table 3). Walking speed had the strongest correlation with the frailty index, compared to the other dimensions of health. Variables used to derive ADL difficulty, number of chronic conditions, and SRH were also used to create the frailty index, which would have contributed to the strong correlation between the frailty index and these variables. As noted in the methods section, all walking related variables were excluded from the frailty index construction.

Table 2 Pearson correlation of walking speed and other dimensions of health (unweighted)

	WS	ADL	CC	FI	SRH
WS	1.00				
ADL	-0.20	1.00			
CC	-0.23	0.16	1.00		
FI	-0.43	0.43	0.60	1.00	
SRH	0.24	-0.17	-0.26	-0.45	1.00

WS: walking speed; CC: Chronic Conditions; FI: Frailty index

Table 3 Spearman correlation of walking speed and other dimensions of health (unweighted)

	WS	ADL	CC	FI	SRH
WS	1.00				
ADL	-0.18	1.00			
CC	-0.25	0.16	1.00		
FI	-0.39	0.39	0.69	1.00	
SRH	0.22	-0.16	-0.29	-0.43	1.00

WS: walking speed; CC: Chronic Conditions; FI: Frailty index

Heteroscedasticity was detected in residual plots when model diagnostics were conducted for models including a dimension of health. Heteroscedasticity was anticipated based on the range and variability of walking speed in some of the explanatory variables. To mitigate the effects of the heteroscedasticity we conducted sensitivity analysis to investigate outliers and we introduced age-squared and height-squared variables to correct for the non-linear nature of continuous age and height variables. Considering the size of the sample with these adjustments we were confident that any remaining heteroscedasticity did not influence the interpretation of p-values in this analysis.

Table 4 Weighted OLS regression results for walking speed and activities of daily living difficulty, adjusted for age

Variable	Coef.	Standard Err.	t	P-value	99% CI	
ADL difficulty						
No difficulty	Ref.					
1 or more	-0.060	0.004	-15.30	<0.001	-0.070	-0.050
(Constant)	0.682	0.053	12.83	<0.001	0.545	0.819

R-squared: 0.143

Adjusted for age and age-squared

CI: Confidence interval

Table 4 presents the weighted OLS regression results for walking speed and ADL difficulty. Participants who reported difficulty or inability to complete one or more ADL had a 4-meter timed walking speed that was 0.06 m/s (99% CI: -0.07, 0.05) slower compared to those who reported no ADL difficulty while controlling for age and age-squared. This was statistically and clinically meaningful finding. A difference of 0.04 m/s indicates a minimal clinically meaningful difference.

Table 5 Weighted OLS regression results for walking speed and the frailty index adjusted for age

Variable	Coef.	Standard Err.	t	P-value	99% CI	
Frailty Index						
≤0.1	Ref.					
>0.1 & ≤0.2	-0.037	0.003	-12.28	<0.001	-0.045	-0.029
>0.2 & ≤0.3	-0.099	0.004	-22.48	<0.001	-0.111	-0.088
>0.3 & ≤0.4	-0.177	0.008	-20.94	<0.001	-0.199	-0.156
>0.4 & ≤0.5	-0.270	0.014	-19.10	<0.001	-0.306	-0.233
>0.5	-0.380	0.040	-9.41	<0.001	-0.484	-0.276
(Constant)	0.709	0.053	13.40	<0.001	0.573	0.846

R-squared: 0.183

Adjusted for age and age-squared

On average participants with a frailty index score greater than 0.5 (the frailest category) walked 0.38 m/s (99% CI: -0.48, -0.28) slower than people with a frailty index score less than or equal to 0.1, after adjusting for age and age-squared (Table 5). This was a statistically significant finding and far exceeded the cut point for substantial clinical significance (0.09m/s). We saw a graded decrease in walking speed by each 0.1 level increase in frailty index score. The decrease in coefficients was clinically significant compared to the reference group and between each level. The difference was minimally clinically meaningful between the first four categories (i.e., ≤0.1, >0.1 & ≤ 0.2, >0.2 & ≤0.3, >0.3 & ≤0.4) and substantially clinically meaningful between the last three categories (i.e., >0.3 & ≤0.4 > 0.4 & ≤0.5, >0.5). Interestingly, in the frailer categories (i.e., >0.3 & ≤0.4, >0.4 & ≤ 0.5 and >0.5) a 0.1 increase in frailty index score was associated with a ~0.1 m/s decrease in walking speed between categories. These results indicated that walking speed measured a construct of health comparable to the frailty index.

Table 6 Weighted OLS regression results for walking speed and number of chronic conditions adjusted for age

Variable	Coef.	Standard Err.	t	P-value	99% CI	
Number of conditions						
No conditions	Ref.					
1 condition	-0.012	0.003	-3.60	<0.001	-0.021	-0.003
2 conditions	-0.037	0.004	-9.73	<0.001	-0.047	-0.027
3 conditions	-0.056	0.005	-11.50	<0.001	-0.069	-0.043
4 conditions	-0.092	0.007	-12.40	<0.001	-0.111	-0.073
5 or 6 conditions	-0.119	0.018	-6.56	<0.001	-0.165	-0.072
Missing	-0.029	0.008	-3.63	<0.001	-0.050	-0.009
(Constant)	0.604	0.053	11.29	<0.001	0.466	0.742

R-squared: 0.147

Adjusted for age and age-squared

All levels of chronic conditions indicated a statistically significant difference in walking speed (Table 6). Having one chronic condition (i.e., heart disease, hypertension, cancer, diabetes, chronic lower respiratory diseases and, arthritis) did not indicate a clinically meaningful difference in walking speed. Having two or three chronic conditions was minimally clinically meaningful. Participants who reported having four chronic conditions had a walking speed 0.09 m/s slower (99% CI: -0.11, -0.07) than participants who reported no chronic conditions. Similarly, participants who reported five or six chronic conditions had a walking speed 0.12 m/s slower (99% CI: -0.17, -0.7) than those who reported no chronic conditions. Both of these findings were substantially meaningfully different from the reference group. The difference in walking speed was not clinically meaningful for any one level increase in number of chronic conditions, this suggested that an increase of at least two chronic conditions was associated with a more clinically meaningful decrease in walking speed.

Table 7 Weighted OLS regression results for walking speed and self-rated health adjusted for age

Variable	Coef.	Standard Err.	t	P-value	99% CI	
Self-rated health						
Excellent	Ref.					
Very good	-0.025	0.003	-7.29	<0.001	-0.034	-0.016
Good	-0.062	0.004	-16.72	<0.001	-0.071	-0.052
Fair	-0.124	0.005	-22.83	<0.001	-0.138	-0.110
Poor	-0.192	0.013	-15.14	<0.001	-0.225	-0.159
(Constant)	0.757	0.053	14.34	<0.001	0.621	0.893

R-squared: 0.174

Adjusted for age and age-squared

The association between SRH and walking speed was statistically significant (Table 7). We found a graded relationship between SRH categories and walking speed and a clinically meaningful decrease in walking speed between each level of SRH. There was a substantial difference between excellent and poor SRH. Compared to excellent SRH the decrease in walking speed for poor SRH was 0.19 m/s (99%CI: -0.22, -0.16). This was a change more than double the difference required for a clinically meaningful difference.

Sex-stratified analysis was not conducted for the frailty index model because sex was not statistically significant when added to the model. Sex-stratified analysis for the other dimensions of health (i.e., ADL difficulty, number of chronic conditions, and the frailty index) highlighted that there was very little difference in the association with walking speed for males and females (see Appendix 7). Age-stratification was performed for all dimension of health models. The general graded relationship in walking speed was maintained through each age category for all dimensions of health. For all dimensions of health, the R-squared value increased for every age category. This suggested that the strength of the association with walking speed increased with age (see Appendix 8).

After controlling for age and age-squared there was a statistically significant and clinically meaningful graded association between walking speed and each dimension of health. The frailty index and SRH showed the most clinically meaningful association with walking speed, this was identified by a meaningful difference at each level of the categorical variable. SRH and the frailty index also had the largest R-squared values, this was not surprising considering the frailty index was constructed using variables from other dimensions of health. This is an encouraging finding as both frailty and SRH have extensive evidence to support they are useful measures of general health. [3,86]

4.3 Walking speed and socioeconomic status

The income coefficients indicated a socioeconomic gradient in walking speed (Table 8). The difference in walking speed between the reference group (< $20,000) and those with a household income of $20,000 to less than $50,000 was not statistically or clinically significant. The remainder of the income levels were statistically significant with an increasing level of clinical significance when compared to the reference group. The highest income category (≥ $150,000) had an average walking speed that was 0.06 m/s (99% CI: 0.039, 0.082) faster compared to the reference group, a substantial clinical difference in walking speed. The incremental increases between each level of income were not clinically significant. Although two of the three education levels were statistically significant (p-value < 0.001), there was no clear gradient in walking speed across this education variable.

Despite a lack of meaningful difference and an inconsistency in statistical significance across health behaviour variables, we still observed the expected trends in health behaviours. For example, the current smokers walked slower than those who had never smoked (-0.026 m/s; 99%CI: -0.039, -0.012), and those who ate two or fewer servings of fruit and vegetables walked slower (-0.034 m/s; 99% CI: -0.046, -0.022) than those who ate 7 or more servings. The exception was that people who drank alcohol regularly walked faster (0.024 m/s; 99% CI: 0.014, 0.035) than those who had not had a drink in a year. This finding is consistent with existing studies using CLSA data that have reported heavy drinkers were healthier than what would be expected.[44,121,122]

Table 8 Weighted OLS regression results for walking speed and socioeconomic status, controlling for demographic, social, health behaviour, and geographic variables.

Variable	Coef.	Standard Err.	t	P-value	99% CI	
Sex						
Female	Ref.					
Male	0.001	0.004	0.39	0.694	-0.008	0.011
Income						
< $20,000	Ref.					
$20,000 to < $50,000	0.016	0.007	2.16	0.031	-0.003	0.036
$50,000 to < $100,000	0.039	0.008	5.19	<0.001	0.020	0.059
$100,000 to < $150,000	0.047	0.008	5.75	<0.001	0.026	0.068
$150,000 or more	0.060	0.008	7.20	<0.001	0.039	0.082
Missing	0.018	0.009	2.06	0.040	-0.005	0.041
Education						
Less than secondary school graduation	Ref.					
Secondary school graduation, no post-secondary	0.028	0.007	3.90	<0.001	0.010	0.047
Some post-secondary	0.017	0.008	2.21	0.027	-0.003	0.037
Post-secondary degree/diploma	0.027	0.007	4.07	<0.001	0.010	0.044
Weight (kg)	-0.002	0.00008	-25.74	<0.001	-0.002	-0.002
Smoking						
Never smoked	Ref.					
Former smoker	-0.007	0.003	-2.86	0.004	-0.014	-0.0007
Current smoker	-0.026	0.005	-4.99	<0.001	-0.039	-0.012
Alcohol Consumption						
Did not drink in the last 12 months	Ref.					
Occasional Drinker	0.012	0.005	2.40	0.016	-0.0009	0.025
Regular drinker (at least once a month)	0.024	0.004	5.96	<0.001	0.014	0.035

Table 8 Weighted OLS regression results for walking speed and socioeconomic status, controlling for demographic, social, health behaviour, and geographic variables.

Variable	Coef.	Standard Err.	t	P-value	99% CI	
Fruit and vegetable servings						
7 or more	Ref.					
5 or 6	-0.010	0.004	-2.36	0.019	-0.022	0.001
3 or 4	-0.018	0.004	-4.12	<0.001	-0.029	-0.007
2 or fewer	-0.034	0.005	-7.15	<0.001	-0.046	-0.022
Physical activity (PASE score)						
Normal level of physical activity	Ref.					
Low level of physical activity	-0.020	0.003	-7.58	<0.001	-0.027	-0.013
Cultural/racial background						
White	Ref.					
Black	-0.095	0.015	-6.37	<0.001	-0.133	-0.056
East/South Asian	-0.013	0.012	-1.13	0.259	-0.044	0.017
South Asian	-0.059	0.014	-4.30	<0.001	-0.094	-0.024
Other racial or cultural origin OR no response	-0.016	0.005	-3.04	0.002	-0.030	-0.003
Multiple racial or cultural origins	-0.027	0.014	-1.90	0.058	-0.063	0.010
High social support availability						
No or no response	Ref.					
Yes	0.023	0.004	5.99	<0.001	0.013	0.034
Marital Status						
Single/never married/never lived with partner	Ref.					
Widowed/divorced/separated	0.001	0.005	0.21	0.836	-0.012	0.014
Married/common law	-0.0008	0.006	-0.14	0.888	-0.015	0.014

Table 8 Weighted OLS regression results for walking speed and socioeconomic status, controlling for demographic, social, health behaviour, and geographic variables.

Variable	Coef.	Standard Err.	t	P-value	99% CI	
Rural/urban						
Urban	Ref.					
Rural	0.015	0.004	3.29	0.001	0.003	0.026
Province						
British Columbia	Ref.					
Alberta	-0.103	0.004	-24.06	<0.001	-0.114	-0.092
Manitoba	-0.044	0.004	-10.40	<0.001	-0.055	-0.033
Ontario	-0.035	0.003	-10.89	<0.001	-0.044	-0.027
Quebec	0.001	0.004	0.39	0.697	-0.008	0.011
Nova Scotia	0.056	0.004	12.42	<0.001	0.044	0.067
Newfoundland and Labrador	-0.040	0.004	-9.08	<0.001	-0.052	-0.029
(Constant)	-0.890	0.311	-2.86	0.004	-1.690	-0.089

R-squared: 0.255

Adjusted for age, age-squared, height, height-squared, and household size

Sex-stratification was not conducted because sex was not statistically significant in the model. After stratifying by age, the graded relationship in walking speed by income category was consistent in the 45 to 54 and 55 to 64 age groups. We observed less consistent socioeconomic gradient and fewer statistically significant coefficients in the 65 to 74, and 75 or older age groups. The R-squared value increased with every age category suggesting that walking speed was better explained by these explanatory variables among older adults (see Appendix 9).

CHAPTER 5 DISCUSSION AND CONCLUSIONS

5.1 Discussion

The goal of this study was to better understand walking speed as a measure of health among older adults in the context of health inequality studies that assess the socioeconomic gradient. The findings from this secondary analysis confirmed that walking speed was associated with other dimensions of health (i.e., ADL, the frailty index, number of chronic conditions, and SRH) used to assess the health of older adults. A major finding of this study was the identification of a socioeconomic gradient within walking speed when controlled for a number of demographic and anthropometric, health behaviour, social, and geographic variables. Additionally, this analysis confirmed that there was little difference in the factors that influence walking speed for males and females. This analysis suggested that the aspects of health that influenced walking speed were consistent with the determinants of health presented in Solar and Irwin's social determinants of health framework.

We found walking speed to be correlated with all of the dimensions of health that we assessed (i.e., ADL, the frailty index, SRH, and number of chronic conditions). The identified association between walking speed and SRH was an important finding because SRH has been used to assess the socioeconomic gradient in health inequality analyses. Another intriguing association that we identified was that between walking speed and the frailty index. We found a statistically significant association, with a clinically meaningful difference in walking speed at each 0.1 interval of the frailty index, this meant that for every 0.1 level increase in frailty score there was a clinically meaningful decrease in walking speed. In one study that examined the association between the frailty index and walking speed using multiple linear regression the author found a statistically significant association between the frailty index and walking speed while controlling for age and sex.[123] Another study found similar characteristics between frail participants (frailty index score > 0.25) and participants who walked slowly (< 0.80 m/s).[124] Opposing results were found by authors who assessed this association in a hospital rehabilitation context. They concluded that the frailty index and walking speed measured different aspects of health.[125] All of these studies had much smaller sample sizes compared to ours, 593, 258 (only 128 were able to walk), and 102, respectively. Frailty indices have been used in many contexts including the assessment of health inequalities.[126] Multiple methods have been established to conceptualize and construct a frailty index.[86,127] Our discussion is limited to the accumulation of deficit frailty index model used in our analysis. The downfall of this frailty index model is the number of variables required to be constructed. Our results suggested that walking speed could be used as a single measure of frailty. As a single measure, walking speed could mitigate the greatest limitation of the frailty index requiring access to a wide range of variables. Using walking speed as a proxy for frailty could also allow for frailty to be measured more often in clinical trials and possibly allow frailty to be included in administrative data. Greater access to frailty data would then strengthen inequality analyses.

Another notable result related to dimensions of health came from age-stratified analysis. The age-stratified analysis revealed that the associations were present in all age categories, this suggested that walking speed was associated with other dimensions of health starting at age 45 (see Appendix 8). In the current literature walking speed is seldomly examined in populations under the age of 60. The exception is a recent study that found walking speed to be associated with factors related to ageing (e.g., physical function, biomarkers, and brain structure), in 45 year olds.[67] Our results were consistent with the findings of this study. Knowing that walking speed is a useful measure of health at age 45 allows for examining change in health inequality during the transition into late life. This information could be helpful for implementing procedures and policies that support people through this transition.

The limited literature that has examined the socioeconomic gradient in walking speed overall established that walking speed was associated with various SES measures (e.g., education, income, employment, and social class).[128] Our results aligned with this pattern. The association between walking speed and education has been identified in the literature.[75,77] Thus, we expected to see a graded association in our sample. Compared to the association between walking speed and income, education was less uniform. We found that participants that graduated secondary school and participants that had a post-secondary degree or diploma walked faster on average than those with less than secondary education. OLS regression results indicated that those who graduated secondary school walked 0.001m/s faster than those with less than secondary education. The difference in our results compared to a similar study in the current literature[75] was that we did not find a gradient in the levels of education and we included an additional category, some post-secondary education, that was not statistically significant. However, our results do suggest that walking speed is associated with education.

Our finding that income was positively associated with walking speed is consistent with the current literature. A systematic review that aimed to examine the association between walking speed, income, education, and/or life expectancy found three studies that assessed this association and all found a relationship.[128] Two of these studies identified the association between walking speed and income in populations 60 and older. This was interesting because the association with income in our sample weakened in the 65 to 74 and 75 and older age groups compared to the 45 to 54 and 55 to 64 age groups. This could be explained by the variable household income. As described previously, income can be a difficult measure in older age groups because it often does not reflect SES after retirement. To better understand this association future research should be conducted using an asset measure of SES. The association between income and age identified in our results was present in the youngest category, this strengthens the justification that walking speed is a useful measure of general health in people starting at age 45. It is also important to note that our results add to the evidence of the association between SES and walking speed because we controlled for a number of factors that influence health.

The identification of the other explanatory variables associated with walking speed in this study expanded our understanding of walking speed as a measure of general health. For example, we learned that smoking and fruit and vegetable consumption were associated with walking speed in the expected direction. Additionally, the results indicated that walking speed does not have a statistically significant association with marital status. In general, our findings suggested that walking speed was explained by determinants of health defined by Solar and Irwin's framework. This is very important because this suggests that walking speed should not be considered only for clinical care but for social and health policy to improve the health of aging populations.[7]

The results of this study identified and confirmed a number of characteristics that make walking speed an appealing measure of general heath for application in the context of health inequality. Walking speed did not differ by sex, the associations between walking speed and other dimensions of health and SRH were both statistically and clinically significant, and walking speed was associated with SES after controlling for a number of other factors that influence health. Results from age-stratified analysis confirmed that walking speed was an indicator of general health starting at age 45-54. Further research using alternative measures of SES (e.g., asset measures) is needed to assess the association with walking speed in age groups 65 and older.

5.2 Strengths and Limitations

The results of this study provide new insight into the literature on measures of general health in older adults. Walking speed has just begun to be evaluated through a social determinant lens, hence, the assessment of health inequalities. This analysis confirmed the association between walking speed and other objective and subjective measures of health and determined that there was a socioeconomic gradient in walking speed. These findings have the potential to change the way we measure general health in adults at the population level.

The CLSA provided rich data that made this study a unique and crucial addition to the current body of literature on walking speed and SES. Specifically, the use of the CLSA brought the following strengths in this study: (1) the diversity of variables included in the analysis; (2) age-stratified analysis that started at age 45; and (3) the generalizability of the study to Canadian adults. The assessment of both determinants and other dimensions of health in this study was a great asset and contributed to a thorough understanding of what walking speed measures. Additionally, previous work in this area mainly focused on a smaller number of variables and often only from one or two dimensions of health. The large sample of the CLSA allowed us to include a large number of variables without sacrificing the power of the study. Age-stratified analyses starting at age 45 were a strength of this research because much of the research in this area employs data starting at age 60 or 65 and there has yet to be an age defined for when walking speed becomes a useful measure. Age-stratified analyses from 45 years of age identified that walking speed could be a useful measure of general health even among middle aged healthy people. Furthermore, both of the above strengths contributed to the final strength associated with the generalizability of this study. The wide range of variables such as rurality, province, and age included in this study made the results generalizable to many populations and provides researchers the rich information needed to decide if walking speed is a measure applicable in their context.

Aside from the strengths associated with the dataset, a major strength of this study was the development of variables based on the social determinants of health framework created by Solar and Irwin. By starting with this framework, we considered a holistic sense of health that has the potential to improve the future application of walking speed. The social determinants of health are important in policy implication and service allocation therefore by including such a framework in this study we are positioning this work to be applicable in efforts to create change and improve health of all older Canadians.

Our study has at least three notable limitations: (1) the cross-sectional nature of the study; (2) the measurement of SES; and (3) the limited socioeconomic gradient within the CLSA.

The cross-sectional design of this study prevented us from determining causation between variables. This study design allowed us to determine correlations between walking speed and other identified variables. We chose a cross-sectional design as only the baseline and first follow-up data of the CLSA were available, and we considered that a three-year follow-up was unlikely to strengthen the objectives that this study aimed to achieve.

This study measured SES using income and education. As mentioned above, measuring SES is a difficult task and becomes increasingly challenging in a sample where many participants are no longer in the work force. Employing accurate measures of wealth using non-self-reported data would be optimal. However, such data were not available in the CLSA at the time of application and are seldom available, thus, infrequently used in population health research. We chose to use income and education because they were what we believed to be the best available measures of SES in the CLSA. Although self-reported, these data were collected by interviewers using carefully designed protocols.

Previous assessment of the study sample has indicated that the CLSA sample was in general more educated than the general population.[129] This was a limitation for this study because we aimed to assess the socioeconomic gradient in walking speed. Ideally to assess the socioeconomic gradient we would have used data that were representative of the distribution of SES in the population. Although this is a notable limitation, the socioeconomic gradient of walking speed this study identified within the CLSA serves as a conservative estimate, which could be steeper in a population with a wider distribution of SES.

5.3 Future Research and Policy Implications

The focus on SES in this study makes the results useful in the context of health inequality research. The finding that walking speed exhibits a socioeconomic gradient has the potential to improve our ability to identify health inequality among older adults in Canada. By better understanding the socioeconomic gradient of health among older adults, institutions and policymakers can more accurately allocate resources to improve the health of this population. As discussed in the background of this thesis, there is the need for a new measure of health in older adults. This study has filled an important gap in the health measurement and health inequality literature as it is crucial for policy makers and researchers to be able to accurately depict the distribution of health in an older population.

Aging and population health surveys may be a promising venue through which walking speed could be incorporated into future research to allow for population-level inequality analyses. Among a list of 11 population health surveys being conducted throughout the world (not including the CLSA) published by the Gateway to Global Aging Data,[130] only two surveys included walking speed as a measure of health. On the other hand, four of the studies included grip strength as a measure of health.[130] The strength of the association between walking speed and frailty and the socioeconomic gradient in walking speed identified in this study provide a strong rationale for including walking speed in all aging data. Based on recent findings that revealed the challenges of using grip strength in the context of health inequality analyses,[44] the findings of this study suggest that walking speed would be a more robust measure to include as a general measure of health. Including walking speed in population aging data would not only increase potential for conducting meaningful inequality research, but it would also allow for health inequality monitoring worldwide.

Currently a limitation to including walking speed in population health research is that it requires an in-person assessment. The results of this study have the potential to evoke interest in developing ways to measure walking speed remotely. Advancements in the use of videos, the wearables, and smart home technologies may improve the remote measurement of walking speed, which in turn could vastly improve the way health inequality is studied among older adults. Additionally, due to the simplicity of the task, walking speed may be easier to measure remotely compared to other physical capability measures, such as grip strength or the timed get up and go test.

With a rapidly aging population it is more important than ever that we have the tools to assess health inequality among older adults.[2] The results of this study have highlighted the strengths of walking speed as a measure of health useful in the context of health inequality. Future research should continue to explore the potential of walking speed to help understand the health of the population in effort to improve delivery and allocation of health services in Canada and around the world.

REFERENCES

1. Phelan JC, Link BG, Tehranifar P. Social Conditions as Fundamental Causes of Health Inequalities: Theory, Evidence, and Policy Implications. J Health Soc Behav [Internet]. 2010 Mar 8 [cited 2019 Jul 29];51(1_suppl):S28–40. Available from: http://journals.sagepub.com/doi/10.1177/0022146510383498
2. Sadana R, Blas E, Budhwani S, Koller T, Paraje G. Healthy Ageing: Raising Awareness of Inequalities, Determinants, and What Could Be Done to Improve Health Equity. Gerontologist [Internet]. 2016 Apr 18 [cited 2018 Nov 21];56 Suppl 2(Suppl 2):S178-93. Available from: https://academic.oup.com/gerontologist/article-lookup/doi/10.1093/geront/gnw034
3. van Doorslaer E, Wagstaff A, Bleichrodt H, Calonge S, Gerdtham U-G, Gerfin M, et al. Income-related inequalities in health: some international comparisons. J Health Econ [Internet]. 1997 Feb 1 [cited 2019 Mar 22];16(1):93–112. Available from: https://www.sciencedirect.com/science/article/pii/S0167629696005322
4. Layes A, Asada Y, Kephart G. Whiners and deniers - what does self-rated health measure? Soc Sci Med [Internet]. 2012 Jul [cited 2019 Jun 9];75(1):1–9. Available from: https://linkinghub.elsevier.com/retrieve/pii/S0277953611006745
5. Canadian Institute for Health Information. Trends in income-related health inequalities in Canada: Technical report [Internet]. 2015. Available from: https://www.cihi.ca/en/trends-in-income-related-health-inequalities-in-canada
6. Devaux M, De Looper M. Income-Related Inequalities in Health Service Utilisation in 19 OECD Countries, 2008–2009 [Internet]. Paris; 2012 [cited 2019 Sep 18]. Available from: https://www.oecd-ilibrary.org/docserver/5k95xd6stnxt-en.pdf?expires=1568813652&id=id&accname=guest&checksum=F52585F0F989E1D379AFEA950F67D700
7. World Health Organization. A Conceptual Framework for Action on the Social Determinants of Health: [Internet]. Geneva; 2010 [cited 2019 Sep 17]. Available from: https://www.who.int/sdhconference/resources/ConceptualframeworkforactiononS

DH_eng.pdf

8. Ecob R, Smith GD. Income and health: what is the nature of the relationship? Soc Sci Med [Internet]. 1999 Mar [cited 2019 Sep 18];48(5):693–705. Available from: http://www.ncbi.nlm.nih.gov/pubmed/10080369

9. Idler EL, Benyamini Y. Self-Rated Health and Mortality: A Review of Twenty-Seven Community Studies. J Health Soc Behav [Internet]. 1997 Mar [cited 2019 Mar 20];38(1):21. Available from: http://www.jstor.org/stable/2955359?origin=crossref

10. A Review of Frameworks on the Determinants of Health [Internet]. 2015 [cited 2019 Sep 18]. Available from: http://ccsdh.ca/images/uploads/Frameworks_Report_English.pdf

11. World Health Organization. Towards a Common Language for Functioning, Disability and Health ICF Towards a Common Language for Functioning, Disability and Health: ICF The International Classification of Functioning, Disability and Health. Geneva; 2002.

12. Statistics Canada. Population Projections for Canada, Provinces and Territories: Highlights [Internet]. 2015 [cited 2019 Sep 18]. Available from: https://www150.statcan.gc.ca/n1/pub/91-520-x/2010001/aftertoc-aprestdm1-eng.htm

13. Statistics Canada. Population Projections for Canada (2018 to 2068), Provinces and Territories (2018 to 2043) Highlights [Internet]. 2019 [cited 2019 Sep 18]. Available from: https://www150.statcan.gc.ca/n1/pub/91-520-x/2019001/hi-fs-eng.htm

14. Wagstaff A, Van Doorslaer E. Measuring inequalities in health in the presence of multiple-category morbidity indicators. Health Econ [Internet]. 1994 [cited 2019 Mar 22];3(4):281–9. Available from: http://www.ncbi.nlm.nih.gov/pubmed/7994327

15. Humphries KH, van Doorslaer E. Income-related health inequality in Canada. Soc Sci Med [Internet]. 2000 Mar 1 [cited 2019 Jun 11];50(5):663–71. Available from: https://www.sciencedirect.com/science/article/pii/S0277953699003196

16. Bonner WIA, Weiler R, Orisatoki R, Lu X, Andkhoie M, Ramsay D, et al.

Determinants of self-perceived health for Canadians aged 40 and older and policy implications. Int J Equity Health [Internet]. 2017 Dec 6 [cited 2018 Dec 9];16(1):94. Available from: http://equityhealthj.biomedcentral.com/articles/10.1186/s12939-017-0595-x

17. Dowd JB, Zajacova A. Does self-rated health mean the same thing across socioeconomic groups? Evidence from biomarker data. Ann Epidemiol [Internet]. 2010 Oct [cited 2019 Jun 9];20(10):743–9. Available from: https://linkinghub.elsevier.com/retrieve/pii/S1047279710001572

18. Adams J, White M. Is the disease risk associated with good self-reported health constant across the socio-economic spectrum? Public Health [Internet]. 2006 Jan [cited 2019 Jun 9];120(1):70–5. Available from: http://www.ncbi.nlm.nih.gov/pubmed/16198383

19. Lindeboom M, van Doorslaer E. Cut-point shift and index shift in self-reported health. J Health Econ [Internet]. 2004 Nov 1 [cited 2019 Mar 20];23(6):1083–99. Available from: https://www.sciencedirect.com/science/article/pii/S0167629604000396

20. Meng X, D'Arcy C. Determinants of Self-Rated Health Among Canadian Seniors Over Time: A Longitudinal Population-Based Study. Soc Indic Res [Internet]. 2016 Apr 20 [cited 2019 Jun 9];126(3):1343–53. Available from: http://link.springer.com/10.1007/s11205-015-0941-6

21. Moor I, Spallek J, Richter M. Explaining socioeconomic inequalities in self-rated health: A systematic review of the relative contribution of material, psychosocial and behavioural factors. Vol. 71, Journal of Epidemiology and Community Health. BMJ Publishing Group; 2017. p. 565–75.

22. Zunzunegui M., Koné A, Johri M, Béland F, Wolfson C, Bergman H. Social networks and self-rated health in two French-speaking Canadian community dwelling populations over 65. Soc Sci Med [Internet]. 2004 May 1 [cited 2019 Jul 24];58(10):2069–81. Available from: https://www.sciencedirect.com/science/article/pii/S0277953603004222

23. Bélanger E, Ahmed T, Vafaei A, Curcio CL, Phillips SP, Zunzunegui MV. Sources of social support associated with health and quality of life: a cross-

sectional study among Canadian and Latin American older adults. BMJ Open [Internet]. 2016 [cited 2019 Jul 24];6(6):e011503. Available from: http://www.ncbi.nlm.nih.gov/pubmed/27354077

24. von Bonsdorff MB, Rantanen T. Benefits of formal voluntary work among older people. A review. Aging Clin Exp Res [Internet]. 2011 Jun 26 [cited 2019 Jul 26];23(3):162–9. Available from: http://link.springer.com/10.1007/BF03337746

25. Kobayashi KM, Cloutier-Fisher D, Roth M. Making Meaningful Connections. J Aging Health [Internet]. 2009 Apr 1 [cited 2019 Jul 26];21(2):374–97. Available from: http://journals.sagepub.com/doi/10.1177/0898264308329022

26. Gele AA, Harsløf I. Types of social capital resources and self-rated health among the Norwegian adult population. Int J Equity Health [Internet]. 2010 Mar 17 [cited 2019 Jul 26];9(1):8. Available from: http://equityhealthj.biomedcentral.com/articles/10.1186/1475-9276-9-8

27. Leinonen R, Heikkinen E, Jylhä M. Predictors of decline in self-assessments of health among older people — a 5-year longitudinal study. Soc Sci Med [Internet]. 2001 May 1 [cited 2019 Aug 14];52(9):1329–41. Available from: https://www.sciencedirect.com/science/article/pii/S0277953600002495

28. Perruccio A V., Katz JN, Losina E. Health burden in chronic disease: Multimorbidity is associated with self-rated health more than medical comorbidity alone. J Clin Epidemiol. 2012 Jan;65(1):100–6.

29. Idler E, Leventhal H, Mclaughlin J, Leventhal E. In Sickness but Not in Health: Self-ratings, Identity, and Mortality. J Health Soc Behav [Internet]. 2004 Sep 22 [cited 2019 Jun 16];45(3):336–56. Available from: http://www.ncbi.nlm.nih.gov/pubmed/15595511

30. DeSalvo KB, Bloser N, Reynolds K, He J, Muntner P. Mortality prediction with a single general self-rated health question. A meta-analysis. J Gen Intern Med [Internet]. 2006 Mar [cited 2019 Jun 16];21(3):267–75. Available from: http://link.springer.com/10.1111/j.1525-1497.2005.00291.x

31. Mavaddat N, Parker RA, Sanderson S, Mant J, Kinmonth AL. Relationship of self-rated health with fatal and non-fatal outcomes in cardiovascular disease: a systematic review and meta-analysis. Kiechl S, editor. PLoS One [Internet]. 2014

Jul 30 [cited 2019 Jun 16];9(7):e103509. Available from: http://dx.plos.org/10.1371/journal.pone.0103509

32. Lee Y. The predictive value of self assessed general, physical, and mental health on functional decline and mortality in older adults. J Epidemiol Community Health [Internet]. 2000 Feb 1 [cited 2019 Jun 16];54(2):123–9. Available from: http://jech.bmj.com/cgi/doi/10.1136/jech.54.2.123

33. Kennedy BS, Kasl S V., Vaccarino V. Repeated Hospitalizations and Self-rated Health among the Elderly: A Multivariate Failure Time Analysis. Am J Epidemiol [Internet]. 2001 Feb 1 [cited 2019 Jun 13];153(3):232–41. Available from: https://academic.oup.com/aje/article-lookup/doi/10.1093/aje/153.3.232

34. Tamayo-Fonseca N, Nolasco A, Quesada JA, Pereyra-Zamora P, Melchor I, Moncho J, et al. Self-rated health and hospital services use in the Spanish National Health System: a longitudinal study. BMC Health Serv Res [Internet]. 2015 Jun 4 [cited 2019 Jun 13];15(1):492. Available from: http://bmchealthservres.biomedcentral.com/articles/10.1186/s12913-015-1158-8

35. Latham K, Peek CW. Self-Rated Health and Morbidity Onset Among Late Midlife U.S. Adults. Journals Gerontol Ser B Psychol Sci Soc Sci [Internet]. 2013 Jan 1 [cited 2019 Jun 14];68(1):107–16. Available from: https://academic.oup.com/psychsocgerontology/article-lookup/doi/10.1093/geronb/gbs104

36. Horsman J, Furlong W, Feeny D, Torrance G. The Health Utilities Index (HUI): concepts, measurement properties and applications. Health Qual Life Outcomes [Internet]. 2003 Oct 16 [cited 2019 Mar 24];1:54. Available from: http://www.ncbi.nlm.nih.gov/pubmed/14613568

37. Jylhä M. What is self-rated health and why does it predict mortality? Towards a unified conceptual model. Soc Sci Med [Internet]. 2009 Aug [cited 2019 Jun 13];69(3):307–16. Available from: https://linkinghub.elsevier.com/retrieve/pii/S0277953609002925

38. Quesnel-Vallée A. Self-rated health: caught in the crossfire of the quest for "true" health? Int J Epidemiol [Internet]. 2007 Dec 1 [cited 2019 Jun 11];36(6):1161–4. Available from: https://academic.oup.com/ije/article-

lookup/doi/10.1093/ije/dym236

39. Cheng S-T, Fung H, Chan A. Maintaining self-rated health through social comparison in old age. J Gerontol B Psychol Sci Soc Sci [Internet]. 2007 Sep [cited 2019 Jun 16];62(5):P277-85. Available from: http://www.ncbi.nlm.nih.gov/pubmed/17906169

40. Abellan van Kan G, Rolland Y, Andrieu S, Bauer J, Beauchet O, Bonnefoy M, et al. Gait speed at usual pace as a predictor of adverse outcomes in community-dwelling older people an International Academy on Nutrition and Aging (IANA) Task Force. J Nutr Health Aging [Internet]. 2009 Dec [cited 2019 Jun 11];13(10):881–9. Available from: http://www.ncbi.nlm.nih.gov/pubmed/19924348

41. Johnston DW, Propper C, Shields MA. Comparing subjective and objective measures of health: Evidence from hypertension for the income/health gradient. J Health Econ [Internet]. 2009 May [cited 2021 Jan 13];28(3):540–52. Available from: https://pubmed.ncbi.nlm.nih.gov/19406496/

42. Cooper R, Kuh D, Hardy R, Mortality Review Group, FALCon and HALCyon Study Teams. Objectively measured physical capability levels and mortality: systematic review and meta-analysis. BMJ [Internet]. 2010 Sep 9 [cited 2019 Mar 24];341(sep09 1):c4467–c4467. Available from: http://www.ncbi.nlm.nih.gov/pubmed/20829298

43. Cooper R, Kuh D, Cooper C, Gale CR, Lawlor DA, Matthews F, et al. Objective measures of physical capability and subsequent health: a systematic review. Age Ageing [Internet]. 2011 Jan 1 [cited 2019 Jan 30];40(1):14–23. Available from: https://academic.oup.com/ageing/article/40/1/14/11243

44. Asada Y, Grignon M, Hurley J, Kirkland S. Cautionary tails of grip strength in health inequality studies: An analysis from the Canadian longitudinal study on aging. Soc Sci Med. 2020 Nov 1;265:113382.

45. Stringhini S, Carmeli C, Jokela M, Avendaño M, McCrory C, d'Errico A, et al. Socioeconomic status, non-communicable disease risk factors, and walking speed in older adults: multi-cohort population based study. BMJ [Internet]. 2018 Mar 23 [cited 2019 Mar 24];360:k1046. Available from:

http://www.ncbi.nlm.nih.gov/pubmed/29572376

46. Ferrucci L, Bandinelli S, Benvenuti E, Di Iorio A, Macchi C, Harris TB, et al. Subsystems contributing to the decline in ability to walk: bridging the gap between epidemiology and geriatric practice in the InCHIANTI study. J Am Geriatr Soc [Internet]. 2000 Dec [cited 2019 Mar 24];48(12):1618–25. Available from: http://www.ncbi.nlm.nih.gov/pubmed/11129752

47. Guralnik JM, Ferrucci L, Pieper CF, Leveille SG, Markides KS, Ostir G V., et al. Lower Extremity Function and Subsequent Disability: Consistency Across Studies, Predictive Models, and Value of Gait Speed Alone Compared With the Short Physical Performance Battery. Journals Gerontol Ser A Biol Sci Med Sci [Internet]. 2000 Apr 1 [cited 2019 Jun 9];55(4):M221–31. Available from: https://academic.oup.com/biomedgerontology/article-lookup/doi/10.1093/gerona/55.4.M221

48. Pamoukdjian F, Paillaud E, Zelek L, Laurent M, Lévy V, Landre T, et al. Measurement of gait speed in older adults to identify complications associated with frailty: A systematic review. J Geriatr Oncol [Internet]. 2015 Nov 1 [cited 2019 Jan 30];6(6):484–96. Available from: https://www-sciencedirect-com.ezproxy.library.dal.ca/science/article/pii/S187940681500082X#bb0150

49. Peters DM, Fritz SL, Krotish DE. Assessing the Reliability and Validity of a Shorter Walk Test Compared With the 10-Meter Walk Test for Measurements of Gait Speed in Healthy, Older Adults. J Geriatr Phys Ther [Internet]. 2013 Jan [cited 2021 Jan 28];36(1):24–30. Available from: https://journals.lww.com/00139143-201301000-00004

50. Graham JE, Ostir G V, Kuo Y-F, Fisher SR, Ottenbacher KJ. Relationship between test methodology and mean velocity in timed walk tests: a review. Arch Phys Med Rehabil [Internet]. 2008 May [cited 2019 Mar 24];89(5):865–72. Available from: https://linkinghub.elsevier.com/retrieve/pii/S000399930800035X

51. Cavanaugh EJ, Richardson J, McCallum CA, Wilhelm M. The Predictive Validity of Physical Performance Measures in Determining Markers of Preclinical Disability in Community-Dwelling Middle-Aged and Older Adults: A Systematic Review. Phys Ther [Internet]. 2018 Dec 1 [cited 2019 Jan 30];98(12):1010–21.

Available from: https://academic.oup.com/ptj/article/98/12/1010/5106879

52. Studenski S, Perera S, Wallace D, Chandler JM, Duncan PW, Rooney E, et al. Physical Performance Measures in the Clinical Setting. J Am Geriatr Soc [Internet]. 2003 Mar [cited 2019 Nov 19];51(3):314–22. Available from: http://doi.wiley.com/10.1046/j.1532-5415.2003.51104.x

53. Cruz-Jentoft AJ, Baeyens JP, Bauer JM, Boirie Y, Cederholm T, Landi F, et al. Sarcopenia: European consensus on definition and diagnosis. Age Ageing. 2010 Apr 13;39(4):412–23.

54. Miller ME, Magaziner J, Marsh AP, Fielding RA, Gill TM, King AC, et al. Gait Speed and Mobility Disability: Revisiting Meaningful Levels in Diverse Clinical Populations. J Am Geriatr Soc. 2018 May 1;66(5):954–61.

55. Kwon S, Perera S, Pahor M, Katula JA, King AC, Groessl EJ, et al. What is a meaningful change in physical performance? Findings from a clinical trial in older adults (The LIFE-P study). J Nutr Heal Aging [Internet]. 2009 Jun 4 [cited 2020 Nov 25];13(6):538–44. Available from: https://link.springer.com/article/10.1007/s12603-009-0104-z

56. Perera S, Mody SH, Woodman RC, Studenski SA. Meaningful change and responsiveness in common physical performance measures in older adults. J Am Geriatr Soc [Internet]. 2006 May 1 [cited 2020 Nov 25];54(5):743–9. Available from: https://onlinelibrary.wiley.com/doi/full/10.1111/j.1532-5415.2006.00701.x

57. Perera S, Studenski S, Newman A, Simonsick E, Harris T, Schwartz A, et al. Are Estimates of meaningful decline in mobility performance consistent among clinically important subgroups? (Health ABC study). Journals Gerontol - Ser A Biol Sci Med Sci [Internet]. 2014 Oct 1 [cited 2020 Nov 25];69(10):1260–8. Available from: https://academic.oup.com/biomedgerontology/article/69/10/1260/668765

58. Cesari M, Kritchevsky SB, Penninx BWHJ, Nicklas BJ, Simonsick EM, Newman AB, et al. Prognostic Value of Usual Gait Speed in Well-Functioning Older Peopleâ€”Results from the Health, Aging and Body Composition Study. J Am Geriatr Soc [Internet]. 2005 Oct 1 [cited 2019 Jan 30];53(10):1675–80. Available from: http://doi.wiley.com/10.1111/j.1532-5415.2005.53501.x

59. Bohannon RW. Comfortable and maximum walking speed of adults aged 20-79 years: reference values and determinants. Age Ageing [Internet]. 1997 Jan [cited 2019 Mar 24];26(1):15–9. Available from: http://www.ncbi.nlm.nih.gov/pubmed/9143432
60. Studenski S, Perera S, Patel K, Rosano C, Faulkner K, Inzitari M, et al. Gait speed and survival in older adults. JAMA [Internet]. 2011 Jan 5 [cited 2018 Oct 17];305(1):50–8. Available from: http://www.ncbi.nlm.nih.gov/pubmed/21205966
61. Pinter D, Ritchie SJ, Gattringer T, Bastin ME, Hernández M del CV, Corley J, et al. Predictors of gait speed and its change over three years in community-dwelling older people. Aging (Albany NY) [Internet]. 2018 Jan 20 [cited 2019 Aug 16];10(1):144–53. Available from: http://www.ncbi.nlm.nih.gov/pubmed/29356686
62. Warren M, Ganley KJ, Pohl PS. The association between social participation and lower extremity muscle strength, balance, and gait speed in US adults. Prev Med reports [Internet]. 2016 Dec [cited 2019 Jul 30];4:142–7. Available from: https://linkinghub.elsevier.com/retrieve/pii/S2211335516300559
63. Abellan van Kan G, Rolland Y, Houles M, Gillette-Guyonnet S, Soto M, Vellas B. The assessment of frailty in older adults. Clin Geriatr Med [Internet]. 2010 May [cited 2019 Jun 16];26(2):275–86. Available from: https://linkinghub.elsevier.com/retrieve/pii/S0749069010000145
64. Fielding RA, Vellas B, Evans WJ, Bhasin S, Morley JE, Newman AB, et al. Sarcopenia: An Undiagnosed Condition in Older Adults. Current Consensus Definition: Prevalence, Etiology, and Consequences. International Working Group on Sarcopenia. J Am Med Dir Assoc [Internet]. 2011 May 1 [cited 2019 Jun 11];12(4):249–56. Available from: https://www.sciencedirect.com/science/article/pii/S1525861011000193
65. Kernick D, Chew-Graham CA, O'Flynn N. Clinical assessment and management of multimorbidity: NICE guideline. Br J Gen Pract [Internet]. 2017 [cited 2019 Jul 29];67(658):235–6. Available from: http://www.ncbi.nlm.nih.gov/pubmed/28450343
66. Ortiz PJ, Tello T, Aliaga EG, Casas PM, Peinado JE, Miranda JJ, et al. Effect of

multimorbidity on gait speed in well-functioning older people: A population-based study in Peru. Geriatr Gerontol Int [Internet]. 2018 Feb [cited 2019 Jun 9];18(2):293–300. Available from: http://doi.wiley.com/10.1111/ggi.13182

67. Rasmussen LJH, Caspi A, Ambler A, Broadbent JM, Cohen HJ, Arbeloff T. Association of Neurocognitive and Physical Function With Gait Speed in Midlife. 2019;2(10):1–15.

68. Liu B, Hu X, Zhang Q, Fan Y, Li J, Zou R, et al. Usual walking speed and all-cause mortality risk in older people: A systematic review and meta-analysis. Gait Posture [Internet]. 2016 [cited 2018 Nov 15];44:172–7. Available from: http://dx.doi.org/10.1016/j.gaitpost.2015.12.008

69. Veronese N, Stubbs B, Volpato S, Zuliani G, Maggi S, Cesari M, et al. Association Between Gait Speed With Mortality, Cardiovascular Disease and Cancer: A Systematic Review and Meta-analysis of Prospective Cohort Studies. J Am Med Dir Assoc [Internet]. 2018 Nov [cited 2019 Jun 11];19(11):981-988.e7. Available from: https://linkinghub.elsevier.com/retrieve/pii/S152586101830327X

70. Vermeulen J, Neyens JC, van Rossum E, Spreeuwenberg MD, de Witte LP. Predicting ADL disability in community-dwelling elderly people using physical frailty indicators: a systematic review. BMC Geriatr [Internet]. 2011 Dec 1 [cited 2019 Jan 30];11(1):33. Available from: http://bmcgeriatr.biomedcentral.com/articles/10.1186/1471-2318-11-33

71. Buracchio T, Dodge HH, Howieson D, Wasserman D, Kaye J. The trajectory of gait speed preceding mild cognitive impairment. Arch Neurol [Internet]. 2010 Aug 1 [cited 2019 Jun 15];67(8):980–6. Available from: http://archneur.jamanetwork.com/article.aspx?doi=10.1001/archneurol.2010.159

72. Rosenberg T, Montgomery P, Hay V, Lattimer R. Using frailty and quality of life measures in clinical care of the elderly in Canada to predict death, nursing home transfer and hospitalisation-the frailty and ageing cohort study. BMJ Open [Internet]. 2019 [cited 2021 Jan 12];9(11). Available from: https://pubmed.ncbi.nlm.nih.gov/31722953/

73. Brunner E, Shipley M, Spencer V, Kivimaki M, Chandola T, Gimeno D, et al. Social Inequality in Walking Speed in Early Old Age in the Whitehall II Study.

Journals Gerontol Ser A Biol Sci Med Sci [Internet]. 2009 Oct 1 [cited 2019 Oct 14];64A(10):1082–9. Available from: https://academic.oup.com/biomedgerontology/article-lookup/doi/10.1093/gerona/glp078

74. Thorpe RJ, Koster A, Kritchevsky S, Newman A, Harris T, Anyonyan H, et al. Race, socioeconomic resources, and late-life mobility and decline: findings from the Health, Aging, and Body Composition study. Journals Gerontol Ser A Biol Sci Med Sci. 2011;66(10):1114–23.

75. Welmer A-K, Kåreholt I, Rydwik E, Angleman S, Wang H-X. Education-related differences in physical performance after age 60: a cross-sectional study assessing variation by age, gender and occupation. BMC Public Health [Internet]. 2013 Dec 10 [cited 2019 Oct 14];13(1):641. Available from: http://bmcpublichealth.biomedcentral.com/articles/10.1186/1471-2458-13-641

76. Zaninotto P, Sacker A, Series JH-J of G, 2013 undefined. Relationship between wealth and age trajectories of walking speed among older adults: evidence from the English Longitudinal Study of Ageing. academic.oup.com [Internet]. [cited 2019 Oct 14]; Available from: https://academic.oup.com/biomedgerontology/article-abstract/68/12/1525/533901

77. Busch T de A, Duarte YA, Pires Nunes D, Lebrão ML, Satya Naslavsky M, dos Santos Rodrigues A, et al. Factors associated with lower gait speed among the elderly living in a developing country: a cross-sectional population-based study. BMC Geriatr [Internet]. 2015 Dec 1 [cited 2019 Oct 14];15(1):35. Available from: http://bmcgeriatr.biomedcentral.com/articles/10.1186/s12877-015-0031-2

78. Jancova-Vseteckova J, … MB-J of aging, 2015 U. Social patterning in grip strength, chair rise, and walk speed in an aging population: the Czech HAPIEE Study. J Aging Phys Act [Internet]. 2015 [cited 2019 Oct 14];23(2):264–71. Available from: https://journals.humankinetics.com/view/journals/japa/23/2/article-p264.xml

79. Plouvier S, Carton M, Cyr D, Sabia S, Leclerc A, Zins M, et al. Socioeconomic disparities in gait speed and associated characteristics in early old age. BMC Musculoskelet Disord [Internet]. 2016 Dec 23 [cited 2019 Oct 14];17(1):178.

Available from:
http://bmcmusculoskeletdisord.biomedcentral.com/articles/10.1186/s12891-016-1033-8

80. Weber D. Differences in physical aging measured by walking speed: evidence from the English Longitudinal Study of Ageing. BMC Geriatr [Internet]. 2016 Jan 28 [cited 2019 Sep 18];16:31. Available from: http://www.ncbi.nlm.nih.gov/pubmed/26822437

81. Birnie K, Martin R, Gallacher J, … AB-JE, 2011 undefined. Socio-economic disadvantage from childhood to adulthood and locomotor function in old age: a lifecourse analysis of the Boyd Orr and Caerphilly prospective studies. jech.bmj.com [Internet]. [cited 2019 Oct 14]; Available from: https://jech.bmj.com/content/65/11/1014.short?casa_token=YW7MhEbCmykAAAAA:H9zq40ETJ6ymV3RoLmaEV71yrlpdwf-V6P0dz7PyfuofMrWnQT6msp4tJoLEeUq6dDxqatn1Pemx

82. Stringhini S, Carmeli C, Jokela M, Avendaño M, Muennig P, Guida F, et al. Socioeconomic status and the 25 × 25 risk factors as determinants of premature mortality: a multicohort study and meta-analysis of 1·7 million men and women. Lancet (London, England) [Internet]. 2017 Mar 25 [cited 2019 Mar 24];389(10075):1229–37. Available from: http://www.ncbi.nlm.nih.gov/pubmed/28159391

83. Raina PS, Wolfson C, Kirkland SA, Griffith LE, Oremus M, Patterson C, et al. The Canadian Longitudinal Study on Aging (CLSA). Can J Aging / La Rev Can du Vieil [Internet]. 2009 Sep 11 [cited 2018 Nov 21];28(03):221. Available from: http://www.ncbi.nlm.nih.gov/pubmed/19860977

84. Raina P, Wolfson C, Kirkland S. Canadian Longitudinal Study on Aging (CLSA) Protocol [Internet]. [cited 2019 Mar 23]. Available from: https://clsa-elcv.ca/doc/511

85. Norman GR, Sridhar FG, Guyatt GH, Walter SD. Relation of Distribution- and Anchor-Based Approaches in Interpretation of Changes in Health-Related Quality of Life. Med Care [Internet]. 2001 Oct [cited 2020 Nov 25];39(10):1039–47. Available from: https://pubmed.ncbi.nlm.nih.gov/11567167/

86. Rockwood K, Mitnitski A. Frailty in Relation to the Accumulation of Deficits. Journals Gerontol Ser A Biol Sci Med Sci [Internet]. 2007 Jul 1 [cited 2019 Sep 22];62(7):722–7. Available from: https://academic.oup.com/biomedgerontology/article-lookup/doi/10.1093/gerona/62.7.722
87. Searle SD, Mitnitski A, Gahbauer EA, Gill TM, Rockwood K. A standard procedure for creating a frailty index. BMC Geriatr [Internet]. 2008 Dec 30 [cited 2019 Jul 30];8(1):24. Available from: http://www.ncbi.nlm.nih.gov/pubmed/18826625
88. Blodgett J. The association between sedentary behaviour, moderate-vigorous physical activity and frailty. Dalhousie University; 2014.
89. Blodgett JM, Theou O, Howlett SE, Rockwood K. A frailty index from common clinical and laboratory tests predicts increased risk of death across the life course. GeroScience [Internet]. 2017 Aug 2 [cited 2021 Jan 17];39(4):447–55. Available from: http://link.springer.com/10.1007/s11357-017-9993-7
90. Mousa A, Savva GM, Mitnitski A, Rockwood K, Jagger C, Brayne C, et al. Is frailty a stable predictor of mortality across time? Evidence from the Cognitive Function and Ageing Studies. Age Ageing [Internet]. 2018 Sep 1 [cited 2021 Jan 17];47(5):721–7. Available from: https://academic.oup.com/ageing/article/47/5/721/4996982
91. Fillenbaum GG. Screening the elderly. A brief instrumental activities of daily living measure. J Am Geriatr Soc [Internet]. 1985 Oct [cited 2019 Mar 23];33(10):698–706. Available from: http://www.ncbi.nlm.nih.gov/pubmed/4045087
92. Fillenbaum GG. Multidimensional Functional Assessment of Older Adults: The Duke Older American Resource and Services Procedures. Multidimensional Functional Assessment of Older Adults. Hillsdale, New Jersey: Lawrence Erlbaum Associates, Inc; 1988.
93. Tinetti ME, Inouye SK, Gill TM, Doucette JT. Shared Risk Factors for Falls, Incontinence, and Functional Dependence: Unifying the Approach to Geriatric Syndromes. JAMA J Am Med Assoc [Internet]. 1995 May 3 [cited 2021 Jan

13];273(17):1348–53. Available from: https://jamanetwork.com/
94. Shinkai S. Walking speed as a good predictor for the onset of functional dependence in a Japanese rural community population. Age Ageing [Internet]. 2000 Sep 1 [cited 2021 Jan 13];29(5):441–6. Available from: https://academic.oup.com/ageing/article-lookup/doi/10.1093/ageing/29.5.441
95. Shinkai S, Kumagai S, Fujiwara Y, Amano H, Yoshida Y, Watanabe S, et al. Predictors for the onset of functional decline among initially non-disabled older people living in a community during a 6-year follow-up. Geriatr Gerontol Int [Internet]. 2003 Dec [cited 2021 Jan 13];3:S31–9. Available from: http://doi.wiley.com/10.1111/j.1444-0594.2003.00094.x
96. Rosano C, Newman AB, Katz R, Hirsch CH, Kuller LH. Association between lower digit symbol substitution test score and slower gait and greater risk of mortality and of developing incident disability in well-functioning older adults. J Am Geriatr Soc. 2008 Sep;56(9):1618–25.
97. Statistics Canada. Canadian Community Health Survey (2008/2009)-Healthy Aging [Internet]. 2008 [cited 2019 Oct 22]. Available from: http://www.statcan.gc.ca/pub/11-631-x/11-631-x2016001-eng.htm
98. Statistics Canada. Table: 13-10-0394-01 Leading causes of death, total population, by age group [Internet]. [cited 2019 Nov 3]. Available from: https://www150.statcan.gc.ca/t1/tbl1/en/tv.action?pid=1310039401&pickMembers%5B0%5D=2.16&pickMembers%5B1%5D=3.1
99. Canadian Longitudinal Study on Aging. Maintaining Contact Questionnaire (Tracking and Comprehensive) [Internet]. 2015 [cited 2019 Mar 23]. Available from: https://clsa-elcv.ca/doc/540
100. Robert S, House JS. SES Differentials in Health by Age and Alternative Indicators of SES. J Aging Health [Internet]. 1996 Aug 30 [cited 2019 Sep 10];8(3):359–88. Available from: http://journals.sagepub.com/doi/10.1177/089826439600800304
101. Kaplan GA, Seeman TE, Cohen RD, Knudsen LP, Guralnik J. Mortality among the elderly in the Alameda County Study: behavioral and demographic risk factors. Am J Public Health [Internet]. 1987 Mar 7 [cited 2019 Oct 4];77(3):307–12. Available from: http://www.ncbi.nlm.nih.gov/pubmed/3812836

102. Costa-Font J. Housing assets and the socio-economic determinants of health and disability in old age. Health Place [Internet]. 2008 Sep 1 [cited 2019 Oct 4];14(3):478–91. Available from: https://www.sciencedirect.com/science/article/pii/S1353829207000780

103. van Jaarsveld CHM, Miles A, Wardle J. Pathways from deprivation to health differed between individual and neighborhood-based indices. J Clin Epidemiol. 2007 Jul;60(7):712–9.

104. Laaksonen M, Roos E, Rahkonen O, Martikainen P, Laaksonen M. Influence of material and behavioural factors on occupational class differences in health. J Epidemiol Community Heal [Internet]. 2005 [cited 2019 Nov 3];59:163–9. Available from: www.jech.com

105. Hirdes JP, Forbes WF. Factors Associated with the Maintenance of Good Self-Rated Health. J Aging Health [Internet]. 1993 Feb [cited 2019 Nov 3];5(1):101–22. Available from: http://journals.sagepub.com/doi/10.1177/089826439300500105

106. Abuladze L, Kunder N, Lang K, Vaask S. Associations between self-rated health and health behaviour among older adults in Estonia: A cross-sectional analysis. BMJ Open. 2017 Jun 1;7(6).

107. DesMeules M, Pong R, Lagacé C, … DH-CI for, 2006 undefined. How healthy are rural Canadians? An assessment of their health status and health determinants [Internet]. cwhn.ca. Ottawa; 2006 [cited 2019 Oct 14]. Available from: http://www.cwhn.ca/en/node/28300

108. Ontario Anti-Racism Directorate. Data Standards for the Identification and Monitoring of Systemic Racism: Collection of personal information | Ontario.ca [Internet]. [cited 2021 Jan 12]. Available from: https://www.ontario.ca/document/data-standards-identification-and-monitoring-systemic-racism/collection-personal-information#section-8

109. Sherbourne CD, Stewart AL. The MOS social support survey. Soc Sci Med [Internet]. 1991 [cited 2019 Jun 14];32(6):705–14. Available from: http://www.ncbi.nlm.nih.gov/pubmed/2035047

110. Gilmour H. Social participation and the health and well-being of Canadian seniors.

Stat Canada, Heal Reports, Cat no 82-003-X [Internet]. 2012 Oct 17 [cited 2021 Jan 12];23(4). Available from: www.statcan.gc.ca,

111. Washburn RA, Smith KW, Jette AM, Janney CA. The physical activity scale for the elderly (PASE): Development and evaluation. J Clin Epidemiol [Internet]. 1993 Feb 1 [cited 2019 Mar 22];46(2):153–62. Available from: https://www.sciencedirect.com/science/article/pii/0895435693900534?via%3Dihub

112. Schuit AJ, Schouten EG, Westerterp KR, Saris WHM. Validity of the physical activity scale for the elderly (PASE): According to energy expenditure assessed by the doubly labeled water method. J Clin Epidemiol [Internet]. 1997 May 1 [cited 2019 Apr 16];50(5):541–6. Available from: https://www.sciencedirect.com/science/article/pii/S0895435697000103

113. Rothman MD, Leo-Summers L, Gill TM. Prognostic significance of potential frailty criteria. J Am Geriatr Soc [Internet]. 2008 Dec [cited 2021 Jan 12];56(12):2211–6. Available from: /pmc/articles/PMC2782664/?report=abstract

114. Statistics Canada. Postal CodeOM Conversion File (PCCF). 2016.

115. Postal Code OM Conversion File (PCCF), Reference Guide [Internet]. Statistics Canada. 2016 [cited 2019 Oct 4]. Available from: https://www150.statcan.gc.ca/n1/en/catalogue/92-154-G

116. Mechanda K, Puderer H. How Postal Codes Map to Geographic Areas [Internet]. Statistics Canada. 2007 [cited 2019 Oct 4]. Available from: https://www150.statcan.gc.ca/n1/pub/92f0138m/92f0138m2007001-eng.htm

117. Canadian Longitudinal Study on Aging. CLSA Technical document: Sampling and computation of response rates and sample weights for the tracking (telephone interview) participants and comprehensive participants. 2017.

118. Lohr S. Sampling: Design and analysis. Boston: Cengage Learning; 2009.

119. StataCorp. Stata statistical software: Release 15. College Station: StataCorp LLC; 2017.

120. Kanters DM, Griffith LE, Hogan DB, Richardson J, Patterson C, Raina P. Assessing the measurement properties of a Frailty Index across the age spectrum in the Canadian Longitudinal Study on Aging. J Epidemiol Community Health

[Internet]. 2017 Aug 1 [cited 2021 Jan 16];71(8):794–9. Available from: http://jech.bmj.com/

121. Verschoor CP, Tamim H. Frailty Is Inversely Related to Age at Menopause and Elevated in Women Who Have Had a Hysterectomy: An Analysis of the Canadian Longitudinal Study on Aging. Journals Gerontol Ser A [Internet]. 2019 Apr 23 [cited 2021 Jan 24];74(5):675–82. Available from: https://academic.oup.com/biomedgerontology/article/74/5/675/4983139

122. Sakib MN, Shooshtari S, St John P, Menec V. The prevalence of multimorbidity and associations with lifestyle factors among middle-aged Canadians: An analysis of Canadian Longitudinal Study on Aging data. BMC Public Health. 2019 Feb 28;19(1).

123. Bongers K. Senior step study: first steps towards self-management in falls prevention [Internet]. Radboud University, The Netherlands; 2017. Available from: https://repository.ubn.ru.nl/bitstream/handle/2066/182826/182826.pdf

124. Sutorius FL, Hoogendijk EO, Prins BAH, Van Hout HPJ. Comparison of 10 single and stepped methods to identify frail older persons in primary care: Diagnostic and prognostic accuracy. BMC Fam Pract [Internet]. 2016 Aug 3 [cited 2021 Jan 21];17(1):1–12. Available from: https://link.springer.com/articles/10.1186/s12875-016-0487-y

125. Arjunan A, Peel NM, Hubbard RE. Gait Speed and Frailty Status in Relation to Adverse Outcomes in Geriatric Rehabilitation. Arch Phys Med Rehabil. 2019 May 1;100(5):859–64.

126. Hajizadeh M, Mitnitski A, Rockwood K. Socioeconomic gradient in health in Canada: Is the gap widening or narrowing? Health Policy (New York). 2016 Sep 1;120(9):1040–50.

127. Fried LP, Tangen CM, Walston J, Newman AB, Hirsch C, Gottdiener J, et al. Frailty in Older Adults: Evidence for a Phenotype [Internet]. Vol. 56, Journal of Gerontology: MEDICAL SCIENCES Copyright. 2001 [cited 2021 Jan 22]. Available from: https://academic.oup.com/biomedgerontology/article/56/3/M146/545770

128. Freire RC, Pieruccini-Faria F, Montero-Odasso M. Are Human Development

Index dimensions associated with gait performance in older adults? A systematic review. Exp Gerontol [Internet]. 2018 Feb 1 [cited 2019 Sep 4];102:59–68. Available from: https://www.sciencedirect.com/science/article/pii/S0531556517307040?via%3Dihub

129. Raina P, Wolfson C, Kirkland S, Griffith L, Griffi L. The Canadian Longitudinal Study on Aging (CLSA) Report on Health and Aging in Canada : findings from baseline data collection. 2010.

130. Gateway to Global Aging Data | Surveys at a Glance [Internet]. [cited 2021 Feb 24]. Available from: https://g2aging.org/?section=surveyOverview#tab-content-4

131. Freire RC, Pieruccini-Faria F, Montero-Odasso M. Are Human Development Index dimensions associated with gait performance in older adults? A systematic review. Exp Gerontol [Internet]. 2018 Feb [cited 2019 Sep 17];102:59–68. Available from: http://www.ncbi.nlm.nih.gov/pubmed/29221941

132. Rothman KJ. BMI-related errors in the measurement of obesity. Int J Obes. 2008;32:S56–9.

APPENDIX 1 CLSA TIMED 4-METRE WALK SOP

Research staff from the CLSA follow the procedure below to conduct the 4-meter timed walk. Participants are allowed to use an assistive device to complete the walk.

clsa élcv Canadian Longitudinal Study on Aging Étude longitudinale canadienne sur le vieillissement	**Title:**	**Timed (4-metre) Walk Test**		
	Version Date:	2014-JUL-10	**Document Number:**	SOP_DCS_0021
	Effective Date:	2014-OCT-15		
Data Collection Site (DCS)	**Version:**	1.2	**Number of Pages:**	3

1.0 Purpose:
The purpose of this document is to describe the standardized procedure for administering the 4-metre walk test.

2.0 Scope:
This document is to be used by the DCS staff when administering and measuring the 4-metre walk test for a study participant.

3.0 Responsibilities:
It is the responsibility of the DCS staff to perform the procedures as described in the current and approved version of the standard operating procedure.

4.0 Related Documents:
Not applicable

5.0 Definitions:
- **Assistive devices:** instruments, devices, or aids that help a person to be more mobile or independent (i.e., cane, walker).

6.0 Equipment:
Not applicable

7.0 Supplies:
- Validated stopwatch; and,
- An area of floor that has been marked to specify the distance in meters.

8.0 Procedure Steps:
Contraindications:
- The participant is unable to stand or walk without the assistance of another person (Contraindications Questionnaire).
  Note: The participant may use an assistive device to stand (make a note of the assistive device in the comments section in Onyx).

> **Important:** Positioning/placement of the participant is critical to the reproducibility and comparison, between visits, for this test. Critical steps marked with ❗

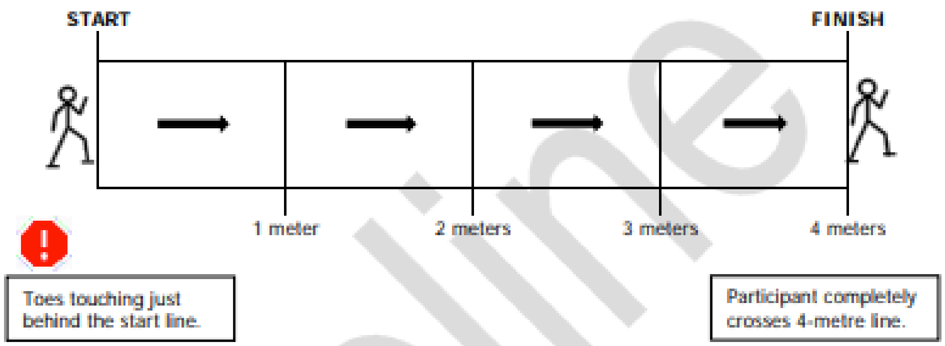
Step 1: At the *Interview Tab* in Onyx, look for 'Timed Walk' measurement in the list of stages. Then select **Start** in the "Actions" in that row.

Step 2: The "Timed Walk: Start" window will pop up.

Step 3: **Scan** the Interview ID barcode then click on **Continue**.

Step 4: Explain the procedure in full and demonstrate the test to the participant. Demonstrate the test by walking at your typical pace from the start position (i.e., toes touching but just behind the start line) and crossing the finish line 4 meters from the start position. The proper start and finish positions are also illustrated in Figure 1.0 below. Click next in Onyx.

Figure 1.0: Start and Finish Positions



Note: If a participant has a walker, it can be placed anywhere in front of them even if it is over the line. The important thing is that their feet are just behind the start line.

Step 5: Allow the participant one practice trial before conducting the test.

Step 6: Ask the participant to return to the starting position. Inform the participant that the timed assessment will begin on the command, "**Ready, Set, Go.**" The DCS research staff member's position is at the finish line.

Step 7: The DCS research staff member will begin timing by starting the stopwatch immediately after speaking the command "Ready, Set, Go." Do not wait for the participant to begin walking before starting the stopwatch.

Step 8: **Stop** the stopwatch when the participant is completely across the finish line.

Step 9: Instruct the participant to stop walking once s/he has walked a few steps past the finish line.

Step 10: **Record** the measurement seconds:milliseconds in Onyx. Complete the remaining questions in Onyx.

Step 11: Click **Next**. The conclusion screen will appear indicating that you have completed the measurements.

Step 12: Click **Finish**. The "Timed Walk: Finish" window will pop up.

Step 13: Indicate in the **comment** field in Onyx if there was anything that may have affected or influenced the measurement. Ensure that comments do not contain any personally identifying information.

Step 14: Click **Continue** to return to the status page.

9.0 Documentation and Forms:

- **CRF_DCS_0021** - 4-Metre Walk Test Case Report Form

10.0 References:

- Multicenter AIDS Cohort Study (MACS) [Internet]. Timed walk and hand grip strength protocol; [updated 2008 Oct 30]. Available from: http://www.statepi.jhsph.edu/macs/Questionnaires/Guidelines/v50guide-frailty.pdf

- Ávila-Funes JA, Gray-Donald K, Payette H. Association of nutritional risk and depressive symptoms with psychical performance in the elderly: The Quebec Longitudinal Study of Nutrition as a Determinant of Successful Aging (NuAge). J Am Coll Nutr. 2008; 27(4):492-8.

Baseline Revision History:

New Version #	**Revision Date**	**Revision Author**	**Content Approval**
1.2	2014-JUL-10	Lorraine Moss	Mark Oremus
Summary of Revisions			
SOP formatting updated.			
Wording of Scope, Purpose and Responsibilities updated and clarified.			
Added 'stop' symbols to emphasize point in CI and Steps 4 and 8.			
New Version #	**Revision Date**	**Revision Author**	**Content Approval**
1.2	2012-Nov-09	Lorraine Moss	Mark Oremus
Summary of Revisions			
Added CRF document number to section 7.0			

APPENDIX 2 CLINICAL SIGNIFICANCE AND WALKING SPEED

The existing literature that assesses the association between walking speed and the social determinants of health, health behaviours, and future health relies on statistical significance to interpret findings. With a large sample size and overwhelmingly statistically significant results it is difficult to extract tangible meaning from statistical significance. To overcome this, we will employ an estimate of clinical difference in walking speed.

There are two commonly used approaches for determining meaningful change, that have been applied to Health-Related Quality of Life[1] and more recently walking speed.[2-4] The first is the distribution-based method that uses a statistical measure of variability (i.e., effect size or standard error of measurement) to interpret results. A limitation of this approach is that it relies on the distribution of the sample data. The second approach is the anchor-based approach that uses the individual or care providers perception of change as an external reference to measure the magnitude of change in the measure of interest.[5]

There are three publications that assessed meaningful change in walking speed using these methods.[2-4] All three study populations included community dwelling older adults, however one study had an additional cohort of stroke survivors,[3] and in another the sample was defined as sedentary[55]. The sample size for two studies was ~400,[2,3] and ~1,000[4] for the final study. Additionally, these studies included multiple physical capability measures, however the results discussed below will reflect the 3- or 4-meter timed walk, exclusively. All three studies used both the distribution- and anchor-based approaches. Both methods produce two estimates: a small or minimal meaningful change and a substantial meaningful change.

To calculate the distribution-based estimates all studies measured effect size and standard error of measure. Cut points for effect size were drawn from the literature and consistent across all three studies (i.e., 0.2 - minimal meaningful difference, 0.5 – substantial meaningful difference). All studies used test-retest reliability from the literature to calculate the standard error of measure. The effect size estimates for small meaningful change were 0.04 to 0.06m/s , 0.03 m/s, and 0.05 m/s for Perera et al.,[3] Kwon et al.,[2] and Perera et al.,[4] respectively. Standard error of measure estimates were only calculated for small meaningful change and were the same as effect size estimates for Perera et al.[3,4], Kwon et al.[2] reported 0.04 m/s standard error of measure estimate. The effect size estimates for substantial meaningful change were 0.10 to 0.14m/s , 0.08 m/s, and 0.12 m/s for Perera et al.,[3] Kwon et al.,[2] and Perera et al.,[4] respectively.

For the anchor-based method all studies used two self-report anchors. All studies included ability to climb one flight of stairs (~10 stairs) and for the second anchor two studies used ability to walk ¼ mile (three to four blocks),[2,4] and the remaining study used ability to walk one block.[3] The response options were consistent for both anchors in the same study, however, varied between studies. Perera et al.[3] chose a 15-point scale to determine direction and magnitude of change, the scale ranged from -7: a very great deal worse to 7: a very great deal better. Minimal meaningful change is defined as a one-level on change the response scale and substantial meaningful change as a three-level change. Kwon et al.[2] used a five-level Likert scale: no difficulty, a little difficulty, some difficulty, a lot of difficulty, and unable to do the activity. A one-level decline/improvement indicated a small meaningful change, and a two-level decline/improvement indicated a substantial change. Perera et al.[4] provided a seven-level Likert scale of difficulty/ease ranging from unable to very easy. A small meaningful change was defined as a one- or two-level change and a substantial meaningful change was defined as a three or more-level change. The small meaningful change estimates were: 0.04 m/s, 0.03 to 0.05 m/s, and 0.03 m/s for Perera et al.,[3] Kwon et al.,[2] and Perera et al.,[4] respectively. The substantial meaningful change estimates were: 0.06 to 0.07 m/s, 0.08, and 0.08 to 0.11 m/s for Perera et al.,[3] Kwon et al.,[2] and Perera et al.[4] respectively. One paper also created a combined estimate by considering results from both approaches, the minimal meaningful estimate was 0.05 m/s and the substantial meaningful estimate was 0.10 m/s. Based on these results we will use the average small meaningful change estimate of 0.04 m/s and the average substantial meaningful change estimate of 0.09 to assist in interpreting OLS regression results. We will adopt the most commonly used anchors (i.e. ability to climb one flight of stairs and ability to walk 3 to 4 blocks) and the simplest response options used by Kwon et al.,[2] to explain the meaningful change in walking speed.

It must be acknowledged that although it is useful for interpretation to have a clinical understanding of change in walking speed these approaches calculate estimates based on within person, not between people comparison. Applying these approaches to cross-sectional data is not ideal, however, because this is an area that has not been developed in the literature it is still beneficial to have some alternative to statistical significance.

References

1. Norman GR, Sridhar FG, Guyatt GH, Walter SD. Relation of Distribution- and Anchor-Based Approaches in Interpretation of Changes in Health-Related Quality of Life. Med Care [Internet]. 2001 Oct [cited 2020 Nov 25];39(10):1039–47. Available from: https://pubmed.ncbi.nlm.nih.gov/11567167/
2. Kwon S, Perera S, Pahor M, Katula JA, King AC, Groessl EJ, et al. What is a meaningful change in physical performance? Findings from a clinical trial in older adults (The LIFE-P study). J Nutr Heal Aging [Internet]. 2009 Jun 4 [cited 2020 Nov 25];13(6):538–44. Available from: https://link.springer.com/article/10.1007/s12603-009-0104-z
3. Perera S, Mody SH, Woodman RC, Studenski SA. Meaningful change and responsiveness in common physical performance measures in older adults. J Am Geriatr Soc [Internet]. 2006 May 1 [cited 2020 Nov 25];54(5):743–9. Available from: https://onlinelibrary.wiley.com/doi/full/10.1111/j.1532-5415.2006.00701.x
4. Perera S, Studenski S, Newman A, Simonsick E, Harris T, Schwartz A, et al. Are Estimates of meaningful decline in mobility performance consistent among clinically important subgroups? (Health ABC study). Journals Gerontol - Ser A Biol Sci Med Sci [Internet]. 2014 Oct 1 [cited 2020 Nov 25];69(10):1260–8. Available from: https://academic.oup.com/biomedgerontology/article/69/10/1260/668765
5. Jaeschke R, Singer J, Guyatt GH. Measurement of health status. Ascertaining the minimal clinically important difference. Control Clin Trials [Internet]. 1989 [cited 2021 Feb 4];10(4):407–15. Available from: https://pubmed.ncbi.nlm.nih.gov/2691207/

APPENDIX 3 FRAILTY INDEX VARIABLES

The variables listed below were considered to create the frailty index using steps created by Searle et al.:[87] (1) variables must be deficits associated with health and age conceptually; (2) the deficit should not have too many missing data; (3) the deficit should be common; (4) the deficit should not be overly common in late age; (5) the deficit must increase in prevalence along with age; and (6) the selected deficits must cover a broad range of body systems.

Included in FI	**Variable**	**Variable Name in the CLSA**	**Cut point**
Yes	Self-rated health	GEN_HLTH_COF1	0: Excellent, 0.25: Very good, 0.5: Good, 0.75 Fair, 1.0: Poor
	Self-rated mental health	GEN_MNTL_COF1	0: Excellent 0.25: Very good 0.5: Good 0.75: Fair 1.0: Poor
Yes	Eyesight rating (self-rated)	VIS_SGHT_COF1	0: Excellent 0.25: Very good 0.5: Good 0.75: Fair 1.0: Poor or non-existent sight
Yes	Hearing rating (self-rated)	HRG_HRG_COF1	0: Excellent 0.25: Very good 0.5: Good 0.75: Fair 1.0: Poor
	5 repetition chair rise	CR_TIME_COF1	0: < 18.88 seconds 1: >18.88 seonds
Yes	Sense of balance	PKD_CAL_COF1	0: Good sense of balance 1: Poor sense of balance
	CES-D 10 scale: Frequency feel fearful or tearful	DEP_FRFL_COF1	0: rarely or never (less than 1 day) 0.33: some of the time (1-2 days) 0.66: Occasionally (3-4 days) 1.0: All of the time (5-7 days)
	CES-D 10 scale: Frequency feel happy	DEP_HAPP_COF1	[See *CES-D 10 scale: Frequency feel fearful or tearful*]
	CES-D 10 scale: Frequency feel could not get going	DEP_GTGO_COF1	[See *CES-D 10 scale: Frequency feel fearful or tearful*]
	CES-D 10 scale: Frequency trouble concentrating	DEP_MIND_COF1	[See *CES-D 10 scale: Frequency feel fearful or tearful*]

Included in FI	Variable	Variable Name in the CLSA	Cut point
	CES-D 10 scale: Frequency feel depressed	DEP_FLDP_COF1	[See *CES-D 10 scale: Frequency feel fearful or tearful*]
	CES-D 10 scale: Frequency feel everything is an effort	DEP_FFRT_COF1	[See *CES-D 10 scale: Frequency feel fearful or tearful*]
	CES-D 10 scale: Frequency sleep is restless	DEP_RSTLS_COF1	[See *CES-D 10 scale: Frequency feel fearful or tearful*]
	CES-D 10 scale: Frequency easily bothered	DEP_BOTR_COF1	[See *CES-D 10 scale: Frequency feel fearful or tearful*]
	CES-D 10 scale: Frequency feel hopeful about the future	DEP_HPFL_COF1	[See *CES-D 10 scale: Frequency feel fearful or tearful*]
Yes	CES-D 10 scale: Frequency feel lonely	DEP_LONLY_COF1	[See *CES-D 10 scale: Frequency feel fearful or tearful*]
	Difficulty taking force or impact in arms, hands	FUL_FORC_COF1	0: No 1: Yes
	Difficulty stooping, crouching, or kneeling	FUL_STOOP_COF1	0: No 1: Yes
	Difficulty pulling/pushing large objects	FUL_PUSH_COF1	0: No 1: Yes
	Difficulty handling small objects	FUL_HDLG_COF1	0: No 1: Yes
	Difficulty making bed	FUL_MKBED_COF1	0: No 1: Yes
	Difficulty standing after sitting	FUL_STDUP_COF1	0: No 1: Yes
	Difficulty washing back	FUL_WSHBK_COF1	0: No 1: Yes
	Difficulty lifting 10 pounds	FUL_LFT10_COF1	0: No 1: Yes
	Difficulty standing for a long period	FUL_ST15_COF1	0: No 1: Yes
	Difficulty sitting for a long period	FUL_SIT1H_COF1	0: No 1: Yes

Included in FI	Variable	Variable Name in the CLSA	Cut point
	Difficulty extending arms above shoulders	FUL_SHLD_COF1	0: No 1: Yes
	Difficulty using a knife	FUL_KNCUT_COF1	0: No 1: Yes
Yes	OARS scale: Able to travel	IAL_ABLTRV_COF1	0: Able to travel around 1.0: Unable to travel around
Yes	OARS scale: Able to do housework	IAL_ABLWRK_COF1	0: Able to do housework 1.0: Unable to do housework
	OARS scale: Able to use telephone	IAL_ABLTEL_COF1	0: Able to use telephone 1.0: Unable to use telephone
	OARS scale: Able to handle money	IAL_ABLMO_COF1	0: Able to handle money 1.0: Unable to handle money
Yes	OARS scale: Able to go shopping	IAL_ABLGRO_COF1	0: Able to go shopping 1.0: Unable to go shopping
Yes	OARS scale: Able to prepare meals	IAL_ABLML_COF1	0: Able to prepare meals 1.0: Unable to prepare meals
	OARS scale: Able to take medicine	IAL_ABLMED_COF1	0: Able to take medicine without any help 1.0: Unable to take medicine by themselves at all
	OARS scale: Able to dress	ADL_ABLDR_COF1	0: Able to dress 1.0: Unable to dress
	OARS scale: Able to get out of bed	ADL_ABLBD_COF1	0: Able to get out of bed 1.0: Unable to get out of bed
	OARS scale: Able to feed	ADL_ABLFD_COF1	0: Able to feed themselves 1.0: Unable to feed themselves
	OARS scale: Able to take care of appearance	ADL_ABLAP_COF1	0: Able to take care of appearance 1.0: Unable to take care of appearance
Yes	OARS scale: Able to take bath	ADL_ABLBT_COF1	0: Able to take bath 1.0: Unable to take bath
Yes	OARS scale: Trouble getting to bathroom in time	ADL_BATH_COF1	0: No 1: Yes

Included in FI	**Variable**	**Variable Name in the CLSA**	**Cut point**
	BMI Classification	HWT_DISW_COF1	0: normal weight 0.5: overweight 1.0: underweight/obese
	Injury from fall	FAL_ATTN_COF1	0: No injury from fall in the last year 0.5: Did not seek medical attention for injury from fall in the last year 1: Received medical attention for injury from fall in the past year
	Broken bone from fall or injury (during adult life)	OST_BONE_COF1	0: No broken Bone 1: Broken bone
	Ever suffered break or fracture	ICQ_FX_COF1	0: Never suffered break or fracture 1: Suffered break or fracture
Yes	Coughed most days – last 12 months	CAO_COFPY_COF1	0: Don't cough most days 1: Cough most days
	Woken up with a cough attack – last 12 months	CAO_WKCOF_COF1	0: Don't wake up with an attack of coughing 1: Did wake up with an attack of coughing
	Cough phlegm most mornings	CAO_FOMAM_COF1	0: Don't cough phlegm most mornings 1: Cough phlegm most mornings
	Frequent colds persisting longer than other people	CAO_COLD_COF1	0: Don't have frequent colds that persist longer than other 1: Has frequent colds persisting longer than other people
	Wheezing or whistling in chest last 12 months	CAO_WHEZ_COF1	0: No wheezing or whistling in chest 1: Wheezing or whistling in chest
Yes	Have prosthetic limb or joint	ICQ_PROSLIM_COF1	0: Don't have prosthetic limb or joint 1: Have prosthetic limb or joint
	Chest pain or discomfort	ROS_PAIN_COF1	0: No chest pain or discomfort 1: Chest pain or discomfort
	Skipped meals	NUR_SKMLSS_COF1	0: Never 0.25: Rarely 0.5: Sometimes 0.75: Often 1: Almost everyday

Included in FI	Variable	Variable Name in the CLSA	Cut point
	Cough choke when swallowing food	NUR_SWLLFD_COF1	0: Never 0.25: Rarely 0.5: Sometimes 0.75: Often 1: Almost everyday
	Frequency difficulty staying awake during normal hours	SLE_STAYFQ_COF!	0: Never 0.25: Less than once per week 0.5: Once or twice a week 0.75: 3-5 times per week 1: 6-7 times per week
	Rheumatism Arthritis	CCC_RA_COF1	0: no rheumatism arthritis 1: have rheumatism arthritis
Yes	Other Arthritis	CCC_AETOT_COF1	0: no other arthritis 1: have other arthritis
Yes	Osteoarthritis Hand	CCC_OAHAND_COF1	0: don't have osteoarthritis in one or both hands 1: have osteoarthritis in one or both hands
Yes	Osteoarthritis Hip	CCC_OAHIP_COF1	0: don't have osteoarthritis in the hip 1: have osteoarthritis in the hip
Yes	Osteoarthritis Knee	CCC_OAKNEE_COF1	0: don't have osteoarthritis in the knee 1: have osteoarthritis in the knee
	Asthma	CCC_ASTHM_COF1	0: no asthma 1: have asthma
Yes	Stroke or CVA	CCC_CVA_COF1	0: no stroke or CVA 1: have stroke or CV
	Memory problem	CCC_MEMPB_COF1	0: no memory problem 1: have memory problem
	Bowel disorder	CCC_IBDIBS_COF1	0: no bowel disorder 1: have bowel disorder
Yes	Glaucoma	ICQ_GLAUC_COF1	0: no over-active thyroid gland 1: have over-active thyroid gland
Yes	Osteoporosis	CCC_OSTPO_COF1	0: no osteoporosis 1: have osteoporosis

Included in FI	Variable	Variable Name in the CLSA	Cut point
Yes	High blood pressure	CCC_HBP_COF1	0: no high blood pressure/ hypertension 1: have high blood pressure/hypertension
Yes	Diabetes	DIA_DIAB_COF1	0: no diabetes 1: have diabetes
Yes	Heart attack	CCC_AMI_COF1	0: no heart attack 1: no heart attack
Yes	Mini-stroke or TIA	CCC_TIA_COF1	0: never experienced a ministroke or TIA 1: did experience a ministroke or TIA before
	Parkinson's Disease	CCC_PARK_COF1	0: no parkinson's disease 1: have parkinson's disease
Yes	Cataracts	ICQ_CATRCT_COF1	0: never suffer from cataracts 1: had/have cataracts
	Back problems	CCC_BCKP_COF1	0: no back problem 1: have a back problem
Yes	Heart disease	CCC_HEART_COF1	0: no heart disease 1: have heart disease
	Migraine headaches	CCC_MGRN_COF1	0: no migraine headaches 1: have migraine headaches
Yes	Intestinal or stomach ulcers	CCC_ULCR_COF1	0: no intestinal or stomach ulcers 1: have intestinal or stomach ulcers
	Over-active thyroid gland	CCC_OTHYR_COF1	0: no over-active thyroid gland 1: have over-active thyroid gland
Yes	Emphysema, bronchitis, COPD	CCC_COPD_COF1	0: no emphysema, chronic bronchitis, COPD, or chronic changes in lungs due to smoking 1: have emphysema, chronic bronchitis, COPD, or chronic changes in lungs due to smoking
Yes	Angina	CCC_ANGI_COF1	0: no angina 1: have angina
Yes	Peripheral vascular disease	CCC_PVD_COF1	0: no peripheral vascular disease 1: have peripheral vascular disease

Included in FI	Variable	Variable Name in the CLSA	Cut point
	Dementia or Alzheimer's	CCC_ALZH_COF1	0: no dementia or Alzheimer's disease 1: have dementia or Alzheimer's disease
	Epilepsy	CCC_EPIL_COF1	0: no epilepsy 1: have epilepsy
Yes	Urinary incontinence	CCC_URIINC_COF1	0: no urinary incontinence 1: have urinary incontinence
Yes	Macular degeneration	CCC_MACDEG_COF1	0: no macular degeneration 1: have macular degeneration
Yes	Under-active thyroid gland	CCC_UTHYR_COF1	0: no under-active thyroid gland 1: have under-active thyroid gland
Yes	Kidney disease	CCC_KIDN_COF1	0: no kidney disease or kidney failure 1.0: have kidney disease or kidney failure
Yes	Bowel incontinence	CCC_BOWINC_COF1	0: never suffer from cataracts 1: had/have cataracts
Yes	Cancer	CCC_CANC_COF1	0: no cancer 1: had cancer
	Mood disorder	CCC_MOOD_COF1	0: no mood disorder 1: have mood disorder
	Anxiety disorder	CCC_ANXI_COF1	0: no anxiety disorder 1: have anxiety disorder
	Mental Alternation Test (MAT)	COGMAT_SCORE_COF1	0: scored 13 points or higher in Mental Alternation Test 1: scored less than 13 point in Mental Alternation Test
	Rey Auditory Verbal Learning (First Recall)	REYI_SCORE_COF1	0: scored 4 points or higher in RAVLT - Immediate Recall Test 1: scored less than 4 points in RAVLT - Immediate Recall Test
	Rey Auditory Verbal Learning (Delayed Recall)	REYII_SCORE_COF1	0: scored 4 points or higher in RAVLT - Delayed Recall Test 1: scored less than 4 points in RAVLT - Delayed Recall Test

Included in FI	**Variable**	**Variable Name in the CLSA**	**Cut point**
	Animal Fluency Test (AFT)	AFT_SCORE_1_COF1	0: recalled at least 12 animals in animal fluency test 1: recalled less than 12 animals in animal fluency test
	Has one or more original teeth*	ORH_TEETH_COF1	0: Yes 1: No
Yes	Wears dentures or false teeth *	ORH_DENT_COF1	0: No 1: Yes
	Uncomfortable eating in the last 12 months	ORH_UNCEAT_COF1	0: Never 0.33: Rarely 0.66: Sometimes 1: Often
	Avoided eating in the last 12 months	ORH_AVDEAT_COF1	0: Never 0.33: Rarely 0.66: Sometimes 1: Often

* Variables are highly correlated

APPENDIX 4 ACTIVITIES OF DAILY LIVING VARIABLE

All ADL items are listed below. We used the below variables to create a dichotomous variable identify inability or difficulty with one or more ADL or no difficulty or inability.

Variable	**Variable Name in the CLSA**	**Question(s)**	**Response options**	**Rationale**
Functional Limitation				
ADL	ADL_ABLDR_COF1	Can you dress and undress yourself without help?	1-Yes 2-No	ADL disability is associated with slower walking speed in unadjusted and adjusted models.[70]
	ADL_HPDR_COF1	Can you dress and undress yourself with some help?	1-Yes 2-No	
	ADL_UNDR_COF1	Are you completely unable to dress and undress yourself?	1-Yes 2-No	
	ADL_ABLFD_COF1	Can you eat without help?	1-Yes 2-No	
	ADL_HPFD_COF1	Can you eat with some help?	1-Yes 2-No	
	ADL_UNFD_COF1	Are you completely unable to feed yourself?	1-Yes 2-No	
	ADL_ABLAP_COF1	Can you take care of your own appearance without help?	1-Yes 2-No	
	ADL_HPAP_COF1	Can you take care of your own appearance with some help?	1-Yes 2-No	
	ADL_UNAP_COF1	Are you completely unable to take care of your own appearance?	1-Yes 2-No	
	ADL_ABLBD_COF1	Can you get in and out of bed without any help or aids?	1-Yes 2-No	
	ADL_HPBD_COF1	Can you get in and out of bed with some help?	1-Yes 2-No	

Variable	Variable Name in the CLSA	Question(s)	Response options	Rationale
	ADL_UNBD_COF1	Are you totally dependent on someone else to lift you in and out of bed?	1-Yes 2-No	
	ADL_ABLBT_COF1	Can you take a bath or shower without help?	1-Yes 2-No	
	ADL_HPBT_COF1	Can you take a bath or shower with some help?	1-Yes 2-No	
	ADL_UNBT_COF1	Are you completely unable to take a bath and a shower by yourself?	1-Yes 2-No	
	ADL_BATH_COF1	Do you ever have trouble getting to the bathroom on time?	1-Yes 2-No	
	ADL_INCNT_COF1	How often do you wet or soil yourself?	1-Never or less than once a week 2-Once or twice a week 3-Three times a week or more	

APPENDIX 5 SOCIOECONOMIC STATUS VARIABLES

Income and education will be used to measure SES.

Variable	**Variable Name in the CLSA**	**Measurement**	**Rationale**
Income	INC_TOT_COF1	1-Less than $20,000 2-$20,000 to $49,999 3-$50,000 to $99,999 4-$100,000 to $149,999 5-$150,000 +	Walking speed is positively associated with income.[131]
Education	ED_ELHS_COM ED_HSGR_COM ED_OTED_COM ED_HIGH_COM	1-Less than high school grad 2-High school grad 3-Some post-secondary/trade certificate 4-College/university certificate 5-Bachelor’s degree 6-Degree higher than bachelors	Walking speed is positively associated with education.[131]

APPENDIX 6 DETERMINANTS OF WALKING SPEED

We used the variables below because they are either associated with walking speed or general health, measured by SRH. Variables that have only been found to be associated with general health are included with the intention of expanding our understanding of what determinants of general health walking speed is associated with. All included references have statistically significant adjusted associations with walking speed or general health.

Variable	**Variable Name in the CLSA**	**Measurement**	**Walking Speed References**	**General Health References**
Demographic and Anthropometric Variables				
Age	AGE_NMBR_COM	Continuous	Bohannon (1997)[59] Studenski et al. (2011)[60] Pinter et al. (2018)[61]	Meng et al. (2016)[20]
Age	AGE_NMBR_COM	1-45 to 54 2-55-64 3-65 to 75 4-75 to 85 5-85+	Bohannon (1997)[59] Studenski et al. (2011)[60] Pinter et al. (2018)[61]	Meng et al. (2016)[20]
Sex	SEX_ASK_COM	0-Male 1-Female	Cooper et al. (2011)[43]	Meng et al. (2016)[20]
Height	HGT_HEIGHT_M_COF 1	Continuous, measured and recorded in	Bohannon (1997)[59]	

Variable	Variable Name in the CLSA	Measurement	Walking Speed References	General Health References
		centimeters by research staff		
Weight	WGT_WEIGHT_KG_COF1	Continuous, weighed and recorded in kilograms by research staff	BMI is a determinant of general health,[16] however evidence suggest that BMI is not an accurate measure in older adults.[132] To avoid misclassification of BMI we will include height and weight separately.	
Social Variables				
Cultural/racial background	SDC_4	1-Black 2-East/Southeast Asian (Chinese, Korean, Japanese, Southeast Asian, Flipino) 3-Indigenous (North American Indian, Inuit, Metis) 4-Latino (Latin America) 5-Middle Eastern (Arab, West Asian) 6-South Asian 7-White 8-Other		Meng et al. (2016)[20]

Variable	Variable Name in the CLSA	Measurement	Walking Speed References	General Health References
		9-Multiple cultural/racial backgrounds		
Marital Status	SDC_MRTL_COF1	1-Married/common-law 2-Single, never married or never lived with a partner 3-Widowed /divorced /separated		Meng et al. (2016)[20]
Social support	SSA_CONFBED_COF1 SSA_NDTLK_COF1 SSA_CRISIS_COF1 SSA_TYTDR_COF1 SSA_SHLOV_COF1 SSA_GOODT_COF1 SSA_INFO_COF1 SSA_CONFID_COF1 SSA_HUGS_COF1 SSA_RELAX_COF1 SSA_MEALS_COF1 SSA_ADVCE_COF1 SSA_MINDOFF_COF1 SSA_CHORES_COF1	Tangible support: 0-100 Affection: 0-100 Positive interaction: 0-100 Emotional or informational support: 0-100 We will analyze the subscales using data driven cut points at quartiles.	Warren et al. (2016)[62]	van Jaarsveld et al. (2007)[103]

Variable	Variable Name in the CLSA	Measurement	Walking Speed References	General Health References
	SSA_SHFEAR_COF1 SSA_SUGG_COF1 SSA_ENJOY_COF1 SSA_PROBLM_COF1 SSA_LOVU_COF1 SSA_PET_COF1			
Health behaviours				
Smoking	SMK_CURRCG_COF1	1-Never 2-Former 3-Current		van Jaarsveld et al. (2007)[103] Laaksosen et al. (2005)[104] Hirdes et al. (1993)[105]
Alcohol Consumption	ALC_FREQ_COF1	Almost every day (incl. 6 times a week 4-5 times a week 2-3 times a week Once a week 2-3 times a month About once a month Less than once a month		Laaksosen et al. (2005)[104]
Fruit and Vegetable Intake	NUR_FRTVEG_COF1	1-<2 servings 2-2 to 4 servings 3-5 to 7 servings		van Jaarsveld et al. (2007)[103] Laaksosen et al. (2005)[104]

Variable	Variable Name in the CLSA	Measurement	Walking Speed References	General Health References
		4->7 servings		
Physical sactivity	PA2_SIT_COF1 PA2_SIT2_COF1 PA2_SITHR_SIT_COF1 PA2_WALK_COF1 PA2_WALKHR_COF1 PA2_LSPRT_COF1 PA2_LSPRT2_COF1 PA2_LSPRTHR_COF1 PA2_MSPRT_COF1 PA2_MSPRT2_COF1 PA2_MSPRTHR_COF1 PA2_SSPRT_COF1 PA2_SSPRT2_COF1 PA2_SSPRTHR_COF1 PA2_EXER_COF1 PA2_EXER2_COF1 PA2_EXERHR_COF1 PA2_HWRK_COF1 PA2_WRK_COF1 PA2_WRKHRS_NB_COF1 PA2_WRKPA_COF1 PA2_REPRTN_COF1 PA2_PALVL_COF1	PASE score 0 – 793 We dichotomized PASE into normal physical activity and low physical activity using cut points created in a sample of community dwelling older adults.[113]	Stringhini et al. (2018)[45]	van Jaarsveld et al. (2007)[103] Laaksosen et al. (2005)[104] Abuladze et al. (2017)[106]

Variable	**Variable Name in the CLSA**	**Measurement**	**Walking Speed References**	**General Health References**
	PA2_PARTPA_COF1 PA2_PRVPA_COF1			
Geographic Variables				
Rurality	SDC_URBAN_RURAL_COF1	0-Urban 1-Rural		DesMeules et al. (2006)[107]
Province	WGHTS_PROV_COF	1-British Columbia 2-Alberta 3-Manitoba 4-Ontario 5-Quebec 6-Nova Scotia 7-Newfound land and Labrador		

*This article showed no difference in walking speed between males and females among older adults.

APPENDIX 7 SEX-STRATIFIED ANALYSIS FOR OTHER DIMENSIONS OF HEALTH

ADL: Weighted OLS regression results for walking speed and ADL difficulty

Sex	ADL	Coef.	Standard Err.	t	P-value	99% CI	
Males	No difficulty	Ref.					
	1 or more	-0.063	0.008	-8.31	< 0.001	-0.083	-0.044
	(Constant)	0.617	0.076	8.16	< 0.001	0.422	0.812
	R-squared	0.115					
Females	No difficulty	Ref.					
	1 or more	-0.054	0.005	-11.54	< 0.001	-0.066	-0.042
	(Constant)	0.757	0.075	10.16	< 0.001	0.565	0.950
	R-squared	0.167					

* All models are adjusted for age and age-squared.

Number of chronic conditions: Weighted OLS regression results for walking speed and number of conditions

Sex	Number of conditions	Coef.	Standard Err.	t	P-value	99% CI	
Males	0 conditions	Ref.					
	1 condition	-0.012	0.005	-2.47	0.013	-0.024	0.0005
	2 conditions	-0.038	0.005	-6.98	< 0.001	-0.051	-0.024
	3 conditions	-0.049	0.007	-7.03	< 0.001	-0.067	-0.031
	4 conditions	-0.074	0.011	-6.96	< 0.001	-0.101	-0.047
	5 or 6 conditions	-0.113	0.019	-5.89	< 0.001	-0.162	-0.063
	Missing	-0.031	0.011	-2.91	0.004	-0.059	-0.004
	(Constant)	0.526	0.076	6.91	< 0.001	0.330	0.722
	R-squared	0.120					

Number of chronic conditions: Weighted OLS regression results for walking speed and number of conditions

Sex	Number of conditions	Coef.	Standard Err.	t	P-value	99% CI	
Females	0 conditions	Ref.					
	1 condition	-0.012	0.005	-2.57	0.01	-0.024	0.00004
	2 conditions	-0.037	0.005	-6.8	< 0.001	-0.051	-0.023
	3 conditions	-0.064	0.007	-9.31	< 0.001	-0.081	-0.046
	4 conditions	-0.108	0.010	-10.64	< 0.001	-0.134	-0.082
	5 or 6 conditions	-0.124	0.030	-4.18	< 0.001	-0.200	-0.048
	Missing	-0.027	0.012	-2.29	0.022	-0.057	0.003
	(Constant)	0.693	0.075	9.25	< 0.001	0.500	0.885
	R-squared	0.173					

* All models are adjusted for age and age-squared.

SRH: Weighted OLS regression results for walking speed and SRH

Sex	SRH	Coef.	Standard Err.	t	P-value	99% CI	
Males	Excellent	Ref.					
	Very good	-0.025	0.005	-4.98	< 0.001	-0.038	-0.012
	Good	-0.058	0.005	-10.91	< 0.001	-0.072	-0.044
	Fair	-0.111	0.008	-14.61	< 0.001	-0.131	-0.091
	Poor	-0.189	0.016	-11.5	< 0.001	-0.231	-0.147
	(Constant)	0.671	0.075	8.96	< 0.001	0.478	0.864
	R-squared	0.145					
Females	Excellent	Ref.					
	Very good	-0.025	0.005	-5.27	< 0.001	-0.037	-0.013
	Good	-0.066	0.005	-12.79	< 0.001	-0.079	-0.053
	Fair	-0.135	0.008	-17.67	< 0.001	-0.155	-0.115
	Poor	-0.197	0.019	-10.11	< 0.001	-0.247	-0.147

SRH: Weighted OLS regression results for walking speed and SRH

Sex	SRH	Coef.	Standard Err.	t	P-value	99% CI	
	(Constant)	0.850	0.074	11.43	< 0.001	0.658	1.041
	R-squared	0.201					

* All models are adjusted for age and age-squared.

APPENDIX 8 AGE-STRATIFIED ANALYSIS FOR OTHER DIMENSIONS OF HEALTH

ADL: Weighted OLS regression results for walking speed and ADL difficulty

Age	ADL difficulty	Coef.	Standard Err.	t	P-value	99% CI	
45-54	No difficulty	Ref.					
	1 or more	-0.051	0.012	-4.44	< 0.001	-0.081	-0.022
	(Constant)	0.192	2.161	0.09	0.929	-5.378	5.761
	R-squared	0.007					
55-64	No difficulty	Ref.					
	1 or more	-0.050	0.008	-6.62	< 0.001	-0.070	-0.031
	(Constant)	0.828	1.056	-0.78	0.433	-3.549	1.893
	R-squared	0.014					
65-74	No difficulty	Ref.					
	1 or more	-0.068	0.006	-10.68	< 0.001	-0.084	-0.052
	(Constant)	-0.281	1.514	-0.19	0.853	-4.181	3.618
	R-squared	0.040					
75+	No difficulty	Ref.					
	1 or more	-0.067	0.007	-9.94	< 0.001	-0.085	-0.050
	(Constant)	0.292	1.419	0.21	0.837	-3.364	3.948
	R-squared	0.083					

* All models are adjusted for age and age-squared.

The Frailty Index: Weighted OLS regression results for walking speed and the frailty index

Age	Frailty Index	Coef.	Standard Err.	t	P-value	99% CI	
45-54	≤0.1	Ref.					

The Frailty Index: Weighted OLS regression results for walking speed and the frailty index

Age	Frailty Index	Coef.	Standard Err.	t	P-value	99% CI	
	>0.1 &≤ 0.2	-0.045	0.007	-6.13	< 0.001	-0.064	-0.026
	>0.2 &≤ 0.3	-0.104	0.020	-5.18	< 0.001	-0.155	-0.052
	>0.3 &≤ 0.4	-0.309	0.076	-4.05	< 0.001	-0.506	-0.112
	>0.4 &≤ 0.5	-0.088	0.060	-1.46	0.143	-0.243	0.067
	(Constant)	-0.080	2.155	-0.04	0.970	-5.633	5.474
	R-squared	0.026					
55-64	≤0.1	Ref.					
	>0.1 &≤ 0.2	-0.034	0.005	-7.29	< 0.001	-0.046	-0.022
	>0.2 &≤ 0.3	-0.108	0.009	-11.52	< 0.001	-0.132	-0.084
	>0.3 &≤ 0.4	-0.156	0.029	-5.41	< 0.001	-0.230	-0.082
	>0.4 &≤ 0.5	-0.276	0.037	-7.41	< 0.001	-0.372	-0.180
	>0.5	-0.534	0.004	-145.34	< 0.001	-0.543	-0.524
	(Constant)	-.698	1.042	-0.67	0.503	-3.383	1.987
	R-squared	0.050					
65-74	≤0.1	Ref.					
	>0.1 &≤ 0.2	-0.034	0.005	-6.94	< 0.001	-0.046	-0.021
	>0.2 &≤ 0.3	-0.098	0.007	-14.78	< 0.001	-0.115	-0.081
	>0.3 &≤ 0.4	-0.190	0.012	-15.38	< 0.001	-0.222	-0.158
	>0.4 &≤ 0.5	-0.273	0.031	-8.81	< 0.001	-0.353	-0.193
	>0.5	-0.433	0.051	-8.51	< 0.001	-0.564	-0.302
	(Constant)	-0.504	1.448	-0.35	0.728	-4.235	3.227
	R-squared	0.109					
75+	≤0.1	Ref.					
	>0.2 &≤ 0.3	-0.086	0.010	-8.52	< 0.001	-0.112	-0.060
	>0.3 &≤ 0.4	-0.162	0.012	-13.04	< 0.001	-0.195	-0.130

The Frailty Index: Weighted OLS regression results for walking speed and the frailty index

Age	Frailty Index	Coef.	Standard Err.	t	P-value	99% CI	
	>0.4 &≤ 0.5	-0.263	0.019	-13.95	< 0.001	-0.312	-0.215
	>0.5	-0.258	0.047	-5.46	< 0.001	-0.380	-0.136
	(Constant)	-0.267	1.357	-0.2	0.844	-3.764	3.230
	R-squared	0.154					

* All models are adjusted for age and age-squared.

Number of chronic conditions: Weighted OLS regression results for walking speed and number of conditions

Age	Number of conditions	Coef.	Standard Err.	t	P-value	99% CI	
45-54	0 conditions	Ref.					
	1 condition	-0.009	0.006	-1.39	0.166	-0.025	0.008
	2 conditions	-0.034	0.010	-3.54	< 0.001	-0.059	-0.009
	3 conditions	-0.055	0.018	-3.12	0.002	-0.101	-0.010
	4 conditions	-0.109	0.035	-3.1	0.002	-0.200	-0.018
	5 or 6 conditions	0.114	0.007	17.41	< 0.001	0.097	0.131
	Missing	0.002	0.022	0.08	0.938	-0.055	0.059
	(Constant)	0.052	2.163	0.02	0.981	-5.523	5.627
	R-squared	0.010					
55-64	0 conditions	Ref.					
	1 condition	-0.010	0.005	-2.01	0.044	-0.024	0.003
	2 conditions	-0.035	0.006	-5.81	< 0.001	-0.051	-0.020
	3 conditions	-0.055	0.009	-6.47	< 0.001	-0.077	-0.033
	4 conditions	-0.099	0.016	-6.31	< 0.001	-0.139	-0.059
	5 or 6 conditions	-0.072	0.064	-1.12	0.264	-0.238	0.094

Number of chronic conditions: Weighted OLS regression results for walking speed and number of conditions

Age	Number of conditions	Coef.	Standard Err.	t	P-value	99% CI	
	Missing	-0.018	0.015	-1.20	0.231	-0.057	0.021
	(Constant)	-0.836	1.052	-0.79	0.427	-3.547	1.875
	R-squared	0.022					
65-74	0 conditions	Ref.					
	1 condition	-0.020	0.006	-3.28	0.001	-0.036	-0.004
	2 conditions	-0.049	0.006	-7.58	< 0.001	-0.066	-0.032
	3 conditions	-0.064	0.008	-8.25	< 0.001	-0.084	-0.044
	4 conditions	-0.091	0.012	-7.75	< 0.001	-0.121	-0.061
	5 or 6 conditions	-0.163	0.023	-7.22	< 0.001	-0.222	-0.105
	Missing	-0.038	0.014	-2.74	0.006	-0.074	-0.002
	(Constant)	-0.422	1.508	-0.28	0.779	-4.308	3.463
	R-squared	0.047					
75+	0 conditions	Ref.					
	1 condition	-0.020	0.011	-1.79	0.073	-0.049	0.009
	2 conditions	-0.037	0.011	-3.33	0.001	-0.066	-0.008
	3 conditions	-0.061	0.012	-5.17	< 0.001	-0.092	-0.031
	4 conditions	-0.099	0.014	-6.84	< 0.001	-0.136	-0.061
	5 or 6 conditions	-0.105	0.023	-4.59	< 0.001	-0.164	-0.046
	Missing	-0.074	0.014	-5.17	< 0.001	-0.110	-0.037
	(Constant)	-0.232	1.416	-0.16	0.87	-3.881	3.417
	R-squared	0.080					

* All models are adjusted for age and age-squared.

SRH: Weighted OLS regression results for walking speed and SRH

Age	SRH	Coef.	Standard Err.	t	P-value	99% CI	
45-54	Excellent	Ref.					
	Very good	-0.013	0.008	-1.68	0.093	-0.033	0.007
	Good	-0.040	0.008	-4.76	< 0.001	-0.061	-0.018
	Fair	-0.095	0.012	-7.72	< 0.001	-0.127	-0.063
	Poor	-0.111	0.028	-3.91	< 0.001	-0.184	-0.038
	(Constant)	-0.097	2.147	-0.05	0.964	-5.629	5.435
	R-squared	0.0251					
55-64	Excellent	Ref.					
	Very good	-0.028	0.006	-5.03	< 0.001	-0.042	-0.013
	Good	-0.060	0.006	-9.81	< 0.001	-0.075	-0.044
	Fair	-0.113	0.009	-12.05	< 0.001	-0.138	-0.089
	Poor	-0.212	0.023	-9.28	< 0.001	-0.271	-0.153
	(Constant)	-0.483	1.038	-0.47	0.642	-3.157	2.191
	R-squared	0.052					
65-74	Excellent	Ref.					
	Very good	-0.027	0.006	-4.76	< 0.001	-0.042	-0.013
	Good	-0.079	0.006	-12.31	< 0.001	-0.096	-0.062
	Fair	-0.146	0.010	-14.9	< 0.001	-0.171	-0.120
	Poor	-0.229	0.021	-10.8	< 0.001	-0.284	-0.175
	(Constant)	-0.553	1.473	-0.38	0.707	-4.348	3.242
	R-squared	0.090					
75+	Excellent	Ref.					
	Very good	-0.037	0.008	-4.5	< 0.001	-0.059	-0.016
	Good	-0.085	0.008	-10.08	< 0.001	-0.107	-0.063
	Fair	-0.163	0.011	-14.54	< 0.001	-0.192	-0.134
	Poor	-0.200	0.023	-8.74	< 0.001	-0.259	-0.141

SRH: Weighted OLS regression results for walking speed and SRH

Age	SRH	Coef.	Standard Err.	t	P-value	99% CI	
	(Constant)	0.001	1.385	0.00	1.000	-3.568	3.570
	R-squared	0.126					

* All models are adjusted for age and age-squared.

APPENDIX 9 AGE-STRATIFIED ANALYSIS FOR FINAL MODEL

Age	Variable	Coef.	Standard Err.	t	P-value	99% CI	
45-54	**Sex**						
	Female	Ref.					
	Male	-0.004	0.008	-0.49	0.626	-0.025	0.017
	Income						
	<$20,000	Ref.					
	20000 to < $50,000	0.018	0.025	0.73	0.464	-0.046	0.082
	50000 to < $100,000	0.043	0.023	1.85	0.064	-0.017	0.104
	100000 to < $150,000	0.057	0.024	2.36	0.018	-0.005	0.119
	150000 or more	0.077	0.024	3.2	0.001	0.015	0.140
	Missing	0.014	0.027	0.52	0.6	-0.056	0.085
	Education						
	Less than secondary school	Ref.					
	Secondary school graduation, No post secondary	0.054	0.021	2.57	0.01	-0.0001	0.108
	Some post secondary	0.030	0.022	1.36	0.175	-0.027	0.087
	Post-secondary degree/diploma	0.054	0.019	2.83	0.005	0.005	0.103
	Height (cm)	0.019	0.008	2.24	0.025	-0.003	0.040
	Height-squared	-0.00005	0.00002	-1.96	0.05	-0.0001	0.00002
	Weight (kg)	-0.002	0.0002	-10	< 0.001	-0.002	-0.001
	Smoking						
	Never smoked	Ref.					
	Former smoker	-0.009	0.007	-1.31	0.191	-0.025	0.008
	Current smoker	-0.015	0.010	-1.45	0.147	-0.041	0.011

Age	Variable	Coef.	Standard Err.	t	P-value	99% CI	
	Alcohol consumption						
	Did not drink in last 12 months	Ref.					
	Occasional drinker	-0.010	0.012	-0.85	0.394	-0.040	0.020
	Regular drinker	0.005	0.010	0.48	0.633	-0.020	0.029
	Fruit and vegetable servings						
	Seven or more	Ref.					
	Five or six	-0.002	0.010	-0.22	0.823	-0.028	0.023
	Three or four	0.0005	0.010	0.05	0.959	-0.024	0.025
	Two or fewer	-0.022	0.011	-2.12	0.034	-0.049	0.005
	Physical activity (PASE score)						
	Normal physical activity	Ref.					
	Low physical activity	-0.017	0.007	-2.31	0.021	-0.036	0.002
	Cultural/racial background						
	White	Ref.					
	Black	-0.136	0.027	-5.01	< 0.001	-0.205	-0.066
	East/South Asian	0.008	0.022	0.34	0.734	-0.050	0.065
	South Asian	-0.057	0.022	-2.64	0.008	-0.113	-0.001
	Other	-0.019	0.009	-2.01	0.045	-0.043	0.005
	Multiple	-0.041	0.026	-1.60	0.11	-0.107	0.025
	High social support availability						
	No	Ref.					

Age	Variable	Coef.	Standard Err.	t	P-value	99% CI	
	Yes	0.028	0.010	2.82	0.005	0.002	0.054
	Marital status						
	Single/ never married/never lived with partner	Ref.					
	Widowed/divorced/separated	0.0004	0.012	0.03	0.974	-0.029	0.030
	Married/common-law	-0.008	0.011	-0.71	0.481	-0.036	0.021
	Urban/rural residence						
	Urban	Ref.					
	Rural	0.024	0.010	2.39	0.017	-0.002	0.050
	Province						
	British Columbia	Ref.					
	Alberta	-0.093	0.009	-10.09	< 0.001	-0.117	-0.070
	Manitoba	-0.027	0.010	-2.75	0.006	-0.053	-0.002
	Ontario	-0.040	0.007	-5.52	< 0.001	-0.059	-0.021
	Nova Scotia	0.060	0.011	5.49	< 0.001	0.031	0.088
	Quebec	0.009	0.008	1.17	0.241	-0.011	0.030
	Newfoundland	-0.034	0.010	-3.45	0.001	-0.060	-0.009
	(Constant)	-1.540	2.193	-0.70	0.483	-7.192	4.113
	R-squared	0.142					
55-64	**Sex**						
	Female	Ref.					
	Male	-0.010	0.006	-1.69	0.09	-0.026	0.005
	Income						
	<$20,000	Ref.					
	$20,000 to < $50,000	0.029	0.014	2.10	0.036	-0.007	0.064

Age	Variable	Coef.	Standard Err.	t	P-value	99% CI	
	$50,000 to < $100,000	0.044	0.013	3.30	0.001	0.010	0.079
	$100,000 to < $150,000	0.053	0.014	3.73	< 0.001	0.016	0.089
	$150,000 or more	0.068	0.014	4.66	< 0.001	0.030	0.105
	Missing	0.031	0.016	1.93	0.053	-0.010	0.072
	Education						
	Less than secondary school	Ref.					
	Secondary school graduation, No post secondary	0.048	0.018	2.65	0.008	0.001	0.095
	Some post secondary	0.047	0.019	2.5	0.012	-0.001	0.095
	Post-secondary degree/diploma	0.050	0.018	2.82	0.005	0.004	0.095
	Height (cm)	0.008	0.006	1.2	0.229	-0.009	0.024
	Height-squared	-0.00001	0.00002	-0.61	0.542	-0.00006	0.00004
	Weight (kg)	-0.002	0.0001	-14.93	< 0.001	-0.002	-0.002
	Smoking						
	Never smoked	Ref.					
	Former smoker	-0.004	0.004	-0.82	0.409	-0.015	0.007
	Current smoker	-0.022	0.008	-2.76	0.006	-0.042	-0.001
	Alcohol consumption						
	Did not drink in last 12 months	Ref.					
	Occasional drinker	0.014	0.009	1.53	0.127	-0.009	0.037
	Regular drinker	0.022	0.007	3.16	0.002	0.004	0.040

Age	Variable	Coef.	Standard Err.	t	P-value	99% CI	
	Fruit and vegetable servings						
	Seven or more	Ref.					
	Five or six	-0.009	0.007	-1.28	0.201	-0.027	0.009
	Three or four	-0.016	0.007	-2.29	0.022	-0.035	0.002
	Two or fewer	-0.034	0.008	-4.40	< 0.001	-0.054	-0.014
	Physical activity (PASE score)						
	Normal physical activity	Ref.					
	Low physical activity	-0.021	0.004	-4.70	< 0.001	-0.032	-0.009
	Cultural/racial background						
	White	Ref.					
	Black	-0.073	0.022	-3.32	0.001	-0.130	-0.016
	East/South Asian	-0.025	0.018	-1.35	0.177	-0.071	0.022
	South Asian	-0.090	0.026	-3.53	< 0.001	-0.156	-0.024
	Other	-0.018	0.009	-2.04	0.042	-0.041	0.005
	Multiple	-0.028	0.023	-1.23	0.218	-0.086	0.030
	High social support availability						
	No	Ref.					
	Yes	0.022	0.007	3.16	0.002	0.004	0.040
	Marital status						
	Single/ never married/never lived with partner	Ref.					
	Widowed/divorced/separated	0.00005	0.008	0.01	0.995	-0.020	0.020
	Married/common-law	-0.004	0.009	-0.47	0.636	-0.027	0.019

Age	Variable	Coef.	Standard Err.	t	P-value	99% CI	
	Urban/rural residence						
	Urban	Ref.					
	Rural	0.009	0.007	1.24	0.215	-0.009	0.027
	Province						
	British Columbia	Ref.					
	Alberta	-0.100	0.007	-14.44	< 0.001	-0.118	-0.083
	Manitoba	-0.032	0.007	-4.58	< 0.001	-0.049	-0.014
	Ontario	-0.033	0.006	-6.03	< 0.001	-0.047	-0.019
	Quebec	0.011	0.006	1.74	0.081	-0.005	0.027
	Nova Scotia	0.062	0.007	8.56	< 0.001	0.044	0.081
	Newfoundland	-0.035	0.007	-4.72	< 0.001	-0.055	-0.016
	(Constant)	-1.573	1.159	-1.36	0.175	-4.560	1.415
	R-squared	0.152					
65-74	**Sex**						
	Female	Ref.					
	Male	0.013	0.006	2.04	0.042	-0.003	0.030
	Income						
	<$20,000	Ref.					
	20000 to < $50,000	0.011	0.013	0.83	0.408	-0.022	0.043
	50000 to < $100,000	0.035	0.013	2.66	0.008	0.001	0.069
	100000 to < $150,000	0.040	0.014	2.81	0.005	0.003	0.076
	150000 or more	0.029	0.015	1.98	0.048	-0.009	0.067
	Missing	0.034	0.015	2.29	0.022	-0.004	0.073
	Education						
	Less than secondary school	Ref.					

Age	Variable	Coef.	Standard Err.	t	P-value	99% CI	
	Secondary school graduation, No post secondary	0.025	0.012	2.02	0.043	-0.007	0.056
	Some post secondary	0.014	0.012553	1.14	0.254	-0.018	0.047
	Post-secondary degree/diploma	0.021	0.010	2	0.046	-0.006	0.048
	Height (cm)	0.012	0.007	1.84	0.066	-0.0045	0.030
	Height-squared	-0.00003	0.00002	-1.26	0.207	-0.00008	0.00003
	Weight (kg)	-0.003	0.0001	-17.32	< 0.001	-0.003	-0.002
	Smoking						
	Never smoked	Ref.					
	Former smoker	-0.016	0.004	-3.58	< 0.001	-0.027	-0.004
	Current smoker	-0.037	0.010	-3.63	< 0.001	-0.063	-0.011
	Alcohol consumption						
	Did not drink in last 12 months	Ref.					
	Occasional drinker	0.025	0.009	2.69	0.007	0.001	0.048
	Regular drinker	0.029	0.008	3.74	< 0.001	0.009	0.049
	Fruit and vegetable servings						
	Seven or more	Ref.					
	Five or six	-0.025	0.007	-3.42	0.001	-0.044	-0.006
	Three or four	-0.037	0.007	-5.02	< 0.001	-0.055	-0.018
	Two or fewer	-0.042	0.008	-5.20	< 0.001	-0.063	-0.021

Age	Variable	Coef.	Standard Err.	t	P-value	99% CI	
	Physical activity (PASE score)						
	Normal physical activity	Ref.					
	Low physical activity	-0.020	0.004	-4.74	< 0.001	-0.031	-0.009
	Cultural/racial background						
	White	Ref.					
	Black	-0.092	0.034	-2.72	0.007	-0.180	-0.005
	East/South Asian	-0.009	0.021	-0.44	0.659	-0.063	0.045
	South Asian	-0.015	0.026	-0.58	0.561	-0.083	0.052
	Other	-0.017	0.010	-1.69	0.09	-0.044	0.009
	Multiple	0.018	0.023	0.77	0.44	-0.042	0.077
	High social support availability						
	No	Ref.					
	Yes	0.031	0.007	4.46	< 0.001	0.013	0.049
	Marital status						
	Single/ never married/never lived with partner	Ref.					
	Widowed/divorced/separated	0.011	0.009	1.23	0.219	-0.012	0.035
	Married/common-law	0.007	0.011	0.64	0.521	-0.021	0.035
	Urban/rural residence						
	Urban	Ref.					
	Rural	0.019	0.008	2.36	0.018	-0.002	0.039
	Province						
	British Columbia	Ref.					

Age	Variable	Coef.	Standard Err.	t	P-value	99% CI	
	Alberta	-0.109	0.007	-15.26	< 0.001	-0.128	-0.091
	Manitoba	-0.058	0.008	-7.61	< 0.001	-0.077	-0.038
	Ontario	-0.032	0.006	-5.59	< 0.001	-0.047	-0.017
	Quebec	-0.006	0.006	-0.96	0.339	-0.022	0.010
	Nova Scotia	0.049	0.007	6.55	< 0.001	0.030	0.068
	Newfoundland	-0.058	0.008	-7.38	< 0.001	-0.078	-0.038
	(Constant)	-1.654	1.514	-1.09	0.275	-5.555	2.248
	R-squared	0.177					
75+	**Sex**						
	Female	Ref.					
	Male	0.033	0.009	3.71	< 0.001	0.010	0.056
	Income						
	<$20,000	Ref.					
	20000 to < $50,000	-0.0008	0.013	-0.07	0.948	-0.033	0.032
	50000 to < $100,000	0.024	0.013	1.78	0.076	-0.011	0.058
	100000 to < $150,000	0.029	0.016	1.83	0.067	-0.012	0.070
	150000 or more	0.030	0.018	1.65	0.098	-0.017	0.077
	Missing	-0.023	0.016	-1.44	0.15	-0.063	0.018
	Education						
	Less than secondary school	Ref.					
	secondary school graduation, No post secondary	0.009	0.011	0.75	0.453	-0.021	0.038
	Some post secondary	-0.014	0.013	-1.09	0.277	-0.047	0.019
	Post-secondary degree/diploma	-0.003	0.009	-0.28	0.778	-0.026	0.021
	Height (cm)	0.007	0.008	0.9	0.37	-0.014	0.028

Age	Variable	Coef.	Standard Err.	t	P-value	99% CI	
	Height-squared	-0.00001	0.00002	-0.46	0.646	-0.00007	0.00005
	Weight (kg)	-0.003	0.0002	-14.43	< 0.001	-0.004	-0.003
	Smoking						
	Never smoked	Ref.	0				
	Former smoker	-0.004	0.006	-0.78	0.437	-0.019	0.010
	Current smoker	-0.047	0.016	-2.94	0.003	-0.087	-0.006
	Alcohol consumption						
	Did Not drink in last 12 months	Ref.					
	Occasional drinker	0.018	0.010	1.76	0.079	-0.008	0.044
	Regular drinker	0.045	0.008	5.83	< 0.001	0.025	0.065
	Fruit and vegetable servings						
	Seven or more	Ref.					
	Five or six	-0.009	0.010	-0.88	0.378	-0.034	0.017
	Three or four	-0.029	0.009	-3.1	0.002	-0.054	-0.005
	Two or fewer	-0.043	0.011	-4.08	< 0.001	-0.071	-0.016
	Physical activity (PASE score)						
	Normal physical activity	Ref.					
	Low physical activity	-0.026	0.006	-4.27	< 0.001	-0.041	-0.010
	Cultural/racial background						
	White	Ref.					
	Black	-0.053	0.039	-1.35	0.178	-0.153	0.048

Age	Variable	Coef.	Standard Err.	t	P-value	99% CI	
	East/South Asian	-0.018	0.025	-0.7	0.483	-0.083	0.047
	South Asian	-0.084	0.046	-1.83	0.067	-0.202	0.034
	Other	0.0001	0.017	0.01	0.994	-0.044	0.044
	Multiple	-0.063	0.032	-1.96	0.05	-0.146	0.020
	High social support availability						
	No or no response	Ref.					
	Yes	0.010	0.007	1.36	0.175	-0.009	0.029
	Marital status						
	Single/ never married/never lived with partner	Ref.					
	Widowed/divorced/separated	0.003	0.013	0.21	0.836	-0.030	0.036
	Married/common-law	0.015	0.015	1.01	0.314	-0.024	0.054
	Urban/rural residence						
	Urban	Ref.					
	Rural	0.003	0.011	0.29	0.768	-0.027	0.033
	Province						
	British Columbia	Ref.					
	Alberta	-0.130	0.009	-14.84	< 0.001	-0.153	-0.107
	Manitoba	-0.086	0.009	-9.45	< 0.001	-0.109	-0.062
	Ontario	-0.044	0.007	-6.03	< 0.001	-0.062	-0.025
	Quebec	-0.031	0.008	-3.66	< 0.001	-0.052	-0.009
	Nova Scotia	0.028	0.010	2.82	0.005	0.002	0.054
	Newfoundland	-0.043	0.010	-4.22	< 0.001	-0.069	-0.017
	(Constant)	-1.166	1.484	-0.79	0.432	-4.991	2.658
	R-squared	0.222					

Age	Variable	Coef.	Standard Err.	t	P-value	99% CI
*All models are adjusted for age, age-squared, and household size						